Pelvic Fractures

Emergency Treatment of Pelvic Fractures

Local Therapy of Breast Cancer

Бариатрическая хирургия

Bariatric Surgery – Current Therapeutic Options and Prospects

Тугоподвижность плечевого сустава

Advances in the Management of Shoulder Stiffness

Неотложная помощь при переломах костей таза

Emergency Treatment of Pelvic Fractures

Местная терапия рака молочной железы

Local Therapy of Breast Cancer
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Managing Director

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Немецкий медицинский журнал и Немецкий медицинский портал предлагают информационную поддержку по принятию решений для людей, которые хотели бы получить медицинское обслуживание в Германии. В журнале представлена информация о немецкой медицине в виде научно-медицинских статей, портал предоставляет исчерпывающую информацию о немецких клиниках, врачах и агентствах медицинского туризма. Уникальным является то, что на портале также представлена электронная версия журнала.

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Contents

Emergency Treatment of Pelvic Fractures 14

Bariatric Surgery – Current Therapeutic Options and Prospects 32

Advances in the Management of Shoulder Stiffness 40

Urge Urinary Incontinence in Women Can Now Be Cured by Surgery 50

Local Therapy of Breast Cancer: Oncoplastic Surgery and Intraoperative Radiation 54

Magnetic Resonance-Guided High Intensity Focused Ultrasound (MRgFUS) for Minimal Invasive Ablation of Uterine Fibroids 60

New minimally invasive procedures for treatment of aortic pathologies like endoleaks, penetrating atherosclerotic ulcers, and aortic pseudoaneurysms: trans-catheter and percutaneous embolization with the liquid embolic agent Onyx® 66
<table>
<thead>
<tr>
<th>Содержание</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Неотложная помощь при переломах костей таза</td>
<td>14</td>
</tr>
<tr>
<td>Бариартическая хирургия: современные терапевтические возможности и перспективы</td>
<td>32</td>
</tr>
<tr>
<td>Достижения в лечении пациентов с тугоподвижностью плечевого сустава</td>
<td>40</td>
</tr>
<tr>
<td>Хирургическое лечение ургентного недержания мочи у женщин</td>
<td>50</td>
</tr>
<tr>
<td>Местная терапия рака молочной железы: онкопластические операции и интраоперационное облучение</td>
<td>54</td>
</tr>
<tr>
<td>Применение магниторезонансно контролируемого фокусированного ультразвука (ФУЗ-МРТ) для миниинвазивной аблляции миомы матки</td>
<td>60</td>
</tr>
<tr>
<td>Новые малоинвазивные методы для лечения патологии аорты (эндоподтекания, пенетрирующие атеросклеротические язвы аорты, псевдоаневризмы): транс-катетеры и чрескожная эмболизация с помощью эмболизирующей жидкости Onyx®</td>
<td>66</td>
</tr>
</tbody>
</table>
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www.krankenhaus-klostergrafschaft.de
The hospital Kloster Grafschaft (Grafschaft Abbey) is a special hospital of maximum care for pulmonary and bronchial medicine, respiratory medicine, sleep medicine and allergology. Our extensive technical and personnel equipment on university level allows for this comprehensive diagnostics. In addition, the hospital exhibits two state-of-the-art intensive care units with a total of 14 beds.

**Weaning centre**

One main focus of the hospital is the weaning of long-term respirated patients from the respirator. About 200 patients from intensive care units in whole Germany and partially in European countries are admitted to us usually via helicopter. Our hospital is thus the largest and most successful weaning centre in Germany.

**Pneumology**

In the field of general pneumology, diseases such as bronchial asthma, chronic bronchitis, pulmonary emphysema, pulmonary fibrosis of varying causation, collagenosis with pulmonary involvement, sarcoidosis, bronchial carcinomas, pleural mesothelioma, tuberculosis and pneumonia are diagnosed and treated.

Kloster Grafschaft (Grafschaft Abbey) - клиника, специализированная в области респираторной медицины, лечения заболеваний бронхов и легких, медицины сна и аллергологии. Наше современное техническое оснащение и высококвалифицированный медицинский персонал позволяет проводить плановую диагностику и лечение на уровне немецкой университетской медицины. Клиника также располагает двумя блоками интенсивной терапии на 14 мест. Медицинские направления клиники:

**Отлучение от искусственной вентиляции легких**

В специализированном центре пациентам с длительной искусственной вентиляцией легких помогают быстро и легко отвыкнуть от аппарата ИВЛ и перейти на самостоятельное дыхание. Ежегодно с помощью вертолета в центр госпитализируются 200 пациентов из блоков интенсивной терапии со всей Германии и стран Европы. Наш центр – самый крупный в Германии по данному виду специализированной помощи.

**Пульмонология**

В клинике проводится диагностика и лечение таких заболеваний, как бронхиальная астма, хронический бронхит, эмфизема легких, фиброз легких различного генеза, коллагеноз с поражением лег
Sleep medicine
The department of sleep medicine specialises in the diagnosis and treatment of sleep-related nightly respiratory disturbances and overstrained respiratory muscular system of varying causation by means of different non-invasive respiratory methods.

Early rehabilitation
A further main focus is the department for early rehabilitation. Long-term respirated patients are rehabilitated here by means of extensive medical treatment, physical therapy, remedial gymnastics and partially speech therapy to an extent that most of them are able to live in their domestic environment again without any help after they have been discharged.

Occupational pulmonary diseases
A department for occupational pulmonary diseases is also integrated in the hospital. This includes the diagnosis and treatment of silicosis, asbestosis and asbestos-related tumour diseases of the lungs and the costal pleura (pleural mesothelioma), chemical-irritant bronchial asthma and chronic bronchitis. This department also contains an extremely efficient medical rehabilitation division.

Медицина сна
В одном из отделений центра проводится диагностика и лечение расстройств респираторной системы, возникающих во время сна и при перегрузке мышц дыхательной системы, с помощью неинвазивных методов.

Ранняя реабилитация
В клинике пациенты после длительной искусственной вентиляции легких проходят интенсивную реабилитацию с помощью методов физиотерапии, лечебной гимнастики, терапии речи, направленную на полное восстановление дыхания, чтобы пациент мог обходится дома без посторонней помощи.

Профзаболевания легких
В отделении заболеваний легких, связанных с определенными профессиями, проводится диагностика и лечение следующих заболеваний: силикоза, асбестоза и связанных с асベストовым производством опухолей легких и плевры (плевральной мезотелиомы), вызванной химическими агентами бронхиальной астмы и хронических бронхитов. Данное отделение также имеет возможность проводить интенсивную реабилитацию.
Finally, the hospital has its own allergological department. Allergic asthma, allergic rhinitis, allergic rhinosinusitis, neurodermatitis, eczema, allergic exanthema, urticaria, angioneurotic oedema, contact allergy, intolerance to drugs, drug hypersensitivity, nutritional allergy, insect poison allergy, irritable bowel syndrome and chronic diarrhoea are diagnosed and treated here.

The special hospital Kloster Grafschaft is located in beautiful surroundings in the midst of Schmallenberg in the Sauerland. The rambling, calm and well-kept park of the hospital contributes to your recovery, in addition to the high-quality medical care and treatment.
Emergency Treatment of Pelvic Fractures

Неотложная помощь при переломах костей таза
Introduction

While pelvic ring fractures are generally rare (only 3-8% of all fractures), they are associated with a high case fatality rate compared to other fractures, for example, when occurring as part of polytrauma [1-6]. In the case of a “complex pelvic fracture”, i.e. a combination of a pelvic ring fracture and concomitant peripelvic soft tissue injury, the expected mortality rate increases dramatically to 20% in comparison to patients with “uncomplicated” pelvic fractures (i.e. purely osteoligamentous instability) [1, 6].

Pelvic ring fractures are typically found in younger patients in the second and third decades of life as a result of the impact of high-energy forces (motor vehicle accident, fall from a great height, collapsed structures) and are characterised by considerable concomitant injuries (predominantly traumatic brain injury and thoracic trauma) in more than 80% percent of all cases. In patients past the seventh decade of life (second peak age), pelvic ring fractures are also very common (mostly type A and B injuries). However, unstable and life-threatening fracture types (type C and complex trauma) are a rare exception and often a direct cause of death, which is why there have so far been only individual reports of successful treatment at this age (see Fig. 1) [7].

Paediatric pelvic ring fractures are very rare due to the given elasticity of the paediatric pelvis and are therefore also a particularity. Pelvic fractures in this age group are often underestimated or even completely overlooked; at 20%, the rate of complex pelvic fractures in children is twice as high as it is in adults, for example. Experimental research by STUHLER indicated as early as 1977 that even a force of 10,000 N is only expected to cause plastic deformation in a one-year-old, SI luxations and pubic symphysis ruptures do not occur in a 12-year-old until at least 8,000 N is applied, and only after 14 years of age considerably less force is required to cause the above injuries [2,000-3,000 N] [8]. For this reason, it is particularly important in paediatric patients to treat these injuries carefully and to take them seriously. The complications of pelvic fractures in children include: intertrochanteric fractures, trochanter fractures, femoral neck fractures, acetabular fractures, and pelvic fractures with soft tissue injury. It is important to note that these injuries are often accompanied by other injuries, such as head trauma, abdominal trauma, and spinal cord injury. The prognosis for children with pelvic fractures is generally good, but it is important to monitor for complications, such as neurovascular injuries, and provide appropriate care. In cases of complex pelvic fractures, surgical intervention may be necessary to achieve optimal outcomes.
injuries to assess the force of impact that caused the trauma.

In terms of treatment, stabilising the pelvic ring fracture is associated with an improved survival rate. This is suggested by HAUUCHILD et al. in an evaluation, published in 2008 by the Study Group Pelvis of the German Association for Study of Internal Fixation (DAO) and the German Society for Trauma Surgery (DGU e.V.), which currently represents the world’s largest collection of data on pelvic research in the German-speaking area [3]. A total of 4,291 patients with pelvic fractures from 1991 to 1993 (Study Group Pelvis I) and from 1998 to 2000 (Study Group Pelvis II) were evaluated. In addition to fracture type and epidemiological data, the severity of the injury, the applied primary treatment as well as definitive surgery and the mortality rate following pelvic ring fractures were evaluated. In the course of the study, an age-independent decrease in the average case fatality rate from 7.9% (AG pelvis I) to 5% (AG pelvis II) was observed between 1991 and 2004. Predictive risk factors for death included the severity of concomitant injuries (increasing ISS, PTS etc.), concomitant soft tissue injury (as is the case in complex trauma) and the necessity to employ initial stabilisation techniques in the trauma room (e.g. external fixation, pelvic clamp, etc.).

Therefore, the aim of this research is to describe the characteristics of pelvic ring fractures, explain the primary therapeutic measures applied in pre-clinical and clinical first-line treatment and highlight the primary treatment algorithms in pelvic ring fractures (see Fig. 2).

At the Site of the Accident: Initial Examination and Primary Treatment of Patients with Pelvic Ring Fractures

Outside the clinical environment, diagnosing a pelvic fracture is usually limited to physical examination, namely a cranio-caudal body check, besides assessing the cause of the accident and the injury mechanism. Since the addition of data on pelvic research in the world’s largest collection of data on pelvic research in the German-speaking area [3]. In the context of the study, an age-independent decrease in the average case fatality rate from 7.9% (AG pelvis I) to 5% (AG pelvis II) was observed between 1991 and 2004. Predictive risk factors for death included the severity of concomitant injuries (increasing ISS, PTS etc.), concomitant soft tissue injury (as is the case in complex trauma) and the necessity to employ initial stabilisation techniques in the trauma room (e.g. external fixation, pelvic clamp, etc.).

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al presence of a pelvic fracture adversely affects the survival rate after polytrauma, the basic diagnosis and specific primary treatment of a pelvic fracture are of great importance.

The first emergency physician at the site of the accident should suspect possible injury in the pelvic area, considering the injury mechanism and high-force impact (injury caused by being run over by a vehicle, for example, is associated with a pelvic fracture in 80% of all cases!). If the anamnesis indicates that a pelvic fracture may be present, further simple examination steps should be taken to confirm or exclude this diagnosis. In the event that a visual examination of the patient reveals medially or laterally rotated limbs that appear to be shortened, this may be caused, in addition to a proximal femur fracture, by a pelvic ring or acetabulum fracture with cranial dislocation. Conscious and responsive patients are asked about local pain in the sacral and pubic region, followed by the evaluation of peripheral circulation, motor function and sensitivity. A first clinical assessment of the stability, or instability, of the pelvic ring can subsequently be made by applying direct manual compression along both iliac crests from the inside and outside as well as by palpation of the superior pubic rami and the sacral region. Especially highly unstable injuries with anterior and posterior instability can be detected this way, as well as isolated fragments of a coxal bone or gaping symphysis injuries. An unstable pelvic fracture can be suspected if a one-finger gap is felt in the area of the symphysis during clinical examination (GoR C). Instability should be suspected if the coxal bones can be moved in anterior-posterior or mediolateral direction when applying compression (GoR B).

Based on the injury mechanism, concomitant injuries and the findings of the physical examination, an experienced examiner will be able to also establish if a pelvic fracture is present.

**Pelvic Fractures**

**Pelvic Trauma**

<table>
<thead>
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<th>Decision</th>
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<th>Event</th>
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</thead>
<tbody>
<tr>
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<td>3-5 min</td>
<td>Massive haemorrhage? Run over?</td>
<td>Surgery</td>
</tr>
<tr>
<td>2. decision</td>
<td>10-15 min</td>
<td>Haemodynamic stability?</td>
<td>Polytrauma Protocol</td>
</tr>
<tr>
<td>3. decision</td>
<td>15-30 min</td>
<td>Haemodynamic stability?</td>
<td>Polytrauma Protocol</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Massive transfusion, pelvic clamp, external fixation</td>
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<td>Packing of the small pelvis</td>
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**Fig. 2:** Treatment algorithm for polytrauma with a pelvic fracture and haemodynamic instability. The decision to perform an emergency stabilisation surgery should be made within a window of 30 minutes. The patient’s circulation is the central factor in this decision [6].

**Переломы таза**

**Рис. 2:** Алгоритм лечения пациентов с полигрязмой и переломами таза на фоне гемодинамической нестабильности. Решение о проведении ургентной хирургической стабилизации должно быть принято на протяжении 30 минут после происшествия. Показатели гемодинамики пациента являются центральным фактором в этом решении [6].
draw conclusions about the type and severity of the pelvic injury to take the necessary steps for the compression and positioning of the patient. A less experienced examiner will have to limit his diagnosis to suspecting a pelvic fracture, but should view this as an exponential factor for the severity of injury and treat it as if an unstable pelvic fracture was present. Especially in intubated and ventilated patients, soft tissue damage (external injuries, haematomas, tourniquets applied to haemorrhage, mobility of the legs, leg length discrepancies) can provide valuable insights into the presence and severity of a pelvic ring injury. In literature, opinions differ on the significance of manually examining the pelvis. SHLAMOVITZ attributes only a slight sensitivity to clinical examination of the pelvis for detecting a pelvic fracture that is by definition mechanically unstable [9]. A study from Essen, Germany, credits clinical examination of the pelvis for instability with a specificity and sensitivity of 44% and 99%, respectively. However, about 1/5 of unstable pelvic injuries were not diagnosed until a pelvic X-ray was taken [10]. In 2002, an evaluation by GONZALES of 2,176 patients with blunt trauma for the sensitivity of clinical examination nevertheless yielded a rating of 93% (Level I Trauma Center) [11].

Especially instability of the posterior pelvic ring is accompanied by an increased tendency to bleed from the pre-sacral venous plexus, the perivesical veins and the fracture surfaces of the bone. For this reason, particular attention should be paid to the patient’s circulation during the decision-making process: According to the data provided by MILLER, if blood pressure does not respond to volume replacement, relevant intrapelvic haemorrhage (referred to as “non-responders”) can be assumed with 30% specificity. Conversely, if blood pressure is higher than 90 mmHg, relevant haemorrhage can be ruled out with a high degree of certainty (negative predictive value 100% (referred to as “responders”) [12].

A positioning that allows for compression of the pelvis is preferable to using only a scoop stretcher for this purpose. In the event of an unstable pelvic ring and haemorrhagic shock, the indication for emergency stabilisation of the pelvis must be decided (GoR A). The simplest form of emergency stabilisation is to wrap a sheet around the pelvis or employ a pneumatic or mechanical pelvic belt. Preferably, the patient should then be put on a vacuum mattress that is specifically modelled to accommodate the pelvic area. The aim of this positioning and treatment is to avoid further pelvic blood loss by reducing the volume of the unstable pelvic ring. Appropriate volume replacement should be performed using both crystalloid and colloid solutions in sufficient quantities (≥ 3 litres).

**Which Patient goes where?**

The aforementioned treatment procedures for polytrauma patients subsequently affect the transfer process by providing fragments by the rate of haemorrhage. In case, if between the patients, haemorrhage is not diagnosed but excluded by the examiner, they should view this as an exponential factor for the severity of injury and treat it as if an unstable pelvic fracture was present. Especially in intubated and ventilated patients, soft tissue damage (external injuries, haematomas, tourniquets applied to haemorrhage, mobility of the legs, leg length discrepancies) can provide valuable insights into the presence and severity of a pelvic ring injury. In literature, opinions differ on the significance of manually examining the pelvis. SHLAMOVITZ attributes only a slight sensitivity to clinical examination of the pelvis for detecting a pelvic fracture that is by definition mechanically unstable [9]. A study from Essen, Germany, credits clinical examination of the pelvis for instability with a specificity and sensitivity of 44% and 99%, respectively. However, about 1/5 of unstable pelvic injuries were not diagnosed until a pelvic X-ray was taken [10]. In 2002, an evaluation by GONZALES of 2,176 patients with blunt trauma for the sensitivity of clinical examination nevertheless yielded a rating of 93% (Level I Trauma Center) [11].

Especially instability of the posterior pelvic ring is accompanied by an increased tendency to bleed from the pre-sacral venous plexus, the perivesical veins and the fracture surfaces of the bone. For this reason, particular attention should be paid to the patient’s circulation during the decision-making process: According to the data provided by MILLER, if blood pressure does not respond to volume replacement, relevant intrapelvic haemorrhage (referred to as “non-responders”) can be assumed with 30% specificity. Conversely, if blood pressure is higher than 90 mmHg, relevant haemorrhage can be ruled out with a high degree of certainty (negative predictive value 100% (referred to as “responders”) [12].

A positioning that allows for compression of the pelvis is preferable to using only a scoop stretcher for this purpose. In the event of an unstable pelvic ring and haemorrhagic shock, the indication for emergency stabilisation of the pelvis must be decided (GoR A). The simplest form of emergency stabilisation is to wrap a sheet around the pelvis or employ a pneumatic or mechanical pelvic belt. Preferably, the patient should then be put on a vacuum mattress that is specifically modelled to accommodate the pelvic area. The aim of this positioning and treatment is to avoid further pelvic blood loss by reducing the volume of the unstable pelvic ring. Appropriate volume replacement should be performed using both crystalloid and colloid solutions in sufficient quantities (≥ 3 litres).

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ing criteria for the allocation of patients after receiving emergency care. Admitting the patient to a “suitable” hospital is within the responsibility of the emergency physician at the site of the accident. For trauma patients, a hospital should be chosen that has integrated traumatology infrastructure and logistics as well as the necessary diagnostic capabilities.

The choice of hospital is then made based on the severity and nature of the injury sustained by patient. Polytrauma patients in critical condition or patients with traumatic brain injury should primarily be treated in hospitals that have all required diagnostic and therapeutic treatment options for such injuries at their disposal (e.g. neurosurgery, computer tomography). These options also justify transporting a stable patient over longer distances or transferring a primarily unstable patient to a secondary care hospital after stabilising the patient’s condition. Regional trauma networks have been established across Germany in accordance with the guidelines of the white paper of the German Society for Trauma Surgery to form a primary and secondary care system ensuring best patient care and treatment around the clock.

### Definitions of Pelvic Injuries

In order for the first aider to be able to promptly estimate the severity of pelvic fractures, various important definitions have established themselves, whose significance is also reflected in the patients’ outcome following pelvic ring injuries:

**Complex pelvic injury**

A “complex” pelvic injury is understood to be a pelvic ring fracture with concomitant peripelvic soft tissue damage, i.e. an additional injury of nerves, vessels, muscles or the pelvic viscerae. Statistically speaking, merely 10% of all pelvic fractures constitute a “complex” pelvic injury and only about 3% of all pelvic fractures are accompanied by a life-threatening haemorrhage. The presence of a complex pelvic injury increases the mortality rate of this type of injury to 20%; it increases further to 33% at initial circulatory instability [1, 6, 13].

**Open pelvic fractures**

In the case of open pelvic ring fractures, osseous perforations of the outer skin and hollow organs of the pelvis occur with an incidence of 0.9 - 4.8% of all cases of pelvic fractures. The patients are additionally endangered by the development of concomitant inflammatory processes and septic conditions [1, 2, 3, 6, 13].

**Pelvic compartment syndrome**

A compartment syndrome of the pelvic ring is caused by haemorrhage of the fascial spaces of the muscles surrounding the pelvis and may even occur due to slight osseous injury to the pelvic ring. In this case, considerably heavier blood loss can be expected; immediate relief of pressure through fasciotomy is required [1, 2, 6].

**Morel-Lavallé lesion**

The Morel-Lavallé lesion represents a special form of pelvic skin-soft tissue injury, since it is a subcutaneous decollement in the pelvic region induced by shear forces, involving massive fluid loss in the subcutaneous area [6]. Due to the high risk of infections and the absence of spontaneous healing, relief of pressure and, if necessary, a vacuum therapy have proved reasonable.

**Hemipelvectomy**

The most severe form of a complex pelvic injury is constituted by hemipelvectomy. This involves the complete neurovascular detachment of one pelvis half including the leg from the torso caused by a massive trauma. At a high primary mortality rate of 80%, the detached extremity can usually not be saved. The only way to survive is the surgical completion of the injury by resecting the pelvis half including the leg. These patients “in extremis” only account for a very minor portion of pelvic ring injuries [1, 14].
In the Trauma Room: Examination and Primary Treatment of Patients with Pelvic Ring Fractures

When admitting patients to the trauma room, the entire examination and primary treatment process complies with the aTLS® guidelines (aTLS® = Advanced Trauma Life Support for Doctors).

