GERIATRIC FRACTURE CARE

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Due to demographic changes the number of geriatric trauma patients is rising. In this fragile population, trauma related emergencies due to falls often result in osteoporotic fractures (“fragility fractures”). Due to osteoporosis, fixation of these fractures becomes more and more challenging. In addition, existing comorbidities in these patients are most likely to cause peri- and postoperative complications with higher mortality rates than in younger patients.

Early mobilisation and treatment of comorbidities in geriatric patients are crucial to achieve status quo ante.
Challenge - Fragility Fracture

- Fracture after simple falls
- Low bone quality
- Challenging operative stabilization

Fragility fractures are a major health problem in many countries. Predictions of the demographic development of the world population point out that the proportion of the geriatric population will increase continuously over the coming decades. Specifically, elderly patients are predisposed to falls caused by cardiovascular diseases, neurological disorders, visual impairment and multiple other indispositions. Due to osteoporosis and the resulting low bone quality, these patients are at high risk for fragility fractures even if they are only falling from standing height.

Owing to declines in physiologic reserves and concomitant osteoporosis in geriatric patients, each fragility fracture proves to be challenging for surgical treatment. Implants providing sufficient stabilisation with low risk of loosening are required to enable early mobilisation, thereby reducing post-operative complications to provide the best possible outcome.

Revision surgery due to loss of reduction and implant cut-out in osteoporotic bone is a common complication in geriatric patients and leads to high mortality.

The main problem in construction failures in osteoporotic bone affect the metaphyseal region or the head-neck fragment – thus cancellous bone. Osteoporosis results in reduced bone mass and these effects in the cancellous bone lead to a smaller bone/implant contact area and therefore decreases the holding power for implants.

With bone augments, the contact area can be increased and the anchorage of the implant in cancellous bone gets stronger. The standardised use of such bone substitutes is widely known in spine surgery for screw fixation within the osteoporotic vertebral body, and newer developments include other body regions such as the hip or the proximal humerus.

Biomechanical investigations and clinical use reveal that additional augmentation of different implants improves cut-out resistance. Therefore augmentation should be considered when dealing with fragility fractures.

References

Comorbidities

- Impact on clinical outcome
- Increased risk for complications
- Interdisciplinary co-management

In medicine, comorbidity describes the effect of all other diseases an individual patient might have other than the primary disease of interest. Therefore a similar severe injury in elderly patients leads to inferior clinical outcome with higher mortality rates compared to younger patients. These multiple comorbidities also complicate the recovery after trauma. It is apparent that more than 50% of the elderly trauma patients have underlying hypertension, and more than 30% have heart disease. Moreover, diabetes, previous cerebrovascular events, chronic obstructive pulmonary disease, dementia, arrhythmias, and endocrine disorders are each identified in more than 10% of the geriatric trauma population. Due to the impaired health of the elderly patients at baseline, they are at increased risk of certain types of trauma and in-hospital complications after any trauma.

The Charlson Comorbidity Index is a tool for quantification of comorbid conditions, which allows estimation of the 1-year mortality. Each condition is thereby assigned a score of 1, 2, 3, or 6 depending on the risk of dying associated with each condition. The scores are summed to provide a total score to which predicts mortality.

When dealing with geriatric patients, the Charlson Comorbidity Index is helpful in decision making.

To improve clinical outcome an interdisciplinary co-management approach is recommended in order to ensure quality of treatment and prevention of complications.

Clinical conditions and associated scores are as follows (Table 1)

<table>
<thead>
<tr>
<th>Comorbid conditions</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myocardial infarction, congestive heart failure, peripheral vascular disease, dementia, cerebrovascular disease, chronic lung disease, connective tissue disease, ulcer, chronic liver disease, diabetes</td>
<td>1</td>
</tr>
<tr>
<td>Hemiplegia, moderate or severe kidney disease, diabetes with end organ damage, tumor, leukemia, lymphoma</td>
<td>1</td>
</tr>
<tr>
<td>Hemiplegia, moderate or severe kidney disease, diabetes with end organ damage, tumor, leukemia, lymphoma</td>
<td>2</td>
</tr>
<tr>
<td>Moderate or severe liver disease</td>
<td>3</td>
</tr>
<tr>
<td>Malignant tumor, metastasis, AIDS</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 1. Charlson Comorbidity Score

References
Osteoporosis

- Age-related decline in BMD
- Individual fracture risk
- Adequate medical treatment
- High demand on implant

The prevalence of osteoporosis and the incidence of fracture varies by sex, yet both men and women experience an age-related decline in bone mineral density (BMD) starting in midlife. Despite increasing incidence of osteoporotic fractures, the treatment outcome is still disappointing with reported mortality rates up to 30% in 1 year and up to 69% in 5 years. Therefore identification of the individual fracture risk and determination of who should get a specific anti-osteoporotic medication are the main goals when evaluating patients for osteoporosis.