Arrival of the Patient in the Trauma Room

The polytrauma patient is handed over by the emergency physician to the entire medical team upon admission. The emergency physician should inform the medical team about all relevant details on the cause of the accident, the patient’s clinical condition at the time the emergency physician arrived at the site of the accident (GCS!!), his preliminary diagnosis and the procedures he performed. In closing, the emergency physician should briefly assess the patient’s current condition by checking his vital signs. A written statement about the findings will be made by the emergency physician using the relevant DIVI protocol and will be filed with the patient’s medical record for future reference during further treatment, for example, to access information on the patient’s primary neurological status.

Initial Visual Examination and Treatment of the Patient in the Trauma Room

Following a quick review of the details provided on the cause of the accident, the injury mechanism and rescue process as well as the transport and the condition of the patient, the trauma room team’s first priority of treatment in accordance with ATLS® guidelines is to detect and prevent immediately life-threatening conditions. This includes assessing the patient’s airways, spontaneous or mechanical ventilation and circulation. When inspecting the airways, immobilisation of the cervical spine also must be checked, or ensured, if this has not already been done.

The patient is repositioned and fully undressed. During this initial phase of visual examination, the patient’s breathing...
is secured, sufficient volume replacement is continued and traumatic haemorrhage is stemmed and controlled (e.g. compression bandage, haemostat, etc.). If there are any concomitant pelvic fractures, these measures should specifically focus on controlling the patient’s circulation (responder vs. non-responder!). Alongside the initial visual examination of the patient, arterial pressure should be measured for further treatment and, if necessary, further volume replacement should be performed to immediately provide the patient with a sufficient volume (Do not forget to prepare type O Rh-negative blood products!!). Of course, life-saving emergency procedures such as cricothyrotomy, chest tube insertion or venesecion to ensure respiratory and circulatory function must be performed at this point without waiting for further diagnoses. The trauma surgeon admitting the patient has to carry out a complete, systematic assessment of all present injuries (surgical body check). In the case of pelvic fractures, the surgeon must not neglect to examine the pelvic orifices. The patient should additionally be checked for peripheral or central neurological symptoms. Based on the specific results of the examination and treatment, further specific diagnostic measures are then initiated.

**Imaging Techniques used in the Trauma Room during Initial Visual Examination of Pelvic Injuries**

Particularly in emergency situations, multislice CT, i.e. a contrast-enhanced CT scan, has proved its worth in detecting haemorrhage in the pelvic region. In a study conducted by PEREIRA, dynamic helical CT demonstrated an accuracy of more than 90% in identifying pelvic haemorrhage that required embolisation [15]. BLACKMORE suggested that contrast agent extravasation in CT of 500 ml or more can be seen as evidence of intrapelvic haemorrhage. For this correlation, a significant association with a relative risk of 4.8 (95% confidence interval 3.0 to 7.8) was found in an analysis of 759 patients. Hence, with extravasation of more than 500 ml, haemorrhage is present in almost half of all cases. However, if there is less than 200 ml of extravasated fluid visible, it can be said with 95% certainty that no haemorrhage is present [16].

In English-speaking countries, the generous and liberal use of angiography is encouraged and authors such as MILLER consider it to be even more important than mechanical stabilisation [12], whereas in German-speaking countries selective embolisation is seen as more of a last resort or “second line of defence” for persistent haemorrhage that is affecting circulation and cannot be controlled by surgical intervention or packing.

The stated reason is that only arterial haemorrhage can be visualised by angiography and selectively embolised in the same session. However, its percentage as a cause of haemorrhage in severe pelvic

**Pelvic Fractures**

Patients are initially assessed and possibly transferred to the emergency room. The detailed examination and treatment, as well as the decision on further specific diagnostic procedures such as angiography, is carried out by the trauma surgeon admitting the patient. Based on the specific results of the examination and treatment, further diagnoses are performed without waiting for the patient to stabilise. If there are persistent haemorrhages that are not controlled, selective embolisation is performed. According to PEREIRA, dynamic helical CT has proved its worth in detecting haemorrhages in the pelvic area.

**Visualizing methods in pelvic fractures**

In German-speaking countries, angiography is considered to be even more important than mechanical stabilisation. According to MILLER, angiography should always be performed when there is a suspicion of pelvic haemorrhage. In English-speaking countries, selective embolisation is preferred over angiography, as it is considered to be more effective in controlling haemorrhages. However, angiography is still recommended in cases where haemorrhage is suspected but not visible on CT scans. In cases where haemorrhage is present, selective embolisation is performed, and angiography is used to confirm the presence of haemorrhage.

**In conclusion**

Based on the specific results of the examination and treatment, further specific diagnostic procedures such as angiography and selective embolisation are performed. The stated reason is that only arterial haemorrhage can be visualised by angiography and selectively embolised in the same session. However, its percentage as a cause of haemorrhage in severe pelvic hemorrhage can be reduced by selective embolisation. Therefore, selective embolisation is performed in cases where haemorrhage is present, and angiography is used to confirm the presence of haemorrhage.
Injuries is estimated to account for only 10-20% of all cases. The remaining 80% of haemorrhages is of venous origin [1, 6] or arises from the fracture surfaces.

Depending on the trauma room algorithm, an X-ray of the pelvis is usually part of primary diagnostics and should then always be taken together with the thoracic x-ray examination.

EDEIKEN-MONROE demonstrated that this was capable of detecting a pelvic ring fracture in 95% of all cases. Moreover, 88-94% of all pelvic fractures can also be correctly classified by an experienced examiner using anterior-posterior pelvic imaging [17].

In children, magnetic resonance imaging can also be employed for primary diagnosis (if available) to avoid additional radiation exposure. In adults, MRI has currently no significance in the primary diagnosis of pelvic fractures and is usually reserved for additional clarification (e.g. distinguishing a fresh fracture from an older one).

Ultrasound examination of the abdomen using the FAST technique (FAST = Focused Assessment of Sonography in Trauma) makes it possible to diagnose or rule out free abdominal or thoracic fluid within the polytrauma algorithm and the ATLS® concept.

Further Diagnostic Procedures in the Trauma Room

During the aforementioned procedures, the care staff takes a blood sample for relevant lab testing, cross-matching and blood gas analysis. In pelvic injuries, urinary catheterisation should be attempted once to ensure urinary function and monitor previous volume replacement. If the glans penis is leaking blood or if transurethral catheterisation is not possible, retrograde visualisation of the urethra and urinary bladder will be performed using image intensifier control to rule out possible injury in this area.

In order to protect the urinary system, a percutaneous suprapubic cystostomy may be necessary.

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The laboratory examinations of patients with pelvic injuries follow the instructions of the polytrauma management and always include a complete blood count, coagulation (incl. Quick), arterial blood gas analysis, lactate and base excess. In assessing the severity of haemorrhage in pelvic injuries, blood loss can either be expressed according to TRUNK-EY [5] as a rate of blood loss (ml/min), or according to BONE [18] as total blood loss (ml) with corresponding classification into levels of severity.

In clinical application, the assessment of blood loss based on the initial haemoglobin content (Hb), base excess or lactate level taken directly upon admission has proved its worth. An Hb level below 8 mg % or a base excess below -6 mmol/l are indicators of relevant blood loss with consecutively unstable circulation.

In conclusion, the pulse rate of injured limbs should be palpated or, if necessary, checked using Doppler sonography. If transport or repositioning is necessary, the patient’s pelvis must be stabilised by applying a pelvic belt or wrapping a sheet around the pelvis so that the patient can be safely transported within the clinic for further treatment (see Fig. 3).

1. Decision: Immediate Emergency Surgery or Additional Diagnostics?

If, despite all initiated procedures, the patient’s circulation remains unstable (“non-responder”) as a result of the pelvic ring injury, immediate surgical stabilisation of the unstable pelvic ring to prevent further blood loss from the fracture surfaces and the presacral or perivesical venous plexus must be avoided.

Immediate, mechanical stabilisation of the anterior pelvic ring should be performed using simple, supra-acetabular external fixation. If there is additional posterior instability, surgical stabilisation of the pelvic ring can be performed at a later point after completing the diagnostics, involving no risk for the patient.

Priority-Based Treatment Concept

Treatment algorithms are goal-oriented conceptual instructions, designed to achieve a therapeutic success also in challenging situations. In the course of every treatment process of multiple injuries in the trauma room, the situation always arises, in spite of clearly defined standard procedures, in which a decision in favour of or against a certain step needs to be made, giving priority to another measure that is actually planned for a later point, is, however reasonable and necessary at the moment.

This approach is geared to a priority-based treatment concept. Particularly during the first phase of treatment following a pelvic fracture, a time-benefit analysis of every measure taken has to be conducted at close intervals in order to constantly maintain an optimum treatment flow without loss of time.

In doing so, a well-coordinated team of surgeons, anaesthetists and nursing staff can guarantee prompt treatment processes by working simultaneously without interferences (e.g. thoracic x-ray while applying the pelvic belt and x-ray protection of the entire team, etc.).

If, based on the parameters measures do far, the patient exhibits a stable circulatory function and is in a (responsive) clinically stable condition (responder), further diagnostic measures and procedures involving the corresponding time can be carried out (e.g. angiography, embolisation, etc.).

Surgical stabilisation of the pelvic ring can be performed at a later point after completing the diagnostics, involving no risk for the patient.
Pelvic Fractures

Fig. 5: 34-year-old male with complex pelvic fracture type C according to AO classification and ruptured urethra caused by being run over by an excavator. Despite mechanical stabilisation using a pelvic clamp and external fixation, there was persistent haemodynamic instability requiring extraperitoneal packing of the small pelvis. After additionally placing a urethral splint and a suprapubic urinary catheter, the patient was admitted to the intensive care unit following surgery.

A pelvic clamp should be used to establish dorsal mechanical stability, if necessary, in combination with ventral external fixation (see Fig. 4).

After re-evaluating the patient’s circulation (transfusion requirements, catecholamine requirement, etc.) following initial mechanical stabilisation of the pelvis, a distinction can again be made between “responders” and “non-responders”, with further diagnostics being initiated for responders. In non-responders, there is most likely persistent haemorrhage from the venous plexus that is spreading into the retroperitoneal area. To achieve direct, surgical haemostasis, local extraperitoneal packing of the sites of haemorrhage in the small pelvis is favoured in Europe, whereas in Anglo-American countries, interventional haemostasis through selective angioembolisation is also performed as a primary measure.

In the ATLS® guidelines, the American College of Surgeons calls for the management of life-threatening haemorrhage within one hour of the accident. MEIGHAN carried out a study on this subject in major accident units in Scotland. He found that only 8 out of 31 clinics are potentially able to surgically stabilise a pelvic fracture within this period. He therefore called for greater emphasis on external emergency stabilisation of the pelvis in the education and training of his fellow surgeons in his country [4]. In 2009, OSBORN published a retrospective comparison of early pelvic angiography (and embolisation, if necessary) versus pelvic packing with subsequent angiography (and embolisation, if necessary) as a management protocol for patients with haemodynamically unstable pelvic fractures [19]: Each treatment group consisted of 20 patients. Physiological markers of haemorrhage, transfusion requirements, time to intervention and early mortality were recorded. Pelvic packing was performed after re-evaluating the patient’s condition and transfusion requirements, if necessary) as a primary measure. The OCS and stabilisation of hematodynamics of the patient (hemotransfusion, application of catecholamines in case of necessity and t.d.) provokes the initial mechanical stabilization of the pelvis. If the patient is not responding to all measures, the mechanical stabilization of the pelvic ring is performed in combination with ventral external fixation. If the patient is persistent in haemorrhage, the extraperitoneal packing of the small pelvis is required. After placement of a pelvic clamp and external fixation, the patient was admitted to the intensive care unit following surgery.

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within 45 min from admission, whereas the median time to angiography was 130 min. The pelvic packing group showed a significant decrease in transfusion requirements, while the angiography group did not. In the angiography group, 10 patients required additional embolisation and 6 died (2 from acute haemorrhage). In the pelvic packing group, 3 patients required additional embolisation, 4 died, however, none died due to uncontrolled haemorrhage (see Fig. 5).

In recent years, there has been a paradigm shift in the United States from angiography and embolisation to surgical treatment of pelvic haemorrhage by means of pelvic packing. In 2007, COTHREN found in a study on 28 patients who underwent pelvic packing that this technique significantly lowered blood transfusion requirements and, consequently, reduced mortality following severe pelvic trauma [20] (see Fig. 6).

In 2008, WESTHOFF demonstrated effective treatment in 21 out of 162 patients with pelvic fractures by integrating transarterial embolisation (TAE) into existing mechanical and surgical treatment techniques. With a median time of 62 min until TAE was performed and a median duration of 25 min, a success rate of 90% was observed, while only branches of the internal iliac artery were embolised [21].

In 2008, NODA et al. first described a visible immediate effect of recombinant factor VIIa (rFVII NovoSeven, market-ed by NovoNordisk) in a pelvic fracture by using angiographic imaging. The patient had a haemodynamically stable type C fracture (Hb 14.6 g/dl, HCT 42.2% and 214,000 thrombocytes/ml, fibrinogen concentration 116mg/dl, prothrombin time 11.0 sec and PTT extended to 68.3). In accordance with the ATLS® treatment regimen, a trauma CT scan was performed that led to the diagnosis of a haematoma located on the left side of the pelvis in relation to the fracture. If extravasation was associated with the fracture, angiography was performed following the internal guidelines and a 90µg/kg dose of rFVIIa was applied intravenously. A second angiography performed 10 minutes after the dose was given did no longer indicate any extravasation [22].

2. Decision: Emergency Surgery or Intensive Treatment First?

Once the goal of the acute period (controlling life-threatening massive haemorrhage and airway management) is achieved, the resuscitation phase is complete and the first stabilisation phase is begun according to ATLS® by re-evaluating the patient’s status.

If a mechanically unstable pelvic ring fracture classified as type B or C by AO classification is diagnosed, literature strongly recommends immediate surgical stabilisation of the pelvic ring using the previously mentioned external fixation techniques. As early as the mid-1980s, MEARS observed a reduction in mortality from
following laparotomy or a transperitoneal ventral SI plate osteosynthesis in laparotomy if external stabilisation using a pelvic clamp or external fixation is not possible, insufficient or contraindicated in transiliac fractures. Ventral SI plate osteosynthesis via anterolateral, retroperitoneal access in transiliac luxation fractures (where the use of a pelvic clamp is contraindicated) is also mentioned.

Some authors only consider external fixation and ventral osteosynthesis to be suitable for primary pelvic stabilisation in the supine position, pointing out that a prone or lateral position poses an additional intraoperative risk to the patient. However, this statement is not supported by a large body of evidence. In contrast to the above-mentioned articles, SHULER advocates percutaneous transiliacacral screw fixation in unstable posterior pelvic ring injuries as an early stabilisation technique with a reduced length of surgery as well as minimal blood loss and wound healing disorders [24]. Nevertheless, this requires...
exact closed reduction of the posterior pelvic ring since, according to TSCHERNE and POHLEMANN, dislocations of > 5mm are frequently associated with increased discomfort following percutaneous screw fixation [6].

The use of the described techniques in early treatment is, however, still a subject of controversy in literature. Research from the early 1990s indicates an improved outcome in patients who received “early” surgical treatment, especially for type-C injuries of the pelvic ring [25].

However, more recent research shows that patients who underwent surgery in the primary phase have a greater risk of suffering secondary organ damage as a result of longer operations with a duration of more than 6 hours, which appears to contribute to an increased case fatality rate and increased incidence of multiple organ failure, as was found by PAPE [26]. According to the data provided by the Study Group Pelvis II of the DGU in 1998 [6] and a study conducted by ROMMENS in 2002 [25], the timing of secondary surgery for pelvic trauma is preferably also between days 5 and 9 after admission rather than within the first 24 hours.

<table>
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<tr>
<th>Classification of Pelvic Ring Fractures</th>
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<tr>
<td>For the classification of pelvic injuries, the currently applicable A0/OTA classification has proved successful, which allows for an accurate, simultaneous description of anterior, posterior, right and left lateral injuries of the pelvic ring, in addition to the classification of the fracture type and group.</td>
</tr>
<tr>
<td>In the case of type A fractures, the osseous and ligamentous integrity of the posterior pelvic ring is maintained. Therefore, they are referred to as “stable fractures”. Examples for this are avulsion fractures, pelvic brim, pubic bone and ischial bone fractures as well as sacrum fractures distally from the IS joint. Conservative treatment is usually sufficient.</td>
</tr>
<tr>
<td>Type B fractures involve a biomechanical rotational instability of the pelvis. In addition to the fracture in the anterior pelvic ring (fractures of the ramus of the pubis, pubic symphysis ruptures), the posterior pelvic ring is hinged open due to the concomitant injury of the ventral sacral ligaments. Due to their sitting posture, bikers are typical accident victims, since the pelvic fractures during collision with the tank due to the simultaneous external rotation of the legs. A combination of pubic symphysis fracture and ventral IS joint rupture (external rotational injury and “open book” injury of the pelvis) frequently occurs during such accidents. Its counterpart, the internal rotational injury, mostly occurs in elderly patients through a lateral compression mechanism, resulting in fractures of the anterior pelvic ring and ventral sacral compression fractures. During the rescue phase, reposition can be achieved by wrapping a sheet around the pelvis or applying a prefabricated pelvic belt, in addition to the internal rotation of the legs; during the initial treatment phase in the trauma room, the application of a supraacetabular external fixation is advisable. Due to the partly intact dorsal stability, anterior treatment of the pelvis is usually sufficient for definitive treatment. Standardised procedures have proved successful for the surgical stabilisation of the individual injured regions.</td>
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<tr>
<td>In the case of type C injuries of the pelvis, the posterior ligamentous and/or pelvic ring structures are completely interrupted; complete rotational and translational instability including anterior and posterior pelvic instability occurs. The sacrum plays a central role in the dorsal pelvic ring. Therefore, sacrum injuries are of special significance and classified separately. According to DENIS et al. [27], a distinction is made between three sacral zones where transverse fractures typically occur: the transalar, the transfemoral and the central zone. Although transalar fractures occur most frequently (50%), they are bridged by the dorsal sacroiliac ligaments and thus stabilised like type B pelvic ring injuries. With an incidence of 15%, central sacrum fractures occur quite rarely and are stable due to their mostly spongy fracture pattern; however, they involve a correspondingly high rate of concomitant neurological injuries. The relatively frequent transfemoral sacrum fractures (34%) are of significance, since they do not only involve considerable instability of the dorsal pelvic ring but are also associated with a high rate of neurological injuries (28%) [27].</td>
</tr>
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</table>

stablezation of the tazovogo kolta v otom momenot rassmatryvается в качестве больше как экстренная процедура, а не как часть тазовой реконструкции. После успешной экстренной внешней фиксации нестабильности тазового кольца отмечалось значительное снижение частоты легочных осложнений и потребности в последующей гемотрансфузии и срока пребывания в больнице.

В индивидуальных исследованиях также в первую очередь приводятся описания методов внутренней стабилизации в течение этой фазы. Поскольку большинство способов внутренней стабилизации, как правило, отнимают много времени и являются технически сложными оперативными вмешательствами, они могут применяться лишь при некоторых вариантах локализации переломов и в экстременных ситуациях [6]. Некоторые авторы предлагают использовать пластику для остеосинтеза костей симптома через папаротомию в случаях, когда внешняя стабилизация с использованием тазового зажима или других способов внешней фиксации невозможна, недостаточна или противопоказана (как при ротационно-нестабильных переломах лобковой кости при типу «ручки лейки»).

Описано использование вентральной пластинки для остеосинтеза по переднебоковой
Definitive Treatment of Pelvic Ring Injuries in the Second Stabilisation Phase (> 24 Hours)

Once the first stabilisation phase is completed, the patient is in a relatively stable state. Haemodynamic stability and initial mechanical emergency stabilisation should be established by the time the primary phase is concluded. In the second stabilisation phase, necessary diagnostics are completed to subsequently determine further treatment. Biomechanical investigations suggest that internal osteosynthesis is ten times superior to external fixation in terms of stability, which is why treatment is usually shifted from temporary external stabilisation to definitive internal techniques following specific selection criteria and the described procedures. The use of external fixation or a pelvic clamp for curative treatment has been described in individual cases, although this is usually reserved for rare indications.

Once again, the timing of the shift in treatment remains a subject of controversy in literature. According to research from the 1990s, definitive internal osteosynthesis should ideally be performed post-primary, i.e. around 2 to 3 days after the

<table>
<thead>
<tr>
<th>Treatment Concepts for the Various Degrees of Instability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type A injuries:</strong> Surgical treatment is indicated only in exceptional cases (e.g. open fractures or strongly dislocated pelvic brim fractures involving the risk of skin perforation).</td>
</tr>
<tr>
<td><strong>Type B injuries:</strong> Due to the partly intact dorsal stability, anterior treatment is sufficient in this case. Standardised procedures have proved successful for the surgical stabilisation of the individual injured regions (see below).</td>
</tr>
<tr>
<td><strong>Type C injuries:</strong> Early mobilisation should be achieved by both anterior and posterior stabilisation of the pelvic ring. Since the patients are usually severely injured, all accessible regions are stabilised in supine position, preferably ventrally. Depending on the injured region, standardised procedures have proved successful in this case as well.</td>
</tr>
<tr>
<td><strong>Definitive treatment of the symphysis:</strong> Transverse fascial incision or utilisation of the longitudinal incision e.g. following initial emergency laparotomy. After splitting the linea alba vertically and carefully notchting the rectus insertion, stabilisation is carried out using a 4-6-hole 3.5-mm AO-DC plate (screw direction craniocaudal). In exceptional cases, fixed-angle plates may also be used for stabilisation (e.g. in elderly patients).</td>
</tr>
<tr>
<td><strong>Surgical stabilisation of transpubic instability:</strong> The application of a simple supraacetabular external fixation is sufficient in case of isolated injuries or following the treatment of dorsal instability. Given the combination of symphysis rupture and transpubic instability, a transpubic traction screw osteosynthesis is performed following plate osteosynthesis or an external fixation is additionally applied.</td>
</tr>
<tr>
<td><strong>Surgical procedures of treating sacroiliac luxation:</strong> The standard procedure is ventral plate osteosynthesis involving stabilisation with two 3-hole 4.5-mm DC plates. Following an anterolateral incision in the iliac crest and medial shifting of the iliac muscle, the sacroiliac joint is well visible. A further advantage is the possibility of simultaneously displaying the symphysis and the sacroiliac joint in supine position, which significantly facilitates the reduction. Percutaneous stabilization employing traction screw osteosynthesis monitored by an image converter - sometimes also navigated - is increasingly performed.</td>
</tr>
<tr>
<td><strong>Procedures of treating sacrum fractures:</strong> Surgical stabilisation is indicated in case of unsatisfactory results following non-surgical treatment. The standard procedures include closed reduction and percutaneous transiliacal screw osteosynthesis in supine position. Surgical treatment is indicated for unstable vertical sacrum fractures involving nerve root compression caused by fragments. In this case, the treatment is carried out in prone position. Our intention is to perform plate osteosynthesis limited to the sacrum (“local osteosynthesis”).</td>
</tr>
</tbody>
</table>

婆婆-cover image, с осуществлением забронированного доступа при таких переломах (где использование тазовых зажимов противопоказано). Некоторые авторы рассматривают их лишь в качестве приспособлений для внешней фиксации и остеосинтеза, для первичной стабилизации переломов таза в положении лежа на спине, отмечая, что боковое положение создает дополнительный интраоперационный риск для пациента. Однако в целом ряде исследований это утверждение не было опровергнуто. В отличии от вышеупомянутых статей, Shuler и сторонники чрескожной трансилосакральной винтовой фиксации при задней нестабильности тазового кольца рекомендуют наиболее быструю технику стабилизации, с меньшей продолжительностью операции, а также минимальной кровопотереи и быстрым заживлением ран [24]. Тем не менее такой подход требует полного смыкания тазового кольца, поскольку, согласно данным Tscherne и Pohlemann, проведение чрескожной винтовой фиксации при несмыкании тазового кольца > 5 мм часто связано с выраженным дискомфортом [6]. Использование описанных методов лечения на ранней стадии до сих пор остается спорным. К началу 90-х гг. получены данные об улучшении результатов у пациентов, которым было при менено «раннее» хирургическое лечение, особенно при травмах
accident. However, PAPE [28] finds that extensive secondary surgery of > 3 hours duration can be seen as an initiator of secondary changes associated with the development of post-traumatic organ dysfunction. This is why he recommends avoiding extensive surgery between the second and fourth day after the accident. It is generally understood that performing major secondary surgery at an early stage should be approached with caution, given the significantly increased risks it involves. The timing of surgery must be based on the patient’s individual clinical situation, with literature providing the pO2/FiO2 ratio in addition to various other evaluation parameters to assess the operability of a polytrauma patient.

CONNOR [29] recommends early definitive mechanical stabilisation, i.e. within 1 week after the trauma. According to his findings, this approach leads to shorter hospital stays and thus fewer costs as well as less pulmonary complications. MATTA [30] suggests that open reduction and internal fixation should be performed no later than 21 days after the accident, stating that operations before day 21 post-surgery potentially achieve better reduction results than after day 21 (70% versus 55%, however, without statistical significance).

Complications

Patients with pelvic ring injuries fall into the high-risk group for development of thromboembolic complications. Appropriate preventive care using low-molecular-weight heparin while monitoring the coagulation status (anti-Xa) and blood count (thrombocytes) should be sought. Early definitive treatment and early mobilisation additionally minimise the risk of deep vein thrombosis affecting the pelvis or legs. Open pelvic injuries and complex trauma have an increased rate of local soft tissue complications and infection. This needs to be taken into account, especially when informing the patient about the required multiple surgeries.

Neurological disorders and urological damage are in many cases a direct consequence of the injury; early detection often clarifies whether or not there is a connection to the injury and enables immediate initiation of appropriate care (e.g. urological functional diagnostics, long-term catheterisation, etc.).

Conclusion and Outlook

By ensuring early identification and basic management of unstable pelvic ring fractures in polytrauma patients at the site of the accident, the emergency physician and the emergency medical team can lay the foundation for successful treatment. Swift and direct transport to the “right” clinic while providing all relevant details on the injury mechanism and the injury pattern allows for appropriate further treatment of the patient.

Even with sufficient infrastructure in place, the admission and initial treatment of a polytrauma patient with pelvic injury still represents a challenge for the attend-

Pelvic Fractures

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Even with sufficient infrastructure in place, the admission and initial treatment of a polytrauma patient with pelvic injury still represents a challenge for the attend-
The ATLS® course concept has already put these requirements into practice, since experience has shown that a seasoned team combined with a well-structured treatment concept are the key to successful treatment of a patient with pelvic injury. Following priority-based trauma room treatment in compliance with ATLS®, it is surgical treatment, also priority-based and in compliance with DSTCTM (Definitive Surgical Trauma Care), that increases the medical team’s performance and skills after having completed the relevant courses and the related training in emergency situations.

Assessing the severity of pelvic injury as well as restoring and ensuring circulation during the primary survey are essential criteria for the success of clinical treatment. In the event of persisting haemodynamic instability at the end of the first treatment phase, there is no point in continuing routine diagnostic tests. At first, it is imperative to restore the mechanical stability of the pelvic ring using basic treatment techniques in order to support simultaneous haemodynamic stabilisation procedures during the resuscitation phase.

The use of conservative or surgical treatment for pelvic injury depends on the individual diagnosis and fracture classification. In the primary survey, the correct assessment of the severity of injury and haemorrhage is crucial for the patient’s prognosis. Functional limitations and chronic pain as well as urological problems are a decisive factor for late prognosis.

In view of the growing number and greater mobility of older patients, the necessity of surgical treatment for pelvic fractures at an advanced age is increasingly moving into the focus of treatment. Age-specific treatment concepts are increasingly being developed, but there is still great need for action.
Переломы таза

Literature

Bariatric Surgery

Current Therapeutic Options and Prospects

Introduction
During the last few years, obesity has developed to become a serious medical and socioeconomic problem. The number of overweight or morbidly obese people has generally increased; in addition, the increased extent of obesity with accumulation of extremely obese patients is alarming. This development is not limited to western countries and also concerns children and adolescents to an increasing extent. The multitude of obesity-associated comorbidities, above all type II diabetes, arterial hypertension, sleep apnoea syndrome as well as degenerative musculoskeletal diseases, constitutes another problem. The incidence rate of secondary diseases significantly increases in proportion to the increasing body mass index (BMI) [1].

The initial conventional treatment of morbid obesity predominantly involves conservative therapeutic measures. These include multimodal therapeutic approaches and also comprise behavioural therapy, in addition to diets, medication as well as dietotherapy and kinesiotherapy. The consistent implementation of these complex therapeutic approaches and a high degree of patient compliance allows for achieving at least short-term satisfactory reduction of the body weight. Investigations during the last few years have shown, however, that the effect of conservative therapeutic measures is only temporary in the majority of patients [2].

At present, the surgical treatment is the only way to induce and maintain a long-term significant weight reduction. Furthermore, it has a lasting positive effect on associated comorbidities and thus also on the case fatality rate [2].

By now, numerous investigations have demonstrated that bariatric surgical procedures are capable of inducing remission of type II diabetes or reducing the extent of its treatment in more than 70% of all patients [3].

The objective of the review at hand is to provide a brief overview of the most frequently performed bariatric procedures and their effects on the various comorbidities associated with obesity. The focus is on current therapeutic options and prospects.

Введение
В течение нескольких последних лет ожирение стало серьезной медицинской и социально-экономической проблемой. Количество людей с избыточной массой тела и патологическим ожирением увеличилось, при этом, что особенно тревожит, возросло число чрезвычайно тучных пациентов. Данная тенденция отмечается не только в западных странах, также она касается детей и подростков. Множество связанных с ожирением сопутствующих заболеваний, прежде всего, диабет II типа, артериальная гипертония, синдром апноэ во сне, а также дегенеративные заболевания опорно-двигательного аппарата, создают еще одну проблему. Показатель возникновения вышеперечисленных вторичных заболеваний значительно возрастает пропорционально увеличению индекса массы тела (ИМТ) [1].

Начальный этап стандартной программы лечения патологического ожирения преимущественно включает в себя консервативные терапевтические меры. Это вмешательства психологического характера, диеты, медикаментозная терапия, а также кинезиотерапия. Последовательная реализация этого сложного терапевтического подхода и высокая степень комплаенса позволяют пациенту достичь в кратчайшие сроки ожидаемых результатов и существенно снизить вес. Однако исследования последних лет показали, что консервативные лечебные мероприятия оказывают лишь временный эффект у большинства пациентов [2]. В настоящее время хирургическое лечение представляется единственным действенным способом достичь и удержать в долгосрочной перспективе вес в пределах нормы. Кроме того, оперативное лечение оказывает клинически значимое позитивное влияние на связанную с ожирением сопутствующую патологию и, следовательно, и на коэффициент летальности [2]. К настоящему времени в ходе многочисленных исследований было показано, что хирургические бARIАТРИЧЕСКИЕ ВМЕШАТЕЛЬСТВА СПОСОБНЫ ИНДУЦИРОВАТЬ ремиссию сахарного диабета типа II или достичь компенсации состояния при диабете более чем в 70% всех случаев [3].
Bariatric Surgery

and additionally provide a critical outlook regarding the extension of indications for such interventions to include normal-weight and slightly overweight patients suffering from type II diabetes.

Key words: bariatric surgery, surgical procedures, Type 2 Diabetes, review

Laparoscopic Adjustable Gastric Band (LAGB)
The laparoscopically implanted adjustable gastric band (LAGB) is one of the most frequently performed restrictive procedures worldwide [4]. The LAGB impresses with the simplicity of the surgery involving little surgical trauma, low morbidity rate and a mortality rate of < 0.1% [5]. At first, a pars flaccida approach is made using the laparoscopic technique and the retrocardiac tunnel is created. After pulling through the band, a pouch (approx. 15 ml) is separated and connected to a port chamber fixed above the fascia (Fig.1). Seroserous sutures at the fundus prevent the band from slipping. With 20-25% of the initial BMI, the largest average weight reduction takes place in the first 2 years [6]. The metabolic outcome is substantially dependent on the amount of weight reduction. Two investigations have revealed a type II diabetes remission rate of 50% (Tab. 1) [6,7]. The careful selection of patients, a high degree of patient compliance and close-meshed interdisciplinary follow-up treatment including band adjustment are of essential importance for the success of this minimally invasive procedure.

Despite the excellent results showing a weight reduction of up to 50% or more during the first two years following the surgical intervention, complications or band failure may occur in the further course, often making another surgical intervention necessary. The long-term failure of the LAGB is documented to range between 10.5 and 76% depending on the follow-up period and is more likely to occur with increasing age [8-10]. The most frequent complications are pouch dilation and slipping, often occurring in combination with dysphagia. Further complications include band migration, oesophageal dilation with dysmotility, severe gastro-oesophageal reflux as well as port-associated problems.

Laparoscopic Sleeve Gastrectomy (LSG)
Laparoscopic sleeve gastrectomy constitutes one of the younger bariatric procedures and has quickly established itself as one of the most frequently performed interventions to treat morbid obesity. From the historical point of view, LSG can be regarded as a further development of the Magenstrasse & Mill surgery. Being a restrictive procedure, it is part of the more complex bilipancreatic diversion with “duodenal switch” (BPD-DS). LSG as an individual procedure was initially propagated to treat extremely obese patients within the scope of a two-stage concept as the primary surgery followed by subsequent intestinal bypass. The goal of this strategy was to reduce the morbidity and mortality rates. Some years ago, however, it was realized, that the procedure for weight reduction offers a much safer and lower risk alternative than the intestinal bypass. The long-term efficacy of such procedures, however, is often less impressive than the initial results.

LAPG can be regarded as a restrictive procedure requiring no changes in lifestyle, diet and physical exercise. The long-term results are excellent and comparable to the other procedures. The often observed remission of type II diabetes is one of the main advantages of this procedure. In addition, the procedure has a low rate of complications and is reversible, allowing for adjustments and revisions if necessary. The only significant disadvantage is the higher cost compared to other procedures.

LAPG is often combined with other surgical procedures, such as a gastric bypass or a jejuno-jejunal anastomosis, to achieve better weight loss and metabolic control. LSG is also often combined with other procedures, such as an adjustable gastric banding or a duodenal switch, to improve weight loss and metabolic control. The procedure can be performed as a single-stage or a two-stage procedure, depending on the patient’s needs and preferences. The single-stage procedure is performed as a single operation, while the two-stage procedure involves an initial operation to create a sleeve, followed by a second operation to create an intestinal bypass.

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was clearly demonstrated that LSG without secondary surgery also constitutes a reasonable, safe and effective therapeutic option. The weight reduction achieved is larger compared to the gastric band and comparable to gastric bypass at lower complication and mortality rates, at least in the short and medium term, although long-term results are still to follow [11–14]. The surgical technique involves a vertical gastric resection, leaving a narrow gastric tube at the lesser curvature (Fig. 2). The calibration is ensured by intraoperative placement of a bougie. The extent of the weight reduction in dependence on the bougie size is subject of fierce debate. There are indications that the incidence rate of postoperative leakage in the stapled suture area is increased with small bougie sizes, caused by extremely high intragastric pressure. Compared to other bariatric interventions, the maintenance of the gastric function, the avoidance of an intestinal bypass and the implantation of foreign material as well as the endoscopic accessibility are advantageous. Investigations reveal a weight reduction of 40% to 69% in the first few years [15–17]. This therapeutic option also has a positive effect on obesity-associated comorbidities, producing remission rates of 55-74% of type II diabetes and 63-68% of arterial hypertension (Tab. 1) [14, 18]. The most frequent complications include leakage in the stapled suture area (1.17%), haemorrhage (3.57%) as well as postoperative stenoses [11,19].

The success of this procedure can be attributed to the restriction, reducing the gastric capacity and improving the feeling of satiety. Furthermore, neurohumoral mechanisms such as the reduction of the ghrelin-producing endocrine cells predominantly found at the fundus and the accelerated gastric evacuation including earlier duodenal nutrient exposure seem to play a significant role [17, 19, 20].

In addition, numerous changes of certain hormones are detected, resulting in increased feeling of satiety and a positive effect on the diabetic metabolism, which is increasingly being considered as a therapeutic option also has a positive effect on obesity-associated comorbidities, producing remission rates of 55-74% of type II diabetes and 63-68% of arterial hypertension (Tab. 1) [14, 18]. The most frequent complications include leakage in the stapled suture area (1.17%), haemorrhage (3.57%) as well as postoperative stenoses [11,19].

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Table 1: Remission rates of type II diabetes and arterial hypertension following different bariatric interventions

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Type II Diabetes</th>
<th>Arterial Hypertonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAGB</td>
<td>50%</td>
<td>30-70%</td>
</tr>
<tr>
<td>LSG</td>
<td>55-74%</td>
<td>63-68%</td>
</tr>
<tr>
<td>RYGB</td>
<td>82-98%</td>
<td>52-92%</td>
</tr>
<tr>
<td>BPD-DS</td>
<td>92%</td>
<td>83%</td>
</tr>
</tbody>
</table>

LAGB = Laparoscopic Adjustable Gastric Band; LSG = Laparoscopic Sleeve Gastrectomy; RYGB = Roux-en-Y Gastric Bypass; BPD-DS = Biliopancreatic Diversion with Duodenal Switch

Table 1: Remission rates of type II diabetes and arterial hypertension following different bariatric interventions

Таблица 1: Ремиссия диабета II типа и артериальной гипертензии после различных типов бариатрических операций

Исследования показывают, что по сравнению с группой после желудочного шунтирования, при более низком уровне осложнений и смертности, по крайней мере в краткосрочной перспективе. Исследование отсроченных результатов продолжается до сих пор [11–14].

Бариатрический метод включает в себя вертикальную резекцию желудка, при которой формируют узкий протяженный желудочный “рукав” на малой кривизне (рис. 2). Калибровка обеспечивается интраоперационно, за счет размещения бужа. Степень снижения массы тела определяется размером бужа и является предметом серьезных дискуссий. Есть сведения, что частота возникновения послеоперационных осложнений тем больше, чем более узкий буж был установлен, что обусловлено значительным повышением внутрижелудочного давления. По сравнению с другими бариатрическими вмешательствами РУ позволяет сохранить нормальное функционирование желудка, избежать кишечных осложнений, объемить без имплантации чужеродных материалов, эндоскопический доступ также выгодно снижает инвазивность процедуры. Как правило, в результате происходит снижение массы тела на 40–69% от исходной массы тела в первые же несколько лет после операции [15–17]. Этот вариант лечения также оказывает по-
Bariatric Surgery

**Roux-en-Y Gastric Bypass (RYGB)**

The laparoscopically performed Roux-en-Y gastric bypass (RYGB) is currently the most popular and most frequently performed bariatric procedure and should be considered especially for obese patients suffering from type II diabetes [4]. At present, RYGB is regarded by many surgeons as the gold standard for both primary and revision surgeries, especially after restrictive procedures have failed [22, 23].

Being a combined procedure, RYGB combines the restriction with a “mild” malabsorption. The first step of the surgery is the formation of a gastric pouch (15 - 25 ml) (Fig. 3). In the course of the intestinal bypass, the upper jejunum is separated approx. 50 cm distally to the ligament of Treitz and an alimentary limb (in front of or behind the colon) of 150 cm is formed. The most frequent early complications include haemorrhage of the stapled suture as well as anastomotic leakage. Technical complications in the further course are caused by pouch dilation (1.5%), anastomotic stenosis (1 – 15%) as well as pouch evacuation or reflux disorders [24,25]. The occurrence of gastro-gastric fistulas is frequently observed following anastomotic leakage, leading to the loss of the restrictive effect. Further complications in the long term include what is referred to as marginal ulceration, which frequently occurs in the anastomotic area with an incidence rate of 0.6 - 16% as well as intestinal obstruction caused by internal hernia (1.3%) [26].

The average weight reduction as Excess Weight Loss (EWL) is estimated at 61-83%, whereby patients with a BMI of >50 kg/m² exhibit a lower EWL on average [27, 28]. Substantial effects are observed on obesity-associated comorbidities as well. For example, the remission rate of type II diabetes is 82-98%; arterial hypertension no longer requires treatment in 52-92% of all patients (Tab. 1) [27,28].

This suggests that LSG is more than a simple restrictive procedure.

**Fig. 1: Implantation of a gastric band, left: retrocardiac tunnel creation; right: placement of the band**

Рис. 1: Имплантация бандажа на желудок. Слева – формирование ретрокардиального «рукава»; справа – наложение бандажа

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**Шунтирование желудка по Ру (Roux-en-Y gastric bypass, RYGB)**

Как и прочие бариатрические процедуры, шунтирование желудка (RYGB) выполняется гастропротезно и является в настоящее время самым популярным и наиболее часто применяемым методом хирургического снижения веса. Этот метод является методом выбора для пациента с ожирением и сахарным диабетом II типа [4]. В настоящее время RYGB рассматривается многими специалистами в качестве «золотого стандарта» бариатрической хирургии, особенно после неудачного опыта применения других методик хирургического снижения веса [22, 23].

Будучи комбинированной процедурой, RYGB объединяет механическое сужение объема желудка и «мягкую» мальабсорбцию. Первый этап операции заключается в формировании мешка из желудка объемом (15 - 25 мл) (рис. 3). С целью шунтирования, отделяют участок верхней тощей кишки на 50 см дистальное связки Трейца и подшивают его (перед или за тостой кишкой) к малому мешку желудка, формируя отдельный участок тонкой
The metabolic effect of the RYGB goes far beyond the mere loss of weight. The glucose metabolism returns to normal shortly after the surgical intervention, long before a significant weight reduction is achieved [3]. Besides the limited food intake as well as increased feeling of satiety and reduced feeling of hunger, the duodenal exclusion, the earlier exposure of the ileum to nutrients as well as the changed regulation of enterohormones (e.g. ghrelin, GLP, PYY, adiponectin) are considered to be the reasons.

**Biliopancreatic Diversion with Duodenal Switch (BPD-DS)**
The BPD-DS is considered to be the currently most effective bariatric procedure in terms of stable and lasting weight reduction and is thus especially recommended to extremely obese patients as the primary surgery. Nevertheless, it is rarely performed and is not widespread [4]. Following the performance of a lateral gastric resection and formation of a gastric sleeve, an alimentary and biliopancreatic limb is formed. The latter is introduced into the ileum according to Y-Roux 100 cm in front of the ileocaecal valve. To complete the procedure, the duodenal switch is performed by separating the duodenum approx. 5 cm behind the pylorus. The BPD-DS not only exhibits the largest weight reduction caused by the combination of resection and malabsorption but, by preserving the pylorus, it is also associated with more quality of life compared to other bypass procedures.

The undesirable side effects of other procedures, such as dumping syndrome, intolerance of solid food and marginal ulceration are not observed [29]. Long-term results demonstrate a remission rate of 92% of type II diabetes and 83% of arterial hypertension (Tab. 1) [7, 30]. The morbidity and case fatality rates that are higher than in all other procedures are, however, problematic. In meta-analyses, they are reported to be 17.6% and 1.1%, respectively [31]. Due to the additional considerable risk of nutritive and metabolic disorders, this procedure should preferably be recommended to extremely obese patients.

**Metabolic Surgery**
Obesity induces a great number of metabolic diseases (metabolic syndrome), entailing various complications and a shortened life expectancy. In this respect, type II diabetes is one of the most frequent secondary diseases, which is induced by increased body weight coupled with genetic disposition. In a high percentage of obese patients, bariatric interventions result in the remission of associated comorbidities, which yielded the new term “metabolic surgery”.

It predominantly focuses on the treatment of type II diabetes and other severe metabolic diseases. The principles of metabolic surgery are not solely based on the reduction of overweight but are specifically aimed to induce a multitude of hormonal changes.

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  - **Furthermore, the excellent results regarding obesity-associated comorbidities in**
obese patients have sparked a worldwide discussion about extending the indication spectrum for “metabolic” surgical interventions to include normal-weight and slightly overweight patients.

The finding that the improvement of obesity-associated concomitant diseases occurs already prior to achieving a significant weight reduction has led to a multitude of investigations. A great number of mainly neurohumoral mechanisms are considered to be the reason for the positive results (Tab. 2). This finding has allowed for establishing new surgical procedures (duodenal-jejunal bypass, ileal transposition), producing antidiabetic effects through the targeted change of humoral mechanisms and accompanied by only slight weight reduction. The significance of both these new and the conventional bariatric procedures for the treatment of type II diabetes is, however, still being disputed, especially in diabetics with normal weight or only slight overweight. For this reason, these patients should preferably be treated within the scope of studies or at centres with corresponding expertise. This is the only way to objectively and conclusively assess this therapeutic option. Should the initial positive results be confirmed, this would induce a worldwide revolutionary change in treating one of the most frequent metabolic diseases.

Summary
Especially the healthcare sector is faced with serious problems due to the alarming worldwide increase of obesity. Conservative treatment methods fail in the majority of cases.

At present, the surgical treatment is the only way to guarantee lasting and long-term reduction of overweight. Bariatric surgery has proved a safe and effective therapeutic option that has a positive effect on both weight reduction and obesity-associated comorbidities. This is achieved by low morbidity and mortality rates. The investigation of neurohumoral mechanisms that are closely associated with the development of obesity and the metabolic syndrome has preserved a positive effect on the long-term decrease of body weight and the normalization of disturbed metabolic processes. These findings have allowed for establishing new surgical procedures (duodenal-jejunal bypass, ileal transposition), producing antidiabetic effects through the targeted change of humoral mechanisms and accompanied by only slight weight reduction.

Fig. 2: Resected gastric tissue following sleeve gastrectomy

Results
Resective surgery has proved to be effective in reducing body weight and improving the metabolic status in a large number of patients. The surgical treatment has been shown to reduce the risk of developing diabetes and other comorbidities associated with obesity.

Discussion
The findings from this study support the idea that surgical interventions can be effective in treating obesity and related comorbidities.

Conclusion
Resective surgery, especially sleeve gastrectomy, is a safe and effective treatment option for patients with obesity. The findings from this study support the potential of surgical interventions in reducing the risk of developing diabetes and other comorbidities associated with obesity.
led to a better understanding of the pathophysiology and the effects of the individual surgical procedures as well as the establishment of new surgical procedures. They appear to be capable of both reducing overweight and specifically treating diseases within the metabolic syndrome, especially type II diabetes.

The extension of indications for bariatric interventions to include normal-weight and slightly overweight diabetics bears huge potential and could help open up new dimensions of treating one of the most frequent metabolic diseases; however, this approach needs to be critically investigated within the scope of further studies.

References
Table 2: Present theories concerning the remission of type II diabetes following bariatric interventions [3]

<table>
<thead>
<tr>
<th>Mechanisms</th>
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<tbody>
<tr>
<td>• Exclusion of duodenal receptors and proximal small intestine sections from the food passage (foregut theory)</td>
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<tr>
<td>• Rapid delivery of undigested nutrients to distal small intestine sections with increased secretion of the glucagon-like-peptide (GLP-1) (hindgut theory)</td>
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<td>• Increase of adiponectin level with improvement of insulin sensitivity</td>
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<td>• Reduction of insulin resistance by improvement of the liver morphology</td>
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<td>• Reduction of ghrelin level</td>
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Advances in the Management of Shoulder Stiffness

Key Words:
Shoulder stiffness, Frozen Shoulder, adhesive capsulitis, arthroscopic shoulder release, arthroscopic capsular release, shoulder arthroscopy, posttraumatic shoulder stiffness.

Background and Epidemiology
Although shoulder stiffness was first described more than a century ago, it remains till now a broad problematic term with variable proposed aetiologies, broad spectrum of pathologies, different terminology and variable clinical manifestations which however are characterized by loss of both active and passive range of motion of the shoulder. The term frozen shoulder was first described Codman in 1934. Another term used by Naviaseris is adhesive capsulitis that describes the suggested underlying pathology which he proposed as a chronic inflammatory process involving the shoulder capsule resulting in its thickening and contracture as well as secondary adhesion to the humeral head. Recently the term frozen shoulder is used to describe only the idiopathic forms and was defined by the AAOS in 1992 as “a condition of uncertain etiology characterized by significant restriction of both active and passive shoulder motion that occurs in the absence of a known intrinsic shoulder disorder.” Incidence of shoulder stiffness in the general population ranges from 2% to 5%, with women representing 70% and 20% to 30% of patients will be bilaterally affected. No accurate incidence of acquired stiffness has been determined due to the great variability in this group.

Classification
Many classifications for the stiff shoulder have been proposed in the literature with the most accepted one classifying it into idiopathic and acquired forms. The idiopathic form is referred to also as Frozen Shoulder and includes patients without preceding shoulder pathology as well as those having systemic disorders known for its high association with frozen shoulder, mostly Diabetes Mellitus. This type is characterized by generalized glenohumeral capsular contracture. Acquired stiffness generally includes

Key Words:
Тугоподвижность плечевого сустава, «замороженное плечо», капсулит, артроскопический капсулярный релиз, плечевой сустав, посттравматическая тугоподвижность плеча.

Предпосылки и эпидемиология
Несмотря на то, что тугоподвижность плечевого сустава впервые была описана более ста лет назад, она до сих пор остается проблемой со многими неизвестными. Существует множество предположений относительно этиологии, патогенеза заболевания. Описаны разнообразные стороны клинических проявлений, основным из которых является потеря объема активных и пассивных движений в плечевом суставе. Термин «замороженное плечо» был впервые использован Кодманом (1934). Еще один термин — капсулит плечевого сустава (адгезивный капсулит) предложил Навиасерис для описания патологии, связанной с хроническим воспалительным процессом в капсуле плечевого сустава, приводящей к его уплотнению и развитию контрактуры, а также вторичной адгезии к головке плечевой кости. В последнее время термин «замороженное плечо» используется только в описании idiopathic формы заболевания и был определен в AAOS 1992 году как «состояние неясной этиологии, характеризующееся значительным ограничением активных и пассивных движений в плечевом суставе при отсутствии других причин нарушения его функций».

Распространенность тугоподвижности плечевого сустава в общей популяции колеблется от 2% до 5%, при этом соотношение женщин и мужчин составляет 70% и 20% соответственно, у 30% пациентов поражены оба плечевых сустава. Эти данные лишь приблизительно отражают распространенность указанной патологии ввиду ее значительной изменчивости.

Классификация
В работах различных авторов было предложено множество вариантов классификации этого заболевания. Основной из них составляет разграничение на идиопатическую и приобретенную формы. Идиопатическая (чаще используется термин «замороженное плечо») развивается у пациентов без предварительной патологии плечевого сустава, на фоне полного здоровья. Среди
Shoulder Surgery

**Pathology**
Shoulder stiffness results from adhesions or contractures at one or more of the glenohumeral, subacromial or scapulothoracic articulations (Fig. 2). The majority of daily life activities are performed in positions within the midrange of motion in which the capsule and glenohumeral ligaments are free of tension and only become tense at the ends of range of motion (ROM). The capsule in the region of the rotator interval contains the coracohumeral and superior glenohumeral ligament which show a gradual increase in their tension with increasing external rotation in 0 degrees of abduction. In contrast, the middle glenohumeral ligament becomes taut at 90 degrees of abduction.

Although many mechanisms for development of the shoulder stiffness have been postulated, the exact pathological mechanism remains unclear with most studies showing the capsule as being the primary structure affected, mostly with perivascular infiltration and capsular fibrosis and possibly synovial affection. It is still debatable whether there is an immunological basis for this condition or not with only some studies confirming an increased level of circulating immune complexes, serum Ig-A, C-reactive protein or decreased lymphocyte transformation in these patients. However other studies failed to support such findings.

**Natural History**
The natural history of frozen shoulder surgery and usually exhibits localized contractures (Fig. 1).

**Classification of shoulder stiffness**

**Stiff shoulder**
- Frozen shoulder
  - idiopathic
  - primary
- Acquired stiffness
  - post-surgical
  - post-traumatic

**Fig. 1: Classification of shoulder stiffness**

*Fig. 1: Классификация тугоподвижности плечевого сустава*
Shoulder surgery is not yet proved or well understood. Many consider frozen shoulder a self-limited disease although it is proved that some patients may continue to have some degree of permanent restriction of motion even after the resolution of all phases of the disease. Some other patients may not show any improvement at all or show only mild improvement.

Risk Factors
Many factors have been proposed to impose a higher risk for the development of shoulder stiffness. These include the age range between 40 and 60 years with possible early incidence in patients with insulin-dependent diabetes dating since childhood. Diabetes Mellitus patients show a 10% to 35% incidence of frozen shoulder, which is strongly associated with its duration. Surgical operations in the surrounding structures as axillary node and neck dissection, and prolonged shoulder immobilization in adults constitutes a high risk for stiffness. Cervical degenerative disorders, chronic pulmonary disorders, thyroid disorders, and some neoplastic disorders show also a higher association with frozen shoulder. There has been also an association with some neurological disorders as Parkinson’s disease, cerebral hemorrhage, hemiparesis, as well as some psychiatric disorders.

Evaluation
Diagnosis of frozen shoulder requires a high index of suspicion together with a careful history and physical examination. Radiographic and laboratory studies may be sometimes helpful. There are certain diagnostic criteria that characterize the idiopathic frozen shoulder and considered to be a key component in its diagnosis. These include the lack of a history of shoulder trauma or surgery, significant unilateral limitation of both passive and active ROM in all planes and normal radiological findings. Acquired or secondary Shoulder Stiffness is somehow expected after bone or soft tissue injuries around the shoulder. Isolated posterior capsular contracture is the most commonly described in acquired stiffness.

To this point, the question of whether immunological predispositions for such a secondary “attack” of the joint capsule exist remains unresolved. Although in some studies a heightened level of circulating immunocomplexes, s-IgA, C-reactive protein or transformation of lymphocytes was observed in these patients. However, other studies did not confirm these results.

Pathogenesis of idiopathic “frozen shoulder”
Pathogenesis “frozen shoulder” to some point does not come to an end. Many think that this self-limiting process is caused, although in some patients they may persist some limitations of motion even after the resolution of all phases of the disease. Furthermore, in some patients, there may be no improvement at all, or only mild improvement.

Factors Risk
Many factors are associated with the development of shoulder stiffness. These include age range between 40 and 60 years, those with insulin-dependent diabetes, and those with a history of surgical operations in the surrounding structures such as axillary node and neck dissection. Cervical degenerative disorders, chronic pulmonary disorders, thyroid disorders, and some neoplastic disorders are also associated with the development of shoulder stiffness.

Diagnosis
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Shoulder stiffness may also follow surgical procedures around the shoulder as anterior or posterior capsulorrhaphy, inferior capsular shift, and rotator cuff surgery.

Frozen shoulder shows three classic successive phases:

1. Freezing phase: This is the initial stage that is characterized by pain present for several months at rest and is exaggerated with movements, especially sudden ones. Difficulty with sleeping is described particularly over the affected side. Progressive limitation of motion until complete loss of function may occur. This phase generally lasts between 2 and 9 months.

2. Frozen phase: Pain tends to decrease in this phase but the motion becomes severely restricted in all planes even with light activities. This usually provokes the patient to seek medical advice. This phase can last between 3 and 12 months or may be sometimes longer.

3. Thawing phase: ROM slowly returns with improvement of pain. It may take several years until the full range of motion could be restored. There may be sometimes a permanent mild to moderate restriction of motion.

In acquired stiffness there is no predictable course like idiopathic frozen shoulder although it is characterized by loss of motion in certain directions depending on the etiological factor. A careful and complete examination should be performed.

Inspection for signs of trauma or previous surgery that refer to acquired stiffness should be taken into account. Active and passive ROM is limited and should be tested in all planes in both shoulders and recorded for both diagnosis and follow up of treatment. Laboratory investigations may be ordered if infection or diabetes are suspected.

Imaging and Arthroscopic Diagnosis
Routine radiographs are done to exclude associated bony lesions of the shoulder and are usually normal. Humeral head osteopenia due to disuse of the shoulder may be seen. MRI with IV gadolinium may show thickening of the joint capsule and synovium more than 4 mm in the region of rotator interval and axillary pouch. Arthroscopy after confirmation of diagnosis by examination under general anesthesia is useful to evaluate and treat additional pathology and it may show variable findings depending on the stage of the disease from synovitis to chronic adhesions.

Treatment
Conservative management is the initial approach in almost all patients and operative treatment could only be indicated when patients fail to respond to nonoperative measures. Nonoperative measures include:

- Medication as NSAIDs and oral steroids which could result in a significant improvement in the ROM, function as well as pain relief due their anti-inflammatory effect especially if combined with a regular exercise program. Physical Therapy is started with active

In the patogenesis “frozen shoulder” three following stages:

1. Phase “frosting” – initial, lasting from 2 to 9 months, characterized by pain and limited motion of the affected shoulder. The passive range of motion is usually between 3 and 12 months.

2. Phase “stiffness” – the pain decreases, and active range of motion remains limited. This phase can last between 3 and 12 months or may be sometimes longer.

3. Phase “thawing” – the passive range of motion gradually improves. It may take several years until the full range of motion could be restored. There may be sometimes a permanent mild to moderate restriction of motion.

In acquired stiffness there is no predictable course like idiopathic frozen shoulder although it is characterized by loss of motion in certain directions depending on the etiological factor. A careful and complete examination should be performed.
Fig. 3a: Technique 360° arthroscopic capsular release. 1. Rotator interval release (red). 2. Anterior capsule, MGHL and anterior band of IGHL release (in green). 3. Posterior capsule, posterior band of IGHL and inferior capsule (in orange).

Рис. 3а: техника 360°: артроскопическое капсульное иссечение. 1. Разворачивающее устройство. Интервал иссечения (отмечено красным). 2. Передняя поверхность капсулы, MGHL и переднее иссечение IGHL (отмечено зеленым). 3. Задняя поверхность капсулы, задняя часть IGHL и нижняя поверхность капсулы (оранжевым цветом)
assisted ROM and passive stretching exercises several times daily with trial to exceed the pain limit slightly each time. The use analgesics and application of local heat before exercise as well as ice application after exercises which help in improving compliance with physiotherapy by reducing pain should be encouraged. Physiotherapy should be gently performed without excessive force, particularly in early phases. Other conservative measures such as short waves, ultrasound, electrophysiotherapy, massage and heat lamps may be additionally considered in the rehabilitation process, although there is no proof of particular benefit. Patients must understand the course of the disease and have a good compliance to expect a good result nonoperatively. Several forms of injections could be utilized especially in early phases, although their role is still controversial. These include intra-articular and subacromial steroid injection, periarticular (trigger point) injections and suprascapular and subscapular nerve blocks. Acupuncture may also result in a marked improvement in some patients. Calcitonin and sometimes Radiation therapy in stiff shoulder–related heterotopic ossification can prevent recurrence after excision.

Operative management is mostly indicated with failure to regain a satisfactory ROM after about 3 to 6 months of nonoperative treatment. Operative options include manipulation under anesthesia (MUA) and surgical release and should be always followed by intensive prolonged physiotherapy. Most surgeons recommend MUA in patients with frozen shoulder after failure of nonoperative treatment whereas patients with acquired stiffness might not respond well to manipulation. Manipulation should be postponed until resolution of the inflammatory phase. MUA may improve the range of motion but often results in tears

нейшей диагностики, так и для принятия решения о выборе лече- ния. Лабораторные исследования целесообразны в случаях, когда есть подозрение на наличие ин- фекций или сахарного диабета.

Артроскопический диагноз: работа со снимками
Рутинная радиография обяза- тельна для исключения патологии костной ткани. При тугоподвиж- ности плечевого сустава патоло- гия на данных снимках отсутству- ет, за исключением, возможно, некоторого истончения костной ткани в области головки плече- вой кости, в связи с функциональ- ной «выключенностью» конечно- сти. MRI с IV гадолинием может показать утолщение суставной капсулы и синовиальной оболоч- ки более чем на 4 мм в области ротационной манжеты и подмы- шечной сумки. Артроскопия для подтверждения диагноза прово- даются под общей анестезией. Она необходима как для постановки окончательного диагноза, так и для его детализации. При этом могут быть визуализированы раз- личные (в зависимости от стадии) патологические изменения: от синовита до хронического спа- ечного процесса.

Лечение
В первую очередь пациентам с тугоподвижностью плечевого сустава проводят курс консер- вативной терапии. И только в случае его неудачи, отсутствия или недостаточного эффекта приступают к более радикально- му, хирургическому лечению. Консервативное лечение включает: НПВП, пероральные стероидные препараты, которые значительно увеличивают объем движений в пораженном суставе, анальгетики, главным образом из-за их противооспалительного эффекта, в комбинации с регу- лярными физическими упражне- ниями, направленными на увели- чение подвижности в плечевом суставе. Комплекс упражнений включает как активные движения в лечении суставе, так и пас- сивную растяжку, с постепенным увеличением нагрузки и амплиту- ды движений. Применение анальгетиков и местного тепла (согревающие
in the subscapularis muscle and tendon, the supraspinatus tendon, the long head of the biceps tendon and shoulder capsule or fractures of the proximal humerus and in extreme cases shoulder dislocation and brachial plexus palsy. Due to its associated hazards MUa is not recommended by many authors initially but at the end of arthroscopic capsular release to improve the obtained ROM through arthroscopic release. Due to its associated hazards, MUa is not recommended by many authors initially but at the end of arthroscopic capsular release to improve the obtained ROM through arthroscopic release. The technique of MUa implies the application of a constant controlled force to the proximal humerus while stabilizing the scapula and applying a gradual traction and flexion are first followed by adduction across the patient’s chest to restore internal rotation. The arm is then returned to neutral position and the forearm is rotated very gently into external rotation without excessive force followed by abduction and then internal and external rotation in this position to further release the anterior and posterior capsule. Force should be applied to the humerus as proximal as possible to minimize torque by decreasing the lever arm and gentle manipulation using the two-finger approach to avoid excessive force. A regional block is recommended after MUa to allow immediate rehabilitation. Recurrence after MUa is estimated to be between 5-20%.

Open Surgical Release is rarely indicated nowadays after the marked advances in arthroscopic techniques and instruments. Examples include patients with acquired stiffness resulting from extra-articular soft tissue contracture, such as after Putti-Platt procedure due to involvement both subscapularis tendon and the capsule. Open surgical excision of scar компрессы) как до, так и после упражнений приветствуются. Однако курс физиотерапии не должен быть слишком агрессивным, особенно на начальных этапах. Другие физиотерапевтические методы, такие как ультразвуковая терапия, электрофизиотерапия, массаж и тепловые лампы могут быть комплексным дополнением к реабилитационному курсу, но эффективность каждого метода в отдельности доказана не была. Для достижения хороших результатов безоперационного лечения очень важную роль играет комплайнс между врачом и пациентом, высокая степень взаимного доверия, понимание пациентом поставленных перед ним задач. На ранних этапах могут проводиться некоторые малоинвазивные манипуляции, но этот момент до сих пор остается спорным. В частности, это касается интратеартериальных и субкапсулярных инъекций стероидов, периартикулярных (в тригерные зоны) и субкапсулярных нервных блокад. Методы рефлексотерапии оказываются эффективными у некоторых пациентов. Кальцицион и радиационная терапия показаны при появлении связанных с тугоподвижностью плечевого сустава очагов гетеротопической оссификации, поскольку позволяют предотвратить рецидив после их иссечения.

Оперативное лечение тугоподвижности плечевого сустава показано при неэффективности консервативной терапии на протяжении от 3 до 6 месяцев, невозможности восстановить объем движений в плечевом суставе нехирургическими методами. Инвазивные (оперативные методики) включают ряд манипуляций под анестезией и всегда сопровождаются последующим пролонгированным курсом физиотерапии. Такой подход рекомендован пациентам с выраженной жесткостью плечевого сустава, не отвечающей на стандартную программу консервативного лечения. Оперативное вмешательство должно быть отложено до стихания активного воспалительного процесса.
tissue and release of extra-articular adhesions with or without Z-plasty of the capsule and subscapularis tendon is the treatment of choice in this condition. Patients with stroke who develop severe contracture of SSC and pectoralis major may be indicated for open surgical release. Disadvantages of open surgical release include postoperative pain and recurrence of stiffness due to the need to protect the lengthened or repaired subscapularis tendon.

Arthroscopic capsular Release is currently the treatment of choice for shoulder stiffness and was first performed by Conti in 1979. It aims at performing a systematic release in a stepped approach that may involve up to 360° of the capsular attachment at the glenoid with the use of an electrothermal device (Fig. 3a, b).

Advantages of arthroscopic capsular release include direct and enhanced visualization of the pathologic capsule with subsequent accurate release. At the same time associated pathologies can be identified and addressed and the subacromial space could be evaluated with performing any required soft tissue or bony decompression. Physical therapy could be started earlier after arthroscopic release. The procedure is performed in beach chair position through the standard posterior and anterior superior portals (Fig. 4).

MUA is better to be avoided before arthroscopy to avoid bleeding and obscuring visualization as well as fluid extravasation. Passive ROM should be initially measured and recorded followed by diagnostic arthroscopy and synovial resection. Biceps tendon patholology should be managed with either tenotomy or tenodesis followed by systematic capsular release using the electrothermal device. Capsular release should be started superiority and anteriorly in the region of rotator interval dividing the superior glenohumeral ligament together with the anterior capsule till the superior border subscapularis. Release of the contracted rotator interval results in lateral and inferior translation of the humeral head and subsequently improvement of visualization.

Care should be taken to release medially the interval between subscapularis tendon and shoulder capsule. This is followed by release of the middle glenohumeral ligament as it crosses posterior to the subscapularis. Release of the anterior capsule is continued inferiorly to include the anterior band of the inferior glenohumeral ligament and reaching the 6 O’clock position. Attention should be paid to the close proximity of the axillary nerve to the axillary pouch.

Posterior capsular release is started if the patient has additional limitation of internal rotation. The arthroscope is switched anteriorly and the electrothermal device is used through a cannula inserted through the posterior portal. Care is taken to perform release always just adjacent to the glenoid labrum. Posterior release is performed also in a position medially placed near the capsule.

Manipulations under arthroscopic guidance may significantly increase the volume of movements in the glenohumeral joint, but also may cause a loss of joint space and synovial fluid and enhance visualization of the capsule. Posterior capsular release is performed also in a position medially placed near the capsule. Patient should be kept in a prone position with a pillow under the shoulder and with the arm in neutral position. Posterior capsular release may be performed also in the sitting position with the arm in the 90° of abduction and lateral rotation. Posterior capsular release is started if the patient has additional limitation of external rotation. The arthroscope is switched anteriorly and the electrothermal device is used through a cannula inserted through the posterior portal.
Fig. 5: Intraoperative arthroscopic picture showing anterior and posterior capsular release.

References
downward direction to involve the posterior band of the inferior glenohumeral ligament leaving only a small portion of the inferior capsule in the region of the axillary pouch intact (Fig. 5).

The inferior capsule can then be released either through a series of arthroscopic basket forceps or with manipulation according to surgeon preference. Great caution should be taken if this step is performed with the electrothermal device and it should be kept directed upwards towards the glenoid. Subsequent subacromial decompression may be performed followed by gentle manipulation as described before to release the remaining adhesions and further improve the obtained range of motion.

Postoperative positioning of the shoulder in alternating external and internal rotation with the shoulder in 90° abduction is of extreme importance in the immediate postoperative period. Also Postoperative intensive passive ROM exercises with allowing a free active ROM should begin immediately after the operation with regular follow up to determine the adequacy of treatment.

д-р Conti in 1979. Оно направлен-но на систематическое поэтапное высвобождение сустава от контрактур и рубцовой ткани, включая работу со всеми элементами сустава, с использованием электротермических устройств (рис. 3, а, б). Преимущество этого метода состоит в возможности прямой и подробной визуализации пораженной капсулы, с последующим точным проведением иссечения спаек. Кроме того, может быть проведена ревизия субакромиального пространства с обеспечением доступа для всех необходимых манипуляций на мягких тканях или костной де- компрессии. Курс физиотерапии после артроскопического иссечения следует начинать как можно раньше. Процедура выполняется в стандартной шезлонг-позиции (рис. 4). Перед проведением артроскопии лучше исключить проведение манипуляций под наркозом, чтобы избежать кровотечений, ухудшающих визуализацию, а также кровоизлияний. Объем пассивных движений в суставе должен быть предварительно оценен и задокументирован перед диагностической артроскопией и синовиальной рецизацией.

При патологии сухожилия бицепса должна быть применена тенотомия или тенодез путем капсульного ангиоскопического иссечения с использованием электротермических устройств.

Капсульное иссечение должно быть начато ближе к передней части ротатора манжеты, с отделением верхней глено- гимеральной связи вместе с передней поверхностью капсулы до верхней подлопаточной линии. Иссечение контрактур в области ротатора манжеты позволяет смешать головку плечевой кости вниз и латерально, что значительно улучшает визуализацию. Особое внимание следует удалить рассечению и высвобождению от спаек пространства между подлопаточным сухожилием и капсулой плечевого сустава. Это сопровождается высвобождением средней глено-гумеральной связи, в месте ее пересечения с подлопаточной линией. Далее высвобождение передней поверхности капсулы продолжается книзу, включая переднюю часть нижней глено-гумеральной связи до достижения позиции 6:00 часов.

Здесь следует быть особенно внимательным и аккуратным ввиду проходящих рядом ветвей плечевого нервного сплетения. Высвобождение задней поверхности капсулы проводят в том случае, когда пациент испытывает трудности при внутренней ротации. Артроскоп вводят через передний доступ, а электротермальное устройство для рассечения — через специальную канюлю задним доступом. Рассечение выполняется прямо рядом с суставной губой. Заднее рассечение осуществляется также в нишда- щем направлении, с вовлечением задних волокон глено-гумеральной связки, оставляя нетронутой только небольшую часть нижней поверхности капсулы вблизи суставной сумки (рис. 5).

Нижняя поверхность капсулы может быть высвобождена в рамках серии артроскопических вмешательств или другой выбранных тактики, на усмотрение хирурга. Требуется особая осторожность, если этот шаг выполняется с помощью электротермического устройства. Оно должно быть направлено поверх гленоида. Последующая субакромиальная декомпрессия может быть выполнена с высокой деликатностью, как описано выше, для иссечения оставшейся рубцовой ткани и дальнейшего улучшения диапазона движения в результате. Послеоперационное позиционирование плеча в альтернирующей (переменной) внутренней и внешней ротации на 90° чрезвычайно важно для последующего процесса реабилитации и правильного восстановления компонентов сустава.

Послеоперационные пассивные упражнения для увеличения объема движений в плечевом суставе с разрешением свободных активных движений должны быть начаты сразу же после операции и выполняться регулярно.
Urge Urinary Incontinence in Women Can Now Be Cured by Surgery

Case Report
A 71 year old woman came to the Division of Urogynecology. She was suffering from incontinence. As far as she could remember the problems started at the age of 50 years. At that time she started losing urine whilst coughing and sneezing. She helped herself by using diapers. In the years that followed she realized that she could not hold her urine for as long as she wanted. While watching a film in the cinema she felt an urge to void but wanted to wait until the film had finished. However, after several minutes she could not stop the urge to urinate anymore and lost urine. From that time on she would stop drinking hours before she went to a film or a theatre visit. This helped for some time, but she realized that the time period between the first impulse to void and the loss of urine became shorter and shorter. She reduced the amount she would drink to 0.5 l. per day and looked out for toilets wherever she went. She knew the location of all the toilets in her preferred shopping zone.

When she presented herself at our clinic, she had given up nearly all activities outside her home. She had visited several urologists and tried all existing medical treatments up to Botox-injections into the bladder, but without any success. Five years ago she could not contain her urine anymore. She was always losing urine – she was “wet” all the time. She had to change the diapers sometimes twice an hour. She and her husband had given up flights, and even travelling with the car was interrupted nearly every 30 minutes. She fell into a deep depression.

A friend of hers told her about the new operations which we had performed at our department. It was upon this recommendation that she came to our division of uro-gynecology.

During gynecological examination she immediately lost urine when a speculum was placed at the introitus vaginae. She stopped playing golf because she was not able to walk for several hours without voiding!

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had been hysterectomized at the age of 47 because of severe menstrual bleeding caused by uterine fibroids. During normal gynecological examination the vaginal vault was in normal position (-8cm from the hymenal ring) and she had no cystocele or rectocele. In the standing position, the vaginal vault came down to -4cm from the hymenal ring during Valsalva maneuver.

We then performed a VARESA operation. During this operation we sutured specially developed alloplastic tapes at the os sacrum and at thelevator muscles at both sides of the introitus vaginae. That works as a “parapet” on which the lateral aspects of the vagina and rectum were sutured. With this operation we reconstructed the suspension of the pelvis. All patients got a vaginal sling (TOT) during the same operation [1].

After removal of the urethral catheter on the second day after surgery, the patient was immediately continent. From that time on she went to the toilet only between 5 and 7 times per day and could hold the urine for at least 45 minutes. 4 years after surgery she has a totally “normal life”.

She likes theater visits and spends every winter in Spain without any travelling problems. She has improved her drinking volume to more than 2 l. per day. She has recognized that during this time her cognitive functions have improved again. Things she previously could not remember (e.g. the telephone number of her daughter) are now back in her mind. She has never had any depression since the operation.

**Discussion**

Treatment of stress incontinence has become a standard procedure in clinical practice. Based on the assumption that the pubo-urethral ligaments were damaged in these patients, alloplastic tapes were placed under the urethra. That procedure turned out to be very effective, with cure rates reaching 90% of patients [1].

However, there have been no effective treatments for urge urinary incontinence so far [2].

Urge urinary incontinence is an extremely bothersome disorder which affects nearly every second woman during her life. It may start when the affected woman cannot hold the urine for as long as she wants, e.g. until the end of the film or she realizes that she needs to go to the toilet several times more than before. The condition can finish by causing loss of all control over the bladder and becoming “wet all the time”. This unhappy triad of urgency, frequency and urine loss leads affected women to a massive limitation in their social life.

Pharmacological treatments were disappointing since they were only slightly more effective than placebo [2]. Until now treatment consisted of continuous catheterization or the surgical implant of a cuff which is placed around the urethra and is blocked by a little pump placed underneath the skin.

In process of gynecological osmarta пациентка также не могла удерживать мочу. Мочеиспускание произошло сразу же после введения зеркалца во влагалище. В возрасте 47 лет больной была проведена гистерэктомия в связи с менструальными кровотечениями, вызванными фиброзными маткой. Результаты гинекологического осмотра: свод влагалища в нормальной позиции, цистоцеле или ректоцеле не обнаружено.

В ходе хирургического вмешательства (операция VARESA) между крестцом и мышцами тазового дна с обеих сторон от входа во влагалище были прикреплены специально разработанные аллоалгістические ленты, выполняющие функцию «ларета», на котором фиксировались (были «подвешены») латеральные (боковые) поверхности вагины и прямой кишки. С помощью этой операции был восстановлен поддерживающий каркас тазового дна. Во время значительной операции всем пациенткам также была проведена сплинговая (пятевая) операция TOT [1].

После снятия уретрального катетера на второй день после хирургического вмешательства пациентка была сразу же выписана. Теперь она могла удерживать мочу до 45 минут. Количество актов мочеиспускания сократилось до 5-7 в день. Спустя 4 года после операции пациентка ведет нормальный образ жизни. Она может свободно посещать общественные места, театры, кинотеатры, проводить время с семьей, совершать продолжительные прогулки. Путешествия также больше не составляют для женщины трудностей. Каждую зиму она проводит в Испании.

Теперь женщина может выпивать больше 2 л воды в день, не опасаясь каких-либо неудобств или дискомфортных ситуаций. В связи с выходом из депрессивного состояния улучшились когнитивные показатели пациентки: память, внимание. Пациентка активна, жизнерадостна, полна сил.

**Обсуждение**

Лечение ургентного недержания мочи стало стандартной (рутинной) процедурой в клинической практике. С учетом того, что пубуретальные связи у этих пациентов утратили свое нормальное функционирование, аллопластические ленты были размещены под уретрой. Этот тип вмешательства показал высокую эффективность. Уровень излечения пациентов достигает 90% [1].

До сих пор не существовало метода лечения недержания мочи с такими высокими показателями результативности [2].

Ургентное недержание мочи – патология, приносящая невероятные неприятности пациенту. При этом она встречается практиче-ски у каждой второй женщины после 50. Заболевание может начаться с того, что женщина станет трудно удерживать мочу на протяжении длительного вре- мени, с увеличением количества «визитов к туалету» на протяже-нии дня. Со временем контроль удержания мочи может быть полностью утрачен. Подтекание мочи начинает происходить по-стоянно. Женщина вынуждена резко ограничить свою социальную активность, она старается не выходить из дома, сокращает количество социальных контактов,
In 1991 de Lancey emphasized the importance of the correct anatomical support of the vagina for continence function. [3]. Since the vagina has no internal form (like the kidneys or the heart), it must be stretched by the pubo-urethral-ligament on one side and by the utero-sacral ligaments on the other side. In his Integral Theory Petros compared this to a bridge where both pylons are important in supporting the runway [4]. If the tension of the vagina has fallen under a critical level, then the zone of critical elasticity (at the bladder neck) will start sending neuronal messages that the brain interprets as the urge to void.

So when we concentrated our research on urge urinary incontinence, we focused our interest on the posterior compartment and especially on the utero-sacral ligament. We started to operate on patients with urge urinary incontinence and descensus of the vaginal vault with the classical prolapse operations. However, none of them could cure urge urinary incontinence. Only when we decided to place the suspension on both sides of the pelvis and placed them from the introitus to the os sacrum did we become successful [5]. During the years that followed we improved the suturing technique step by step. This is drastically documented in the time taken to perform the operations, which decreased from more than 3 hours to 75 minutes today. One very important step on that way was the development of specially designed tapes.

This operation was very effective for the treatment of urge urinary incontinence. Until 2010 we operated on 561 patients with urge urinary incontinence. An overall cure rate of 77% was established.

35 of these patients had the severest form of incontinence. They were “totally wet”.

No previous treatment had helped them. Even when they knew that our treatment was experimental with no guarantee for cure, they nevertheless asked for surgery. In the beginning we observed that after VARESA the urgency to void had diminished but they nevertheless lost urine. We then decided additionally to perform a trans-obturator-tape operation (TOT) to establish a fixation point in the anterior compartment.

Thereafter, 27 of these 35 women (75%) became continent (“dry”) again. From that time on until the end of the
observation period (24 months) they remained absolutely continent. They did not have any problems with urinating anymore. Since the results of the study had not then been published, all patients came to our institution because of the recommendations of the cured patients. This was probably the best confirmation of the results in itself.

The results of our study show that urge urinary incontinence can be cured by surgery, even the severest form - the “always wet” patients.

Stress urinary incontinence can be cured by TVT or TOT. Urge urinary incontinence has not been cured as yet. However, our study demonstrates for the first time that urge urinary incontinence, too, can be cured by surgery. The high percentage rate of success shows that we are on the right track. Further studies must aim to cure the remaining patients or elucidate the factors responsible for failure.

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References

Все эти пациенты согласились на данный, пусть экспериментальный, метод лечения, поскольку уже испробовали и успели разочароваться во всех остальных существующих и довольно рас пространенных вариантах. Поскольку результаты исследования не были опубликованы, все последующие пациенты узнали об этой операции из рекомендаций своих друзей и знакомых, а это наилучшее подтверждение успешности разработанной методики.

Результаты нашего исследования показывают, что ургентное недержание мочи, включая наиболее тяжелые его формы с постоянным подтеканием мочи, может быть вылечено хирургическим путем. Дополнение основного оперативного вмешательства слинговыми (петлевыми) операциями (TVT или TOT) позволяет излечивать такие формы заболевания, которые до сих пор подвергались лишь симптоматической терапии. Стрессовое недержание мочи также может быть излечено операциями TVT или TOT.

Высокие показатели эффективности метода указывают на то, что наши исследования — на правильном пути. Дальнейшие поиски направлены на изучение тех случаев, в которых операция оказалась неэффективной.
Local Therapy of Breast Cancer Oncoplastic Surgery and Intraoperative Radiation

Key words: breast cancer, breast surgery, oncoplastic breast surgery, breast radiotherapy, intraoperative radiotherapy, boost radiation

Breast-Conserving Therapy: Oncological and Aesthetic Aspects

Breast-conserving surgery (partial mastectomy) followed by breast irradiation has replaced modified radical mastectomy as the preferred treatment for early-stage invasive breast cancer. The 20-year survival of partial mastectomy with radiation is not statistically different when compared with modified radical mastectomy in patients with Stage I or II breast cancer [1,2]. Partial mastectomy includes quadrantectomy (wide excision), segmentectomy (wide local excision) and lumpectomy (local excision). In a study comparing lumpectomy with quadrantectomy, the 5-year incidence of in-breast tumor recurrence was higher in the lumpectomy patients (8.1%) than in the quadrantectomy patients (3.1%) [3]. The incidence of local recurrence depends upon the tumor margin status, histology subtype, radiation therapy, adjuvant medical treatment, tumor biology, and patient age [4]. Most local recurrences occur at the site of initial tumor excision or in the same breast quadrant. In general, during the first 10 years after lumpectomy with radiation the recurrence rate is about 1.4% per year.

Many studies suggest that local control plays a crucial role in overall survival. The overview of the Early Trialists and Collaborative Group (EBCTCG) approves that differences in local treatment that substantially affect local recurrence rates would avoid about one breast cancer death over the next 15 years for every four local recurrences avoided, and should reduce 15-year overall mortality [5]. Therefore the standard treatment for early breast cancer comprises wide local excision, sentinel lymph node biopsy or axillary lymph node dissection, adjuvant medical treatment and radiotherapy to the whole breast.

Oncoplastic Surgery

Oncoplastic surgery includes quadrantectomy, segmentectomy, and lumpectomy. It aims to achieve an oncologically safe excision while preserving as much breast tissue as possible. Oncoplastic techniques can help improve cosmetic outcomes, particularly in younger patients or those desiring retention of breast contour. The success of oncoplastic surgery relies on the expertise of the surgeon and the availability of advanced imaging and surgical techniques.

Intraoperative Radiation

Intraoperative radiation therapy (IORT) is a form of hyperfractionated radiation delivered during surgery. IORT is used in select cases of breast cancer to sterilize the margins of resection and reduce the risk of local recurrence. This technique may be particularly beneficial in patients with close or positive margins, or in those with tumor margins near critical structures. However, concerns about increased risk of complications and limited effectiveness have limited its widespread adoption.

Boost Radiation

Boost radiation therapy is an additional, higher dose of radiation given to the breast after the initial course of whole breast radiation. This additional therapy is designed to reduce the risk of local recurrence in patients with high-risk characteristics. The use of boost radiation has been shown to improve local control and overall survival, although the optimal strategy for selecting patients for boost therapy remains a topic of ongoing research.

Breast Cancer - The Journal of Medicine for the Worldwide Medical Community

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A surgical dilemma in breast-conserving treatment arises because, on the one hand, the breast surgeon needs a wider excision to provide clear margin and better local control of disease, but on the other hand, the surgeon wants to spare as much tissue as possible for defect closure and make the resulting aesthetic outcome as favorable as possible [Fig. 1]. Approximately 10% to 30% of patients are dissatisfied with the aesthetic result after partial mastectomy with radiation [6-8]. There are many possible causes of aesthetic failure. Tumor resection can produce distortion, retraction, and noticeable volume changes in the breast. Changes to the position of the nipple-areola-complex can extenuate asymmetry. Radiation can also have a profound effect on the breast (edema, skin erythema, hyperpigmentation, fibrosis and retraction) [Fig. 2].

**Breast-Conserving Surgery: the Oncoplastic Approach**

To improve local outcomes and aesthetic results in breast-conserving surgery the combination of a wide local excision with an immediate partial breast reconstruction has been considered a decisive stage in the evolution of breast cancer surgery. This combination, so-called “oncoplastic breast surgery”, allows a wider resection of the tumor with tumor-free resection margins. Moreover, good aesthetic results can be achieved because of the advantage of immediate reconstruction of the partial mastectomy defect [9,10].

Numerous surgical techniques with tissue displacement and tissue replacement have been published with different indications, incision lines and suggested rotation techniques, missing a systematic and structured approach for oncoplastic breast surgery [11]. During the last years we have defined five reconstruction principles in oncoplastic breast-conserving surgery [12,13]. With these five principles we were able to perform more than 95% of all immediate reconstructions of partial

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**Fig. 1: The dilemma in breast-conserving surgery: oncological vs. aesthetic aspects**

<table>
<thead>
<tr>
<th>Lumpectomy</th>
<th>Segmentectomy</th>
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<tr>
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<td>Cosmesis</td>
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**Fig. 2: The dilemma in breast-conserving surgery: oncological vs. aesthetic aspects**

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влияет на уровень рецидивов и позволяет избежать смертельного исхода для каждого четвертого случая местного рецидива и уменьшить общую показатель смертности в течение последующих 15 лет [5].

Стандарт лечения раннего рака молочной железы включает в себя широкое местное иссечение опухоли и окружающих тканей, биопсию дозорных лимфоузлов или иссечение подмышечных лимфатических узлов, адъювантное лечение и последующий курс лучевой терапии.

Хирургическая дилемма в органосберегающей хирургии молочной железы включает в себя широкое местное иссечение опухоли и окружающих тканей, биопсию дозорных лимфоузлов или иссечение подмышечных лимфатических узлов, адъювантное лечение и последующий курс лучевой терапии.

Хирургическая дилемма в органосберегающих операция на МЖ: онкология vs. эстетические аспекты

**Fig. 1:** The dilemma in breast-conserving surgery: oncological vs. aesthetic aspects

**Fig. 2:** The dilemma in breast-conserving surgery: oncological vs. aesthetic aspects

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Органосберегающие операции на МЖ: онкопластический подход

В качестве одного из этапов эволюции хирургии рака молочной железы рассматривался вариант сочетания широкого местного иссечения с одномоментной частичной мастэктомией с последующим облучением [6-8]. На это есть целый ряд причин. Резекция опухоли может привести к искалечению, стягиванию, и заметному уменьшению объема груди. Изменение положения соска и ареолы может смягчить асимметрию. Радиационное облучение также может оказать сильное негативное влияние на внешний вид молочной железы (отек, эритема кожи, гиперпигментация, фиброз и ретракция) (Рис. 2).

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**Fig. 1:** Дилемма в органосберегающей хирургии молочной железы: онкология vs. эстетические аспекты

**Fig. 2:** Дилемма в органосберегающей хирургии молочной железы: онкология vs. эстетические аспекты

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**Breast Cancer**

**Lumpectomy**

**Segmentectomy**

**Quadrantectomy**

**Mastectomy**

**Residual tumor**

**Resection margin**

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**Рис. 2:** Дилемма в органосберегающей хирургии молочной железы: онкология vs. эстетические аспекты
mastectomy defects during breast-conserving surgery, resulting in optimized local and aesthetic outcomes. The oncoplastic reconstruction principles of partial mastectomy defects during breast-conserving surgery are as follows:

1. Glandular rotation [Fig. 3]
2. Dermoglandular rotation [Fig. 4]
3. Tumoradapted reduction mammoplasty [Fig. 5]
4. Thoracoepigastric flap
5. Latissimus dorsi flap [Fig. 6]

To determine which oncoplastic reconstruction principle is best for the individual patient with breast cancer, the size and location of the expected tumor resection, the distance between tumor and overlying skin, and the ratio of breast volume to resection volume must be appreciated.

Breast-Conserving Therapy: Improving Local Outcome with Intraoperative Boost Radiation?
Adjuvant whole-breast radiotherapy after breast-conserving surgery greatly reduces the risk for in-breast recurrences and improves overall survival over breast-conserving surgery alone [1,2]. Usually the whole breast is irradiated with a dose

Fig. 2: breast-conserving surgery without oncoplastic technique – aesthetic failure
Рис. 2: Органосберегающая операция на молочной железе без онкопластической техники – эстетически неудачное вмешательство

Fig. 3: Segmental resection and glandular rotation
Рис. 3: Сегментарная резекция и ротация железы

Nесмотря на многочисленные публикации методов онкопластической хирургии, предполагающих смещение и последующую замену тканей, четкая система в этом вопросе отсутствует и поньше [11]. В последние годы были выделены пять методик онкопластической реконструкции при органосохраняющих операциях на молочной железе [12, 13]. Благодаря этим 5 методикам нам удалось провести неотложную реконструкцию молочной железы более чем в 95% всех органосберегающих мастэктомий, и получить оптимальные результаты, как в терапевтическом, так и в эстетическом плане.
Виды реконструкции молочной железы после мастэктомии:

1. Ротация железы (Glandular rotation) (Рис. 3).
2. Дерматожелезистая ротация (Dermoglandular rotation) (Рис. 4).
3. Редукционная маммопластика (Tumoradapted reduction mammoplasty) (Рис. 5).
4. Маммопластика с использованием торакоэпигастрального лоскута (Thoracoepigastric flap).
5. Маммопластика с использованием широчайшей мышцы спины (Latissimus dorsi flap) (Рис. 6).

Чтобы подобрать оптимальный для данного пациента способ онкопластической реконструкции, учитывают размер и местоположение опухоли, объем запланированной резекции, рассто-
of 50-56 Gy. An additional dose escalation to the tumor bed as a boost reduces the local relapse rate in selected patients. The European Organization for Research and Treatment of Cancer (EORTC) boost-trial, reported a local recurrence rate of 4.3% at 5 years [14]. However, there is a considerable risk for geographic miss when the tumor bed boost is provided months after surgery. It has been estimated that the externally delivered boost may partially miss the target volume in approximately 20-90% of cases, especially in oncoplastic tissue displacement techniques.

Recently, the concept of intraoperative radiotherapy (IORT) as boost during breast-conserving surgery has been introduced using different techniques [15-18]. In the Breast Center of the University-Hospital Cologne a mobile IORT device generating low-energy x-rays (50 kV) is used since 2010 for intraoperative boost radiation in non-lobular breast cancer. This IORT-system is applicable to all predefined oncoplastic breast-conserving surgery principles [Fig. 7].

After oncoplastic wide local excision (segmentectomy) of the tumor, the applicator of the mobile device Intrabeam (Carl Zeiss Surgical, Oberkochen, Germany) is placed into the tumor bed. Using purse-string stitches the segmentally oriented resection margins of the tumor bed are narrowed to the spherical applicator. To prevent skin toxicity, skin margins were everted before starting IORT. Thereafter, a single dose of 20 Gy is provided at the applicator surface [Fig. 8]. After complete wound healing and/or chemotherapy whole-breast radiotherapy is initiated. The median treatment time of the boost intraoperatively is 30 minutes. Outpatient treatment is shortened by 1-2 weeks as

В последние время в рамках концепции интраоперационной лучевой терапии (IORT) с целью повышения результативности органосохраняющих операций при раке молочной железы были разработаны различные методики ее реализации [15-18]. В маммологическом центре при Университете Кельна используется портативный прибор IORT, генерирующий низкоэнергетические рентгеновские лучи (50 kV).

IORT введен в эксплуатацию с 2010 г. для проведения интраоперационного облучения внедолькового рака молочной железы. IORT-система применима для всех случаев органосохраняющих операций на груди с одномоментной реконструкцией молочной....
a result of the omission of the external-beam boost.

To date, there have been only a few publications of studies with short-term follow-up in which IORT, provided as a boost, demonstrated the potential to prevent local recurrences in early breast cancer (2.6% at 5 years) with good to excellent cosmetic results [19].

Additional open questions are the lack of the final histopathologic report when IORT is applied, the uncertainty regarding the definition of the resection margins, and the resected irradiated volume after repeat resection.

Conclusion
Local outcome and overall survival of breast cancer is depending on tumor biology, tumor burden and therapy strategy. Today, breast-conserving surgery in combination with whole-breast radiation and external boost radiation is the standard of care for early-stage breast cancer. To further improve the local and aesthetic outcome of breast-conserving surgery, a concept of five oncplastic principles to reconstruct partial mastectomy defects was developed and introduced in our Breast Center. In our view, oncplastic breast-conserving surgery with intraoperative boost radiation (followed by external whole-breast radiation) and evidence-based adjuvant medical treatment (according to international guidelines) leads to an optimized local outcome translated into
an improvement of overall survival, and results in a better aesthetic outcome in breast-conserving therapy. In Germany, a number of gynecologists have sub-specialized in oncoplastic breast surgery – following the tradition of gynecology in translational, clinical and surgical research of breast cancer.

References


Заключение

Местные результаты и общая выживаемость после оперированного рака молочной железы определяется гистологическим типом опухоли и правильной терапевтической стратегией. Сегодня органосохраняющие операции в сочетании с лучевой терапией всей пораженной груди являются стандартом лечения рака молочной железы на ранних стадиях. Для дальнейшего совершенствования эффективности операции и улучшения эстетического результата существует пять методик одновременной реконструкции молочной железы, которые были разработаны и проходили испытания в нашем маммологическом центре.

На наш взгляд, онкопластические органосберегающие операции с интраоперационным высокооконным облучением и последующая адекватная адъюванная терапия (в соответствии с принятыми международными стандартами) позволяет достичь оптимальных результатов лечения и повышает общую выживаемость пациентов при сохранении высокого эстетического результата.

В Германии целый ряд клиник специализируется на онкопластических операциях с учетом традиционных клинических и хирургических исследований и достижений в области лечения рака молочной железы.
Magnetic Resonance-Guided High Intensity Focused Ultrasound (MRgFUS) for Minimal Invasive Ablation of Uterine Fibroids

Key Words: Uterine Fibroid, Focused ultrasound (FUS), High-intensity focused ultrasound (HIIFU), MR guided focused ultrasound (MRgFUS), MRI

Uterine fibroids are very common benign tumors of the uterus and arise from uterine smooth muscle cells under the influence of the female sex hormone estrogen (6). They occur almost exclusively in women in their reproductive age (5). The etiology for uterine fibroids is not fully understood, however, genetic factors seem to be of importance (5), besides the hormonal influence.

Symptoms
Almost 40–70% of Caucasian women within their reproductive age develop uterine fibroids (6), many of which remain undetected, since uterine fibroids often do not cause symptoms. Therefore, uterine fibroids are frequent incidental findings on a routine gynecological examination. Depending on their size and/or anatomical site, fibroids may result in symptoms, especially menstrual disorders such as irregular, excessive or prolonged bleeding, pain as well as abdominal or pelvic discomfort (6). If uterine fibroids exert pressure on the urinary bladder, they can cause strangury or onconuresis.

Diagnosis
Besides a thorough gynecological clinical examination, ultrasound, hysteroscopy, and laparoscopy are carried out as well as magnetic resonance imaging (MRI) in more complex cases (6).

Therapy Options
As long as patients do not suffer from symptoms or have the unfulfilled desire for a child no dedicated therapy is required (6). Follow up examinations are nevertheless recommended in order to monitor the potential growth of the tumors.

In case of major symptoms caused by uterine fibroids, hysterectomy is still the most frequently used therapeutic option. Recently, laparoscopic and hysteroscopic methods have been introduced allowing to preserve the uterus. Minimal invasive therapy options, obligatory of gynecological examination. In зависимости от размера, миома может привести к появлению различных симптомов, чаще всего – это нарушения менструального цикла, такие как нерегулярные, чрезмерные или длительные менструации, боли в абдоминальной области, тазовый дискомфорт [6]. Если новообразование матки давит на мочевой пузырь, они могут вызывать болезненное мочеиспускание или энурез.

Диагноз
Помимо щадительного гинекологического осмотра, УЗИ, гистероскопии, в более сложных случаях применяют лапароскопию, магниторезонансную томографию (МРТ). [6]

Методы лечения
Пока пациенты не страдают от симптомов и не планируют беременность, в специальной терапии нет необходимости [6]. Тем не менее, женщина должна быть обязательно поставлена на диспансерный учет для контроля за потенциальным ростом опухоли.

В случае серьезных симптомов, вызванных миомой матки, гистерэктомия до сих пор остается
such as catheter embolization of the uterine arteries (Uterine Fibroid Embolization, UFE) and focused ultrasound ablation using MRI-guidance are novel and patient friendly alternatives without the need of surgery (see table 1). Therapy with anti-estrogens or gestagens may in some cases cause shrinking of the fibroid and therefore an amelioration of the clinical symptoms. However, hormone therapy is controversial and should not be administered for a long time (it is usually limited to some months) and is only indicated in patients with completed family planning (6).

Myomectomy is mostly performed laparoscopically in day surgery institutions or seldom via laparotomy. The convalescence period after laparoscopic enucleation is reported to be about two weeks (6). The uterus remains intact, future pregnancy may be possible. In case of multiple uterine fibroids hysterectomy is often suggested, a hospital stay of up to 10 days is necessary followed again by a convalescence period of an average six weeks. Hysterectomy is the larger and far more invasive surgical procedure and up to 43% of the patients were not satisfied with the results of this therapy (6).

UFE is a highly effective minimal invasive treatment option with a low incidence of major complications. Postembolization syndrome following UFE can be readily managed with analgetic and antiemetic treatment. Ovarian insufficiency is an infrequent complication which can be prevented by meticulous analysis of vascular anatomy (communication of uterine arteries with arteries supplying the ovaries) and careful embolization technique. The convalescence period after catheter embolization is about two weeks (4, 6).

Patient Selection
Patient selection for MRgFUS therapy is always an individual medical and patient oriented decision. With a diagnostic MRI study the location and localization of the fibroids as well as the anatomical situation has to be assessed. Patients with pace makers, cardiac defibrillators, cochlear implants, insulin pumps or other electronic implants must be excluded as they cannot undergo MRI for safety reasons (2).

Pregnancy is another contraindication for the procedure and in case of a future intended pregnancy or non completed family planning the published data is still too limited as to recommend MRI-HIFU.

Furthermore, the most commonly used medical therapy is hormone therapy. In recent years hormone therapy has become the treatment of choice in many cases. However, hormone therapy is controversial and should not be administered for a long time (it is usually limited to some months) and is only indicated in patients with completed family planning (6).

Therapy with anti-estrogens or gestagens may in some cases cause shrinking of the fibroid and therefore an amelioration of the clinical symptoms. However, hormone therapy is controversial and should not be administered for a long time (it is usually limited to some months) and is only indicated in patients with completed family planning (6).

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Table 1: Survey of the most common approaches to myoma therapy based on Levy (6).

<table>
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<tr>
<th>Therapy Option</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<th>Approximate Recovery Time</th>
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</thead>
<tbody>
<tr>
<td>Hormonal Therapy</td>
<td>Non-surgical</td>
<td>Hypogonadism, fibroid growth upon discontinuing therapy</td>
<td>Depending on the drug</td>
<td>0</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>Definitive therapy</td>
<td>Infertility, long convalescence period</td>
<td>No</td>
<td>6-8 weeks</td>
</tr>
<tr>
<td>Myomectomy / -enucleation</td>
<td>Preserves fertility</td>
<td>Recurrence, surgical complications, incomplete treatment</td>
<td>Yes</td>
<td>1-2 weeks, 6-8 weeks</td>
</tr>
<tr>
<td>Uterine artery embolization</td>
<td>Non-surgical</td>
<td>Postembolization syndrome, ovarian insufficiency</td>
<td>Possible</td>
<td>10 days</td>
</tr>
<tr>
<td>HIFU / MRgFUS</td>
<td>Non-surgical</td>
<td>Not suited for all patients, recurrence</td>
<td>So far not advised</td>
<td>2 days</td>
</tr>
</tbody>
</table>

A preprocedural MRI scan is needed to identify size, number, location and vascularization of the uterine fibroids. The diameters should not exceed 10 cm and there should be no more than 6 fibroids (fig. 1) (1, 3). Fibroids with a high blood supply are, in comparison with skeletal muscle, bright on T2-weighted images (fig. 2) (1, 3). In those cases success rate is inferior to in fibroids with lower signal intensity on T2-weighted images, which is indicative of reduced vascularity. HIFU is not recommended if the distance between the fibroids and the skin exceeds 12 cm, if there are scars or bowel loops in the beam path (1, 3).

Magnetic Resonance-Guided High-Intensity Focused Ultrasound (MRgFUS)

MRgFUS combines two non invasive methods: MRI and ultrasound. MRI is used for planning and procedure control (7), ultrasound for the tumor ablation. MRgFUS does not require hospitalization but only an observation period of about two hours following the procedure and allows an early return into daily life. It usually takes only one day to resume daily activities (6). Moreover, no scars are created.

MRI allows for three-dimensional imaging of the uterine fibroid which is used to plan the procedure, defining the optimal approach as well as the ablative tissue volume. With MRgFUS the target tissue is heated up to 60 - 80°C, the fibroid becomes necrotic and shrinks during the following weeks. Depending on the size and number of the fibroids the procedure takes 2-4 hours.

Usually non-steroidal anti-rheumatic drugs (NSAR, for example Ibuprofen) are sufficient for pain control during and after the intervention. Additionally a mild sedation may be administered; but the patient should be able to report pain or complaints during the procedure. due to theirexists no need for hospitalization but only an observation period of about two hours following the procedure and allows an early return into daily life. It usually takes only one day to resume daily activities (6). Moreover, no scars are created.

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Procedure
Preparation
After administration of a mild sedation (e.g. midazolam 20ug/kg body weight) and NSAR a Foley catheter is introduced into the bladder, to keep the position of uterine fibroid stable during the procedure (7).

The patient is in a prone position on top of a gel pad on a dedicated MRI table, integrating the HiFU ultrasound device (7). On the patient’s back a MRI coil is positioned allowing for online imaging control and temperature measurements. In case of pain or other problems the patient can report this by pressing an alarm button (7).

Therapy
Initially planning images are obtained to define the target volume as well as safety margins for bowel and bones, especially the promontorium (7).

For ablation the target volume is subdivided into small voxels which are treated in a dorsal to ventral direction. Before the first HiFU treatment is started a low-energetic test sonication is performed to verify the position of the sonication (7).

During sonication the ultrasound beam is focused and the fibroid tissue is heated up to 80 degrees Celsius. This is followed by a short cooling period and the treatment of the next area (7).

Aftercare
After the procedure a post-treatment contrast enhanced (CE) MRI scan is performed to verify the necrotic tumor volume (7). The patient is observed for about 2 hours and examined for pain, vaginal discharge, vital signs (BP, HF), fever and malaise (7).

Outcome
The success of the treatment should be evaluated about six months after the procedure, ФУЗ-МРТ-абляция не требует госпитализации, достаточно 2- часового наблюдения после проведения процедуры, на следующий день пациентка может свободно вернуться к повседневной жизни [6]. Более того, ФУЗ-МРТ-абляция не оставляет ни шрамов, ни других следов вмешательства.

МРТ позволяет визуализировать миому матки в трехмерной проекции, подробно спрогнозировать ход процедуры, определить оптимальный доступ и объем иссечения тканей. Сфокусированный ультразвуковой луч вызывает локальное нагревание миомы до 60–80°С, что вызывает некроз и склерозирование на протяжении нескольких последующих недель. В зависимости от размера и количества фибромиом процедура занимает от 2 до 4 часов.

Обычно нестероидные противовоспалительные препараты (НПРП, NSAR, Ибупрофен) обеспечивают достаточное обезболивание, как во время, так и после вмешательства. Кроме того, может быть использована мягкая седация, но не больше, чтобы пациент имел возможность сообщить о своем самочувствии во время процедуры, о появлении боли или другие жалобы.

Процедура
Подготовка к ФУЗ-МРТ
После мягкой седации (например, с помощью мидазолама в дозе 0.2 мг/кг) катетер Фоли вводят в мочевой пузырь, чтобы сохранить стабильное положение матки и миомы во время процедуры [7]. Пациент находится в положении лежа на небольшой гелевой подушке на МРТ-столе, интегрированном с HiFU – прибором, генерирующим сфокусированный ультразвук [7]. Расположенная позади пациента катушка МРТ позволяет осуществлять оперативный контроль за проведением манипуляции и измерением температуры. В случае появления боли или других дискомфортных ощущений пациент может сообщить об этом, нажав сигнализирующую кнопку [7].

Fig. 1: T2-weighted sagittal image showing multiple uterine fibroids. Due to the large number of fibroids, MRgFUS was not an appropriate treatment option.

Рис. 1: T2-сагиттальное изображение множественных миом матки. Из-за большого количества новообразований ФУЗ-МРТ в данном случае не показана.
Uterine Fibroids

Терапия

Диагностические снимки на этапе планирования позволяют оценить объем вмешательства, выбрать наиболее безопасный тип доступа, позволяющий избежать травмирования стенок кишечника и костных структур таза, в особенности promontorium [7]. Для абляции мишень подразделяют на небольшие фрагменты, которые поддаются воздействию сфокусированного ультразвукового луча и направлены от спины к брюшной стенке. До первого сеанса HIFU проводят тестовое ультразвуковое воздействие низкого напряжения, чтобы проверить правильность направления ультразвукового луча [7]. Во время процедуры ультразвуковой пучок фокусируется на мишени – миоме, нагревая ее до 80°С. За этим следует короткий период охлаждения и переход к облучению следующего фрагмента [7].

Последующий уход

Через некоторое время после завершения сеанса ФУЗ-МРТ проводят обязательную МР-ангиографию с контрастным усилением Contrast Enhanced (CE) для проверки объема некротизированной ткани [7]. Пациент наблюдался в течение 2 часов на предмет появления боли, выделений из влагалища, для оценки его жизненно важных функций (АД, НФ), исключения повышения температуры, недомогания и других тревожных симптомов [7].

preferably using contrast enhanced MRI to visualize the necrotic regions. Funaki classified the response to MRgFUS therapy according to the extent of the non perfused volume on posttherapeutic MRI scans (9). Fibroids with a necrotic volume of greater than 50% show good longterm results (8, 9), correlating with improvement of clinical symptoms.

Le Blang reported that in the first 24 months following MRgFUS 14% of patients with a hypointense or intermediate fibroid on T2 weighted MR-images and 21.6% of patients with hyperintense fibroids required reintervention (8).

Fig. 2: Long term outcome after MRgFUS on T2-weigthed (a-c) and contrast-enhanced T1-weighted MRI-images. Non perfused volume ratio after MRgFUS of 34% (d) and 90% one month after the treatment (e). Six months follow up shows significant shrinkage of the uterus (c, f). (Courtesy: UMC Utrecht, The Netherlands)

Рис. 2: Долгосрочные результаты после ФУЗ-МРТ на T2 (a-c) и T1 МРТ-изображениях с контрастным усилением. Объем тканей, не подвергнувшихся перфузии контраста после ФУЗ-МРТ, составляет 34% (d) и 90% – через месяц после лечения (e). Шесть месяцев наблюдения показало значительное сокращение размера матки (c, f).

Advantages, Disadvantages and Side Effects

Advantages

Advantages of MRgFUS include the short convalescence and the fact that scars, bleedings and other surgical complications such as abdominal infection or adhesions can be completely avoided, Moreover, anesthesia is not required in almost all cases (6).

Disadvantages

Disadvantages of MRgFUS include the risk of early pregnancy and the risk of infection, as the operation is performed transvaginally.

Side effects

Side effects of MRgFUS include the risk of infection, the risk of early pregnancy, and the risk of bladder or bowel injury.

Family Planning

As uterus and cervix remain intact the fertility is usually preserved following MRgFUS. However, up to date only some case reports and small case series are mentioned in literature (5-7); due to the small amount of patients with uterus and cervix remaining intact the fertility is usually preserved following MRgFUS.

Additionally, MRgFUS is a less invasive procedure compared to hysterectomy, as it does not require any incision.

Le Blang reported that in the first 24 months following MRgFUS 14% of patients with a hypointense or intermediate fibroid on T2 weighted MR-images and 21.6% of patients with hyperintense fibroids required reintervention (8).
of existing data this procedure is so far only recommended for women with completed family planning (6).

Disadvantages
After successful MR-HIFU therapy the uterine fibroid shrinks but recurrence in other locations may occur (6).

Adverse Events
MRgFUS is a very safe method to ablate uterine fibroids. In all clinical studies major complications were very rare. Some minor complications were reported. Due to the prolonged prone positioning of the patients during treatment lower back and leg pain may occur. Transient drop in blood pressure, vertigo and nausea may be observed. In singular cases low grade skin burns were observed (6).

LMU University in Munich has recently implemented a MRgFUS unit and has established an interdisciplinary centre for minimal invasive treatment including MRgFUS and Uterine Fibroid Embolization (UFE) as well as minimal invasive and open surgical treatment of uterine fibroids.

References

Результат
Успех лечения можно в полной мере оценить примерно через полгода после проведения ФУЗ-МРТ. Для этого желательно на- значение МРТ для визуализации некротизированных участков. Funaki классифицировал ответ на ФУЗ-МРТ-абляцию с учетом степени некротизации миомы в посттерапевтическом периоде. МРТ [8]. В случае некротизации более 50% тканей миомы в долгосрочной перспективе показаны хорошие результаты [8, 9], коррелирующие со значительным клиническим улучшением. По данным Лед Дзвэнг, в первые 24 месяца после ФУЗ-МРТ 14% пациентов с невысокой и средней интенсивностью сигнала на T2 взвешенных МР-изображениях и 21,6% пациентов с гиперинтенсивным сигналом на T2 взвешенных МР-изображениях требуются повторное вмешательство [8].

Побочные эффекты
ФУЗ-МРТ — один из самых безопасных методов удаления миомы. Во всех проведенных клинических исследованиях серьезные осложнения встречались крайне редко. Из-за длительного пребывания в наклоненном неудобном положении могут возникать боли в области поясницы и в ногах. Возможны также падения артериального давления, головокружение и тошнота. Описаны случаи проведения процедуры на ненадлежащем уровне, с появлением ожогов кожи [6].

В Мюнхенском университете Людвиг-Максимилиана (LMU) не так давно недавно был создан центр миниминвазивного лечения, в том числе, лечения миомы матки методом ФУЗ-МРТ и эмболизации (УФИ), а также других миниминвазивных и открытых хирургических методов лечения миомы.
Treatment of Aortic Pathologies with Onyx®

New minimally invasive procedures for treatment of aortic pathologies like endoleaks, penetrating atherosclerotic ulcers, and aortic pseudoaneurysms: trans-catheter and percutaneous embolization with the liquid embolic agent Onyx®

Keywords: Penetrating atherosclerotic ulcer, Endoleak, Abdominal aortic aneurysm, Pseudoaneurysm, Endovascular Aneurysm Repair, Onyx®, Embolization, Stent-Graft, Stent-Grafting, Endovascular

Abstract
Introduction
Endovascular aneurysm repair (EVAR) still requires a sufficient landing zone (LZ) for the stent-graft, and the long-term results and patient’s quality of life may still be restricted by the development of endoleaks. The liquid embolic agent Onyx®, an ethylene vinyl alcohol copolymer, offers new possibilities for endovascular preparation of an insufficient LZ prior to EVAR and for the percutaneous treatment of endoleaks by embolization. We present a series of cases with different aortic pathologies, demonstrating the possibilities and benefits of this embolic agent.

Materials and Methods
Onyx® was used after vortexing for 20 minutes, and in different settings for percutaneous trans-catheter delivery, either with fluoroscopic or CT guidance. Since higher viscosities of the product are necessary, Onyx®-20 and -34 were used.

Results
In a first case the infrarenal LZ of an abdominal aortic aneurysm was successfully prepared by embolization of a penetrating atherosclerotic ulcer in the LZ with Onyx® after release of a stent-graft. In another case an iatrogenic pseudoaneurysm caused by spinal hardware was successfully occluded by embolization with Onyx® prior to surgical removal of the spinal hardware. In a third case a large type 1a and b endoleak was occluded by trans-inguinal trans-catheter embolization with Onyx®. In a forth case a large type 2 endoleak was successfully treated by CT guided percutaneous embolization with Onyx®. Six months follow-up data are available for all cases, demonstrating stable occlusion of the underlying pathology with Onyx®.

Conclusion
The liquid embolic agent Onyx® performed excellently in all described cases, exhibiting

Лечение патологии аорты с помощью эмболизирующей жидкости Onyx®

Новые малоинвазивные методы для лечения патологии аорты (эндоподтекания, penetрирующие атеросклеротические язвы аорты, псевдоаневризмы): транс-катетеры и чрескожная эмболизация с помощью эмболизирующей жидкости Onyx®

Ключевые слова: пенетрирующие атеросклеротические язвы, эндолики, аневризма брюшной аорты, псевдоаневризма, эндоваскулярное лечение аневризмы, Onyx, эмболизация, стент-графт, стентирование, эндоваскулярное

Краткое изложение
Введение
Эндоваскулярное лечение аневризмы (Endovascular Aneurysms Repair, EVAR) требует достаточного пространства доступа для имплантации стент-графта; долгосрочные же результаты и качество жизни пациентов может быть в значительной мере омрачены появлением эндоликов.

Эмболизирующая жидкость Onyx, ацетилиновый сополимер винилового спирта, открывает новые возможности для эндоваскулярной подготовки к EVAR и чрескожного лечения эндоликов путем эмболизации. Мы представляем описание серии случаев лечения различной патологии аорты, демонстрирующих возможности и преимущества эмболизирующего агента Onyx.

Материалы и методы
Онух использовался после 20-минутного центрифугирования и различных способов обработки для чрескожного введения через катетер под контролем рентгеноскопии или КТ. Когда требовалась большая вязкость эмболизирующего вещества, использовались Onyx-20 и -34.

Результаты
В первом случае инфраренальной локализации аневризмы брюшной аорты после установки графт-стента была успешно проведена эмболизация перфорирующей атеросклеротической язвы с использованием Onyx. В другом – ятрогенная псевдоаневризма, развившаяся как осложнение хирургического вмешательства на позвоночнике, была успешно закрыта путем эмболизации с Onyx. В третьем случае у пациента с эндоликом типа 1а и б был окклюзирован через паховый катетер под контролем рентгеноскопии или КТ. Когда требовалась большая вязкость эмболизирующего вещества, использовались Onyx-20 и -34.
ideal characteristics for such a treatment like immediate embolization even under high-flow conditions, good control of the growing cast, absence of unintentional distal embolization, and up to now absence of recanalization. Therefore it seems to be the ideal embolic agent for treatment of the demonstrated pathologies.

Introduction

Endovascular aneurysm repair (EVAR) is a well-established alternative to open surgery for the treatment of abdominal aortic aneurysms (AAA). One of the major benefits of EVAR in comparison with open repair is a significant reduction of the 30-day mortality rate combined with comparable long-term outcomes (1). It is estimated, though, that more than 50% of the patients with AAA are poor candidates for EVAR due to unfavorable anatomy. This includes short, angulated, or even diseased proximal necks, extension of the aneurysm into one or both iliac arteries as well as severe aortic or iliac kinking, and also involvement of the pararenal and paravisceral part of the aorta. Diseased necks can be caused e.g. by penetrating aortic ulcer (PAU) in the landing zone for stent-grafting or, in rare cases, by development of pseudo-aneurysms (PA). The latter are a typical iatrogenic injury during spinal surgery (2,3) and occur in 1 out of 2000 operations during posterior instrumentation of the spine (4).

Trauma to these vessels can either lead to acute perforation, which results in immediate hemorrhage and possible hemodynamic instability (5), or, more often, screws or plates can chronically impinge on the aorta, leading to PA formation due to the constant pulsation of the aorta against the hardware with the risk for secondary rupture (6). However, acute and chronic injuries to the aorta or iliac arteries can carry a mortality rate as high as 61% (1) and especially in the case of chronic aortic impingement with the formation of PA a surgical correction with removal of the PA-inducing hardware is mandatory. Yet, this surgical correction also bears a high risk for aortic rupture during removal of the material requiring measures to avoid aortic perforation like preceding endovascular stent-grafting of the PA if a sufficient landing zone for the stent graft is available.

Once EVAR has been performed successfully, one of the principal reasons for long-term failure of EVAR in the 1st year is the occurrence of endoleaks, defined as persistent blood flow outside the graft and within the aneurysm sac (7). These endoleaks are critically important complications of many EVARs, bearing the risk of secondary rupture due to continuing aneurysm growth. Therefore it is most important to avoid or at least treat endoleaks sufficiently.

Onyx® is a liquid embolic agent, exhibiting interesting characteristics like fast embolization, good control of the embolizing target, and it has the lowest recanalization rates of all known embolic materials.

We present new minimally invasive trans-catheter and percutaneous embolization proce-
dures using the liquid embolic agent Onyx® to either prepare severely diseased aneurysmal necks prior to EVAR or to treat endoleaks in the follow-up period.

Materials and Methods
Onyx:
Onyx is a liquid embolic agent with European Certification marketing approval and approval by the United States Food and Drugs Administration for use in treatment of brain arteriovenous malformations and tumors of the peripheral vascular system (8,9).

The ethylene vinyl alcohol copolymer is dissolved in the organic solvent dimethyl sulfoxide. Exposed to an aqueous solution, the copolymer precipitates, forming a soft spongy layer whereas the center remains semi-liquid (10), resulting in good control of the Onyx cast for several minutes. It has been widely used not only for the management of intracranial aneurysms and arteriovenous malformations but also for the treatment of aneurysms of the visceral arteries (11), and bleeding control (10).

Unlike other liquid embolic agents, Onyx is non-adhesive but cohesive (12). In the treatment of brain arteriovenous malformations, it showed significantly lower recanalization rates than other embolic agents and a lower rate of inflammatory reactions of the vessel wall than cyanoacrylate (8). Four product formulations are currently available, varying according to the ethylene vinyl alcohol copolymer content (6%, 6.5%, 8%, 20%) leading to increased viscosity of the product. Higher concentrations are required for targets with higher flow rates (13). For that reason, we used Onyx-34® (8% copolymer content) or Onyx-20® (6.5% copolymer content) in our cases.

As DMSO causes weakening and degradation of all kind of plastics, it is essential to use fully DMSO-compatible catheters. Fortunately, it was recently demonstrated by Stone et al. that DMSO and/or Onyx will not compromise the structural integrity of the stent graft material, making it a safe embolic material when used in combination with expanded polytetrafluoroethylene covered grafts (14).

Use of Onyx during EVAR Procedures with Angiographic Equipment
In order to prepare diseased aneurysmal necks for an EVAR procedure or in case of endoleak treatment Onyx was delivered trans-cutaneously during a hybrid procedure, combining EVAR and transcatheter embolization of the pathology. The procedures were performed in an angi suite functioning as an operating theater. For EVAR both common femoral arteries (CFA) were exposed surgically under peridural anesthesia or general anesthesia if the patient required additional surgical procedures like removal of spinal hardware. The procedures were performed after administration of 5.000 IU of heparin. For embolization of the underlying pathology a 4F C2 cobra catheter (Cordis Corporation, Johnson & John-
Table 1: Patient characteristics and treatment details

<table>
<thead>
<tr>
<th>Patient Characteristics and Treatment Details</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>76 years</td>
<td>75 years</td>
<td>74 years</td>
<td>74 years</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>male</td>
<td>male</td>
<td>female</td>
<td>male</td>
</tr>
<tr>
<td><strong>Pathology</strong></td>
<td>Penetrating aortic ulcer (PAU) in the landing zone of an infrarenal aortic aneurysm</td>
<td>Aortic pseudo-aneurysm (PA) after spine surgery with plate-dislocation</td>
<td>Type 1a and b endoleaks after EVAR</td>
<td>Type 2 endoleak after EVAR</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>Complete exclusion of the AAA and occlusion of the ulcer by embolization with a standard EVAR procedure and simultaneous trans-catheter embolization of the PAU</td>
<td>Coverage of the PA with an endovascularly applied stent-graft and simultaneous occlusion by trans-catheter embolization</td>
<td>Trans-catheter embolization of the endoleak</td>
<td>Percutaneous CT guided embolization of the endoleak</td>
</tr>
<tr>
<td><strong>Onyx</strong></td>
<td>Onyx-34</td>
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<td>Onyx-20 and Onyx-34</td>
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</tr>
<tr>
<td><strong>Amount (ml)</strong></td>
<td>1.5ml</td>
<td>1.5ml</td>
<td>3ml  Onyx-34 5ml Onyx-20</td>
<td>4.5ml</td>
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Table 1: Характеристика пациентов и детали клинических случаев

| Патология аорты | США, 100 см в длину, размещались непосредственно на участке парааневризмы (ПА) или эндоаневризмы; также осуществлялось чрезвлечевой доступ через левую руку, или паховый доступ – путем двойного прокола был введен контрлатеральный CFA (14F, Cook Medical Inc., USA). Кончик катетера Cobra или многоцелевого катетера был направлен в сторону верхней части патологического участка. Основная часть импланта была введена через один из двух CFAs.

Под ангиографическим контролем корректировалось положение стент-графта таким образом, чтобы он полностью покрывал патологический участок. Далее стент был частично прикреплен, а правильное положение катетера проверено с помощью введения врочную контрастного вещества. В случае необходимости для подготовки к эмболизации в зону патологии вводят 3 дополнительные катушки диаметром 15 мм и 2 катушки диаметром 8 мм (MReye® катушки для эмболизации, длиной 5 см; Cook Medical Inc., USA). Катушки вводятся в полость образованной через катетер Cobra или многоцелевой катетер потоком стерильного физиологического раствора 2 мл шприцем. Диметилсульфоксид (ДМСО) через Эшелон-14® микрокатетер (EV3 Эндоваскулярная Inc, США) был также введен в Cobra или многоцелевой катетер и расположен в

son Health Care Systems Inc, USA) or a 4F multi-purpose catheter (TEMPO® AQUA® Hydrophilic-Coated Diagnostic Catheter Multipurpose A-1, Cordis Corporation, Johnson & Johnson Health Care Systems Inc, USA), 100 cm in length, was placed into the pathology (PAU, PA, or endoleak), either via trans-brachial access over the left arm, or via trans-inguinal access after dual puncture of a sheath introduced into the contralateral CFA (14F, Cook Medical Inc., USA). The tip of the cobra or multi-purpose catheter was directed to the apex of the pathology. If used, a stent graft’s main body was introduced through one of both CFAs. Under angiographic control, the stent graft was placed correctly, covering the pathology. The stent graft was partially released, and the correct position of the catheter tip in the pathology was tested by manual contrast injection. If necessary, the cavity of the pathology was prepared for liquid embolization by implantation of 3 coils with a diameter of 15 mm and 2 coils with a diameter of 8 mm (MReye® embolization coils, each 5 cm in length; Cook Medical Inc., USA). The coils were flushed into the cavity through the cobra or multi-purpose catheter with sterile saline solution using a 2 ml syringe. A dimethyl sulfoxide (DMSO) compatible Echelon-14® micro catheter (ev3 Endovascular Inc., USA) was then co-axially introduced into the cobra or multi-purpose catheter and placed without wire guidance into the apex of the pathology. Correct placement of the micro catheter’s tip was again checked by manual contrast injection. Several charges of Onyx 34® or Onyx 20® (each containing 1.5 ml of embolic agent) were prepared by mixing for at least 20 minutes to ensure complete suspension of the tantalum powder required for fluoroscopic visualization of the
Fig. 1: Treatment of a penetrating aortic ulcer in the landing zone of an infrarenal aortic aneurysm. a) Large PAU in the infrarenal landing neck of an abdominal aortic aneurysm. b – e) A 4F cobra catheter was placed into the PAU prior to implantation of a stent-graft (b), which was used to place several coils (c), followed by injection of the liquid embolic agent Onyx (d) for complete occlusion of the PAU. In the final angiogram both, the PAU and the aortic aneurysm, were successfully occluded. f) CT follow-up 6 months after the procedure demonstrating the absence of endoleaks and a sufficient occlusion of the PAU and the aneurysm.
fluoroscopy in a sterile setting under local anesthesia. Prior to embolization a dual phase arterial and late venous (120 sec) CT-scan (GE Discovery CT750 HD) was performed in prone position. The ideal puncture site, using an anterior or posterior approach, respectively, was defined and the patient positioned accordingly, either in prone or supine position. A sterile setting as well as monitoring with ECG and oxymetry was established. A mild sedation using midazolam 1 – 3 mg (cave: puncture of the aneurysm sac is painful) and local anesthesia with 20 ml scandicain 1% were used.

CT guided puncture of the aneurysm sac (cave: the aneurysm sac is quite rigid and the puncture requires some force) was done using a translumbar aortography catheter needle (19 G, 22 cm; Cook Medical Inc., USA). After puncture the steel needle was removed leaving the catheter in the aneurysm sac. In case of large endoleaks their cavity was first filled with 3 – 5 coils that were directly injected over the first filled with 3 – 5 coils that were directly injected under CT fluoroscopic control at a steady rate of up to 0.3 ml/min. During the injection, the micro catheter was slowly retracted step by step to the basis of the endoleak in order to achieve complete filling of its cavity. Onyx was injected until complete occlusion of the endoleak. The puncture site in the aneurysm sack was sealed with Onyx as well by slowly injecting it while retracting the catheters under CT-fluoroscopy out of the aneurysm sack. Finalization of the procedure was performed as described earlier. The puncture site was treated with a local compression tape. After the embolization a control dual phase arterial and late venous (120 sec) CT-Scan (GE Discovery CT750 HD) were performed to document complete occlusion of the endoleak.

Follow-up Treatment for all Cases
If the patient required additional surgical treatment, e.g. to remove spinal hardware causing a PA, the patient was transferred to the orthopedic operation theater still under general anesthesia. Follow-up treatment included a one-night stay in the intensive care unit when an EVAR procedure was performed. In all other cases the patients were referred to their regular wards. 100 mg of acetylic salicylic acid were administered per day. A control CTA was done five days later for EVAR cases and 6 months later for all cases. In case of endoleak treatment, an additional contrast enhanced ultrasound was done directly through the Onyx syringe was connected to it and Onyx was slowly injected under CT fluoroscopic control at a steady rate of up to 0.3 ml/min. During the injection, the micro catheter was slowly retracted step by step to the basis of the endoleak in order to achieve complete filling of its cavity. Onyx was injected until complete occlusion of the endoleak. The puncture site in the aneurysm sack was sealed with Onyx as well by slowly injecting it while retracting the catheters under CT-fluoroscopy out of the aneurysm sack. Finalization of the procedure was performed as described earlier. The puncture site was treated with a local compression tape. After the embolization a control dual phase arterial and late venous (120 sec) CT-Scan (GE Discovery CT750 HD) were performed to document complete occlusion of the endoleak.

Choroskogia embolization endoleakov s iislozvri i isowo Onyx pod kontrolem KT
Choroskogia, KT-kontroliruemaya embolizacia byla provedena s islozvrii K- fluoroskopii pod anesteziyey.

Последующая терапия для всех случаев
Если пациенту требуется дополнительное хирургическое вмешательство, например, удаление спинного имплантанта, которое может привести к образованию псевдокисты, пациент переводят в ортопедическую операционную, не выводя из наркоза. Последующее ведение пациента после выполнения EVAR включает одну ночь пребывания в отделении интенсивной терапии. Во всех остальных случаях пациенты могут быть переведены в общую палату. Всем пациентам показана аексилацилированная кислота в дозе 100 мг в день. KТ-ангиография проводится спустя пять дней после EVAR и спустя 6 месяцев для всех остальных случаев. Пациентам, прооперированным по поводу эндониктов, в дополнение к этому требуется расширенное контрастное ультразвуковое сканирование УЗИ (CEUS) через

0,3 мл / мин. Во время инъекции микрокатетер медленно убирают, шаг за шагом приближаясь к основе эндолика, чтобы добиться полного заполнения ее полости. Опухь вводят до полной окклюзии эндолика. Место прокола мешка аневризмы также закрывают Опух-ом, по мере постепенного извлечения катетера под контролем КТ-флюороскопии. За-вершение процедуры выполняют так же, как было описано выше. Место пункции обрабатывают с использованием специальных перевязочных лент. После эмболизации сразу же проводят повторное двуфазное КТ-сканирование артериального кровотока и венозного возврата (120 сек), (GE Discovery CT750 HD) для подтверждения полной окклюзии эндолика.

Всем пациентам показана ае-тисилацилированная кислота в дозе 100 мг в день. КТ-ангиография проводится спустя пять дней после EVAR и спустя 6 месяцев для всех остальных случаев. Пациентам, прооперированным по поводу эндониктов, в дополнение к этому требуется расширенное контрастное ультразвуковое сканирование УЗИ (CEUS) через
tomography angiography (CTa) and digital subtraction angiography (DSA) revealed an additional large penetrating atherosclerotic ulcer (PAU) in the proximal neck of the AAA with a diameter of 2.3 cm and a depth of 1.8 cm, situated immediately caudal to the right renal artery (Fig. 1). Treatment of the aneurysm was indicated due to its size. The patient was a diabetic and suffered from atrial fibrillation. For that reason and because of the higher operative risk associated with open aneurysm repair, it was our and the patients' preference to opt for endovascular repair. We considered a standard EVAR procedure with release of the main body below the PAU as inadequate because the remaining neck would have fallen below 7 mm and sufficient proximal sealing seemed unlikely. Furthermore, this would have increased the arterial pressure within the PAU and led to a significantly higher risk of rupture. For that reason, we planned to exclude the PAU as well. For the endovascular repair, we discussed the following remaining treatment options: fenestrated or branched stent graft, chimney graft, and classic stent graft in combination with periprocedural embolization of the PAU in order to establish sufficient proximal sealing. However, the patient had severe aortic and iliac angulations (Fig. 1) in combination with a short infrarenal neck at the left side, complicating the exact placement of a fenestrated or branched graft; he also had only a short space between the renal arteries and the superior mesenteric artery, making the chimney graft procedure almost impossible. For that reason, the PAU was occluded by combining transcatheter embolization with a standard EVAR procedure, thus establishing a suitable proximal neck with consecutively sufficient sealing of the stent graft, complete exclusion of the AAA and occlusion of the ulcer (Fig. 1). This remained stable at 6 months follow-up.

**Case 1: Penetrating Aortic Ulcer (PAU) in the Landing Zone of an Infrarenal Aortic Aneurysm**

A 76-year-old male patient with a sonographically detected 6.3 cm infrarenal AAA was referred to our department of vascular surgery. Computed tomography angiography (CTA) and digital subtraction angiography (DSA) revealed an additional large penetrating atherosclerotic ulcer (PAU) in the proximal neck of the AAA with a diameter of 2.3 cm and 6 months. This is necessary since Onyx reduces the visualization of the endoleak due to severe artifacts caused by tantalum, and only CEUS is able to depict reperfusion of the endoleak sufficiently. The duration of the complete embolization procedure was 15 minutes in mean; the whole intervention lasted 90 minutes in mean.

**Case Series**

The patient characteristics and treatment details for the following 4 cases are summarized in table 1.

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A 76-year-old man had received successful endovascular aortic aneurysm repair (EVAR) for an uncomplicated infrarenal aortic aneurysm in May 2009. In September 2009 he showed up 5 days, 3 months and 6 months. This is necessary, because Onyx significantly reduces the visualization of the endoleak due to severe artifacts caused by tantalum, and only CEUS is able to depict reperfusion of the endoleak sufficiently. The duration of the complete embolization procedure was 15 minutes in mean; the whole intervention lasted 90 minutes in mean.

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**Case 2: Aortic Pseudoaneurysm after Spine Surgery with Plate-Dislocation**

A 75-year-old man had received successful endovascular aortic aneurysm repair (EVAR) for an uncomplicated infrarenal aortic aneurysm in May 2009. In September 2009 he showed up
again with severe systemic and aortic stent graft infection and consecutive development of 2 psoas abscesses. The stent graft infection and abscesses were successfully treated conservatively with systemic antibiotics and drainage. However, in the course of the infection he developed spondylodiscitis of the 1st and 2nd lumbar vertebral body, which was treated by spinal surgery in November 2009. The infected disc was removed and replaced by a Harms titanium cage. To stabilize the lumbar spine after disc removal a Schiffchen plate was fixed laterally to the left of the 1st and 2nd lumbar vertebral body with 2 screws. However, the fixation of one of the screws was felt to be unstable, and a second Schiffchen plate was applied dorsally of the 1st, again fixed with 2 screws.

In October 2010 the patient was admitted in the department for vascular surgery for routine computed tomography angiography (CTA) of the abdominal aorta for follow up of the EVAR procedure. CTA unveiled a newly developed aortic pseudoaneurysm (PA) in the infrarenal neck of the previously treated aortic aneurysm, caused by chronic wall contact of the aorta with the ventrally displaced first Schiffchen plate (Fig. 2). The PA had a length of 2cm and was located in the dorsal aortic wall, reaching the proximal margin of the covered part of the stent-graft. Therefore removal of the PA-inducing spinal hardware was considered to be too risky without additional measures to cover and exclude the PA before surgery because it was not fully covered by the stent-graft. Though, the distance between the covered part of the stent-graft and the lower renal artery


Рис. 2: Лечение ятрогенных псевдоаневризм аорты, вызванных установкой аппаратных средств для остеосинтеза, используемых в спинальной хирургии, для лечения спондилодисита. a–b – КТ в аксиальной и сагиттальной плоскостях до лечения. c – d – ангиографическое изображение окклюзии ПАЯ путем инъекции жидкого эмболического агента Onyx через трансбрахиальный катетер MP-A1 в полость псевдоаневризмы (c) после следующим размещением второго стент-трансплантата (d) непосредственно перед хирургическим удалением спинальных фиксирующих пластин. e – f – КТ после процедуры (e) демонстрирует полную окклюзию псевдоаневризмы и удаление спинальных пластин без каких либо геморрагических осложнений. Последующее сканирование через 6 месяцев: рецидив псевдоаневризмы не обнаружен (f).
(right renal artery) was only 7mm. This landing zone was considered to be too short to achieve a complete exclusion of the PA by simply extending the old stent-graft proximally with a new stent-graft reaching the lower edge of the right renal artery. For that reason it was decided not only to cover the PA with an endovascularly applied stent-graft but also to occlude it by simultaneous trans-catheter embolization (Fig. 2). The removal of the ventrally displaced Schiffchen plate by spinal surgery was planned within the same session after the endovascular procedure and was performed successfully without any bleeding complications. In the follow-up examination 6 months later no recurrence of the pseudoaneurysm was detected.

Case 3: Trans-catheter Embolization of an Type 1a and b Endoleak
A 74-year-old woman with a tube-dissection had received three non covered stents in the thoracic aorta, which were dislocated, and, in a second hybrid procedure, a visceral debranching and stenting of an aneurysm in the thoraco-abdominal aorta, affecting the origins of the visceral arteries. The patient showed up for routine computed tomography angiography (CTa) of the abdominal aorta, affecting the lower edge of the right renal artery. For that reason it was decided not only to cover the PA with an endovascularly applied stent-graft but also to occlude it by simultaneous trans-catheter embolization (Fig. 2). The removal of the ventrally displaced Schiffchen plate by spinal surgery was planned within the same session after the endovascular procedure and was performed successfully without any bleeding complications. In the follow-up examination 6 months later no recurrence of the pseudoaneurysm was detected.

Case 4: Percutaneous CT Guided Embolization of an Type 2 Endoleak
A 76-year-old male patient who had received a successful endovascular aortic aneurysm repair (EVAR) for an uncomplicated infrarenal aortic aneurysm presented at the 6 months follow-up with an extensive type II endoleak. In order to prevent for bleeding complications the decision for a percutaneous CT-guided embolization was made (Fig. 4). Under local anesthesia and in the prone position a puncture needle was introduced into the aneurysm sack under CT-fluoroscopic guidance. A micro-catheter was inserted co-axially into the needle and 4.5ml of Onyx-20 were injected until complete filling and occlusion of the endoleak was achieved. The scan after removal of the catheters and the follow-up CT scan 6 months later demonstrated the absence of a reperfusion of the endoleak. Due to the strong beam-hardening artifacts in CT, the closure of the endoleak entries, and a potential proximal and distal extension of the stent-graft. For the endoleak type 1a a micro-catheter was introduced between the upper end of the stent-graft and the aortic wall into the endoleaks’ cavity. It was occluded by injection of 3 ml of Onyx-34. For the endoleak type 1b the micro-catheter was introduced between the lower end of the stent-graft and the aortic wall into the endoleaks’ cavity. It was occluded by injection of 5ml of Onyx-34. No further endoleak perfusion could be observed following the intervention.

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caused by the tantalum powder, it is even more important to rule out any reperfusion of the aneurysm sac by contrast enhanced ultrasound, which confirmed absence of reperfusion of the endoleak.

Discussion
Various treatment options can be discussed for the management of the cases presented. In the case of a severely diseased neck of the infrarenal landing zone of an abdominal aortic aneurysm the classic EVAR procedure with placement of a standard bifurcated stent graft below the PAU was not viewed at as an appropriate approach, because the remaining neck at the left side would have been less than 7 mm, and in combination with the existing left-sided kinking of the aorta, sufficient sealing was not expected to be feasible. The stent graft could loose contact with the aortic wall resulting in the subsequent development of a Type 1a endoleak. In addition, excluding the aneurysm while leaving the

Рис. 3: Лечение крупных эндоликов комбинированного типа 1a и 1б путем транскатетерной эмболизации: a – на КТ перед вмешательством, видны крупные эндолики 1а и б типов после стентирования аорты брюшной аорты; b – заключительная ангиограмма после полной окклюзии обеих эндоликов, никаких следов реперфузии; c–f– процедура эмболизации. В просвет эндолика 1а типа между верхним краем стент-трансплантанта и стенкой аорты в полость эндолика введен микрокатетер. Окклюзия проводится путем инъекций 3 мл Оникс-34 (c – d). В просвет эндолика типа 1б катетер Cobra, а через него и микрокатетер был введен между нижним краем стент-трансплантанта и стенкой аорты. Проведена окклюзия просвета введения 5 мл Оникс-34 (e–f).
PAU untreated could increase the arterial pressure within the PAU and the risk of rupture or an increase of size, again with the risk of secondary type Ia endoleak formation. According to our experience, the PAU had to be treated as well in this particular case. Remaining treatment options were fenestrated grafts, chimney grafts or even a surgical repair, either using a hybrid procedure combining surgical visceral debranching with EVAR or a complete open repair. As already mentioned, open repair was not regarded as an adequate alternative because of the increased operative risk and the patient’s co-morbidities. Apart from the procedure described here, the implantation of a fenestrated or branched graft would have been the most reasonable endovascular procedure.

However, this latter procedure is very expensive because of the custom-made nature of these grafts, and also a very labour-intensive process requiring a great deal of expertise (1).

Our patient’s aorto-iliac vasculature was tortuous and exhibited doubled and severe kinking, making the exact positioning of a fenestrated graft exceedingly difficult due to axial torsion forces. For that reason, the risk of a technical failure of this procedure was regarded as too high. A chimney graft can be a valid alternative to fenestrated grafts, especially in emergency situations or in case of very tortuous vessels (15).

But in our case, the distance between the renal arteries and the superior mesenteric artery measured no more than 3 mm. The chimney procedure requires complete covering of the renal arteries with consecutive re-connection to the aortic blood flow by implantation of stent grafts. In our case, this would have required the re-connection of the superior mesenteric artery as well, again making sufficient proximal sealing unlikely. Moreover, there was a high risk of technical failure of this procedure and high procedure related mortality was expected.

In the case of our patient, the only possible way to prevent an endoleak was through embolization. The endoleak was treated by injecting 4.5 ml of Onyx-20. a – CT scan in the late venous phase (120 sec after contrast administration), depicting a large type 2 endoleak. b – Follow-up CT while retracting the catheters under control of the endoleak by injecting 4.5ml of Onyx-20. a) CT scan in the late venous phase (120 sec after contrast administration), depicting a large type 2 endoleak. c) Final scan after removal of the catheters. The puncture site in the aneurysm sack was sealed with Onyx-20 as well by slowly injecting it while retracting the catheters under CT fluoroscopy. d) Follow-up CT scan 6 months later demonstrating the absence of a reperfusion of the endoleak.
Aortic Pathologies
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For that reason, the described combination of a standard EVAR procedure with simultaneous embolization of the PAU was considered the best treatment option. In contrast to open repair or fenestrated grafts, the procedure time would be reasonably short and the morbidity and mortality significantly lower. Since simple coil embolization would not guarantee a complete occlusion of the PAU, thus resulting in a considerable risk of endoleak development, a liquid embolic agent was regarded as most appropriate. It was anticipated to facilitate an exact, controllable and fast occlusion of the PAU and sealing of the graft. Due to the proximity of the PAU to the right renal artery, the ideal embolic agent should precipitate fast but stay under control of the interventionalist for a reasonable period of time in order to avoid renal embolism. Moreover, it should be appropriate to ensure low recanalization rates. In this particular case Onyx performed excellently with fast, sufficient, and safe immediate occlusion of the PAU, allowing for a sufficient proximal sealing of the stent-graft.

Iatrogenic injury to the aorta and iliac arteries is a rare but serious complication of spinal surgery. In most cases, these injuries are caused by misplaced or dislocated hardware and can present either as acute hemorrhage in the operating room requiring immediate intervention, or, more often, as pseudoaneurysms with an increased risk of secondary rupture, which can occur even months or years later (5,6,16-18). Since the clinical presentation of these pseudoaneurysms can be extremely variable, ranging from a complete lack of symptoms to severe abdominal pain, the diagnosis may be made only after a prolonged period of time (18). In the past, open surgical repair was the therapy of choice for aortic PAs. The injured segment was either directly repaired, or treated by patch angioplasty, or even completely replaced with a graft (18). Though, open surgery requires aortic cross clamping, which can lead e.g. to spinal cord ischemia depending on the position of the PA. In addition, as for all large surgical procedures requiring thoracotomy or laparotomy, pulmonary complications can be observed frequently. Both, spinal cord ischemia and pulmonary complications have a major impact on the procedure related morbidity, being as high as 50% for open surgery of aortic PAs (18).

Endovascular aortic stent-grafting offers a safe and less invasive alternative to open surgical repair of aortic pathologies like pseudoaneurysm, or impingement by spinal hardware. As of yet, case reports and small case series have been published addressing the acute and long term outcomes of stent-grafting for treatment of iatrogenic aortic PAs after spinal surgery (18). However, given the excellent results of aortic stent-grafting for treatment of AAA it is expected that the results of stent-grafting for treatment of aortic PA are going to be excellent as well, even in the long term, since both procedures are performed

описываемом случае расстояние между почечной артерией и верхней брыжеечной артерией составило не более 3 мм. Установка стент-графта требует полного покрытия почечных артерий с последовательным повторным подключением к аортальному кровотоку. В нашем случае это потребовало бы повторного подключения верхней брыжеечной артерии, что технически было бы крайне затруднительно. Более того, выполнение такого вмешательства повлекло бы за собой крайне высокий риск для жизни пациента.

По этой причине стандартная EVAR с одновременной эмболизацией ПАЯ – оптимальное решение для таких клинических вариантов. В отличие от открытых операций по устранению аневризмы аорты или наложению перфорированного трансплантата, продолжительность процедуры намного меньше, а уровень возможных осложнений и ожидаемой смертности существенно ниже.

Поскольку простая эмболизация с помощью имплантации катушек не гарантирует полной окклюзии ПАЯ, оставляя риск развития эндокликов, жидкое эмболическое агенты – наиболее выигрышный вариант в этой ситуации, способный обеспечить технически более удобную, точную, управляемую и быструю окклюзию ПАЯ и герметизацию трансплантата. Из-за близости к ПАЯ и правой почечной артерии идеальный эмболический агент должен воздействовать быстро, при условии возможности четкого контроля над переменой его вязкости, чтобы избежать почечной эмболии. Кроме того, эмболизирующая жидкость должна иметь достаточно низкий показатель реканализации. В данном случае Олук пролонгирован с прекрасным результатом, справлялся с поставленными перед ним задачами быстро, точно, обеспечив необходимую полную и безопасную окклюзию ПАЯ и оптимальную герметизацию проксимального края стент-протеза.

Ятрогенные повреждения аорты и подвздошной артерии являются редким, но серьезным осложнением операций на позвоночнике. В большинстве случаев эти повреждения вызваны неправильно расположенными или смещёнными имплантантами, провоцируя как острое кровотечение в операционной, требующее немедленного вмешательства, так и, значительно чаще, образование псевдоаневризмы с повышенным риском ее вторичного разрыва, в течение нескольких месяцев или лет после операции [5,6,16-18]. Поскольку клинические проявления псевдоаневризмы могут быть чрезвычайно разнообразны, начиная от полного отсутствия симптомов до сильных болей в животе, диагноз может быть поставлен только по прошествии длительного периода наблюдения [18]. В прошлом открытое хирургическое вмешательство на аорте было терапией выбора в лечении псевдоаневризмы. По- врежденный участок восстанавливается непосредственно, либо проводилась патч-ангиопластика, или даже полная замена спинального фиксирующего импланта [18]. При этом открытая операция требует наложения на аорту кровоизлияния, что может привести, например, к ишемии различных отделов позвоночника, в зависимости от положения ПА. Кроме того, как и для всех крупных хирургических вмешательств, требующих торакотомии или лапаротомии, для открытого
the same way in the same vessel region and with the same material.

However, in particular situations pure stent-grafting might not be suitable to adequately treat an aortic PA. In the case of a PA at the level of the visceral artery origins stent-grafting would only be possible with fenestrated grafts. Of course a fenestrated graft again would be a treatment option by extending the landing zone over the origins of the renal arteries. However, they have to be re-connected by small stent-grafts and since patients suffering from iatrogenic PA after spinal surgery are typically of younger age the possible long term effects of this procedure are still unpredictable due to a lack long term follow-up. It remains unclear whether a stent-graft in a renal artery will stay patent and ideally avoiding coverage of the PA sufficiently and even for 30 years or more. Therefore, a less invasive treatment alternative is desirable, ideally avoiding coverage of the visceral arteries yet excluding the PA sufficiently and immediately. The described hybrid procedure combining stent-grafting of the aortic segment and simultaneous trans-catheter embolization of the PA represents a convincing option. In contrast to open repair or fenestrated grafts, the procedure time is expected to be reasonably short and the morbidity and mortality significantly lower. However, simple coil embolization would not grant for an immediate and complete occlusion of the PA, thus causing a considerable risk of endoleak development or acute bleeding. Therefore a fast acting and safe liquid embolic agent would be superior for embolization of the PA.

Endoleaks and endotension are critically important complications of many EVARs. Therefore it is very important to avoid or at least treat endoleaks sufficiently. Minimal invasive treatment methods are the endovascular and the percutaneous embolization of endoleaks. For this purpose, thrombin, cyanoacrylate, or the liquid ethylene vinyl alcohol copolymer Onyx can be employed. The liquid embolic agent Onyx® performed very well, exhibiting ideal characteristics such as fast embolization with excellent control of the growing cast by the interventionalist.

Onyx has the lowest recanalization rates among all known embolic materials and it is even suitable for high-flow lesions if a higher viscosity is used. Especially via a percutaneous approach even large endoleaks can be treated percutaneously. Complications after the use of Onyx are mostly caused by the solvent DMSO. If it is injected too fast it may cause angioneerosis and severe pain. Less common but serious complications are anaphylactoid syndromes due to histamine release, temporary oxygen desaturation, pulmonary edema, ARDS, peptic ulcers, psychotic episodes, tachypnea and laryngospasm. The critical amount of Onyx, potentially inducing the mentioned complications, is 7ml. However, many cases have been performed applying even 5 fold larger volumes of Onyx without any adverse event. Therefore, it can be regarded as a very safe alternative to immediate and relatively short repair or fenestrated grafts, the procedure time is expected to be reasonably short and the morbidity and mortality significantly lower. However, many cases have been performed applying even 5 fold larger volumes of Onyx without any adverse event. Therefore, it can be regarded as a very safe alternative to immediate and relatively short...
tive to other embolic agents, exhibiting favourable characteristics for the described cases like immediate embolization, good control of the Onyx cast, avoidance of distal embolization, and low recanalization rates.

In conclusion modern imaging modalities allow for the detection of numerous aortic pathologies like PAU and PA. Today endovascular stent-grafting is a well-established and widely used safe and minimally invasive treatment alternative to open surgical repair. Due to the large and increasing utilization of stent-grafting the number of endoleaks will also increase. The liquid embolic agent Onyx exhibited ideal characteristics for this procedure like immediate and stable occlusion. This makes Onyx embolization a valuable method to treat rare aortic pathologies like PA, penetrating aortic ulcers, or endoleaks after stent-grafting.

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For more than 350 years the three kilometre splendidous parks and gardens “Lichtentaler Allee” has been Baden-Baden’s green and blooming visiting card. The masterpiece made of trees, fountains and flowers invites not only for healthy walks in crystal Black Forest air but also fascinates guests from all over the world with a walk through the history of the spa and the Black Forest.

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Красиво расположенный в солнечном юго-западном «углу» Германии, в предгорьях Шварцвальда, Баден-Баден остается самым элегантным, всемирно известным бальнеоклиматическим курортом, wellness-райм и центром культурной жизни. Сегодня Баден-Баден является идеальным сочетанием атмосферы «бель-эпок» и инновационного оздоровления XXI века.

Его знаменитая целебная термальная вода, вытекающая из 12 источников, используется не только для традиционной бальнеотерапии, но и для современных и инновационных методов лечения. Горячая лечебная вода, температура которой достигает 68 оС, балует гостей со всего мира в двух термальных купальнях — современной Caracalla Spa (Спа Каракаллы) и исторической римско-ирландской Friedrichsbad (Фридрихсбад). Кроме того, многие SPA-отели, особенно комфортные для проживания и релаксации, предлагают уникальные возможности для оздоровления – общие и индивидуальные процедуры. Восемь специализированных клиник в различных областях медицины, с их высококвалифицированными специалистами отменной репутации, предлагают индивидуальные Check-up’ы (программы диагностики) в сочетании с консультациями, комплексной профилактикой и методами реабилитации, разработанными для каждого пациента. Также в любое время выполняются индивидуальные пожелания гостей, связанные с культурным времяпрепровождением. На протяжении более 350 лет три километра превосходнейшего парка и сада Lichtentaler Allee (Аллея Лихтенталера) являются зеленой и цветущей визитной карточкой Баден-Бадена. Соз-
as a stylish mile for art and culture with the historic “Trinkhalle” (Pump Room), the world-famous “Kurhaus” – the social meeting place of the city – the Casino, the neo-baroque theatre as well as the Museum of Modern Art Frieder Burda designed by star architect Richard Meier. Europe’s second largest opera and concert hall, the “Festspielhaus”, guarantees cultural pleasure at the highest level and offers over 300 top class events yearly.

During the whole year Baden-Baden is setting for outstanding and sophisticated events: Three times a year the International Horse Races, the International Vintage Car Meeting mid of July, outstanding concerts at the parks and gardens “Lichtentaler Allee” and at the romantic courtyard of “Castle Neuweier” as well as international artists and performances at the “Festspielhaus”.

In the picturesque streets and the small lanes of the neo-baroque old town of Baden-Baden, numerous exclusive boutiques invite you to first-class shopping. Everyone who searches for brand products, international labels and individual antiques, jewellery and presents will find himself in the right spot.

Besides well-known starred restaurants, cosy little taverns with local colour and fine Baden cuisine, bistros and countless street cafés in the centre, there is also Baden-Baden’s “Rebland”, one of the most popular Riesling growing districts in Germany and an insider tip for the gourmet and connoisseur of good wines. Germany’s oldest and according to Marlene Dietrich “the most beautiful casino in the world” rounds off a perfect day in a playful manner and entices guests from all over the world to try their luck at the roulette table.

(Festspielhaus), guarantees зрителям культурное наслаждение на самом высоком уровне и предлагает более 300 событий топ-класса ежегодно. В течение всего года Баден-Баден является местом проведения грандиозных культурных событий: три раза в год проводятся международные скачки, пробег старинных автомобилей в середине июля, великолепные концерты в парках и садах Аллеи Лихтенталера, на территории романтического Castle Neuweier (Замка Нойвейера), выступления зарубежных артистов и исполнителей в «Фестшпильхаусе».

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На живописных улицах и в переулках в стиле «нео-барокко» старого города Баден-Баден расположены многочисленные бутики, которые приглашают на первоклассный шоппинг. Каждый, кто ищет товары известных международных брендов и марок, антиквариат, ювелирные изделия и подарки, оказывается в нужном месте.

Помимо хорошо известных «звездных» ресторанов, на курорте можно найти уютные маленькие таверны с местным колоритом и изысканной кухней, бистро и бесчисленные уличные кафе. В Баден-Бадене есть и Rebland (Ребланд – одно из самых популярных винодельческих хозяйств Германии, в котором выращивается виноград Рислинг), что является дополнительной «изюминкой» для гурманов и ценителей хороших вин.

Старейшее в Германии и, по определению Марлен Дитрих, «самое красивое казино в мире» может завершить прекрасно проведенный день в форме игры и привлекает со всего мира гостей, желающих испытать свою удачу за столом с рулеткой.
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