The gold standard for measuring bone mineral density is the dual-energy x-ray absorptiometry (DEXA). BMD is reported as T-score where osteoporosis is present at a T score below -2.5 and osteopenia is present at a T score between -1 to -2.5 according to the WHO criteria. In 2011 Schreiber et al. revealed that Hounsfield units obtained from clinical computed tomography scans that are made for other purposes provide an alternative method of determining regional bone mineral density. The information could eventually be applied toward fracture risk assessment, diagnosis of osteoporosis, and early initiation of needed treatment.

Efficient operative fracture treatment, with implants that enable high mechanical load capacity in osteoporotic bone, is crucial to ensure early post-operative mobilisation. In addition, medical treatment of present osteoporosis is essential to support recovery. However, still only a minority of the geriatric patients with sustained osteoporotic fracture receive adequate medical treatment subsequently.

References

X-ray Signs

- DEXA not always available
- Unspecific signs
- Cortical thickness index

The gold standard to measure bone mineral density is the dual-energy x-ray absorptiometry (DEXA)\textsuperscript{25} however, this is not available in every hospital. Oblique signs in conventional x-rays of the femur such as reduced thickness in trabecular structure and thin cortex, intra-cortical defects, trabecular structure, increased radiolucency, pre-fractures and current fracture type can suggest underlying osteoporosis. Several examination methods of conventional x-rays are described.\textsuperscript{46} Dorr et al. developed radiographic classifications of bone quality and validated them with histologic parameters.\textsuperscript{47} Thereby, conventional anteroposterior and lateral radiographs of the hip are assessed to delineate bone quality of the proximal femur. The cortical thickness index shows a significant positive correlation with the T-Score of the femoral neck. A cortical thickness index lower than 0.40 (lateral film) and 0.50 (ap film) has been described as a threshold for osteoporosis.\textsuperscript{46}

References


Pre-fractures - As early indicators

- Indicator fractures
- Identification
- Early medical treatment of Osteoporosis
- Change of treatment

Traditionally, low energy fractures of the thoracolumbar spine, distal radius, proximal femur, and proximal humerus have been considered to be osteoporotic. More recently it has been suggested that pelvic fractures and fractures of the ribs, and diaphyseal fractures of the tibia and fibula should also be considered to be osteoporotic.43,44,45

To initiate adequate medical treatment of osteoporosis, it is imperative to identify these fractures as early as possible as osteoporotic fractures. Furthermore, if an osteoporotic fracture occurs despite antiosteoporotic premedication, a change of medical therapy should be considered because patients showing previous low energy fractures are likely to suffer from severe osteoporosis and are at higher risk for experiencing a catastrophic failure of the implant in weak bone.

References
Trauma

• Low energy trauma
• Simple falls
• Identification of risks for falling
• Falls prevention

How did the fracture occur? “simple fall”

Clinically, a fragility fracture is defined as one that occurs as a result of a low-energy trauma, such as a fall from a standing height or lower, or no identifiable trauma. Traffic accidents and high-energy traumata are infrequent injury mechanisms in the elderly patient. It is important to differentiate between high and low energy fractures in the elderly.

A fragility fracture caused by a fall is often the first symptom of underlying osteoporosis. One of three elderly individuals over 65 years of age experiences one fall per year, while in those above 80 years, it is already one out of two.

One out of ten falls requires hospital treatment and one out of 100 falls leads to a hip fracture. There is a positive correlation between the number of risk factors and the probability of actually falling.

Previous falls, strength, gait and balance impairments, and use of specific medications range amongst the strongest predictors.

By identifying individuals with a high risk of falling, targeted fall prevention interventions could be directed at those most likely to benefit from them.

References
Compliance

• Low in this population
• Dementia
• Additional implant stability

A high number of the geriatric fracture patients suffer from dementia or other cognitive disturbances which makes patient compliance more difficult. For good patient outcome – patient compliance is key to success. If we need to fully rely on the implant stability itself, any addition to stability is welcome.\textsuperscript{5,7-13}

References
Geriatric fractures constitute a major source of disability and diminished quality of life in the elderly. Age, gender, comorbid conditions, prefracture functional abilities, and fracture type have an effect on the outcome regarding ambulation, activities of daily living, and quality of life.36 The Barthel Index and the Parker Mobility Score are tools to evaluate possible activities of daily living and mobility. The Barthel Index is used to measure performance in basic activities of daily living by scaling the presence or absence of fecal or urinary incontinence, the help needed with grooming, toilet use, feeding, transfers (e.g. from chair to bed), walking, dressing, climbing stairs, and bathing. For each question, there are two to four ordinal responses with a fixed count, which are summed-up. The maximum of 100 points states that the patient is independent in his basic activities of daily living.37 The Parker Mobility Score evaluates the patient’s ability to walk inside and outside and to go shopping or visiting family. For each question, there are four ordinal responses with a fixed count that are summed-up. The score ranges from 0 to 9, where the maximum score indicates independent mobility. In addition, the use of a walker is asked without counting.38

To improve outcome regarding activities of daily living and quality of life, state-of-the-art surgical treatment of geriatric fractures according to evidence-based international guidelines is fundamental.36 Quality of the surgical management (capacity, stability), the fracture type, and dislocation play an important role in the outcome of geriatric patients.39 Augmentation of the implant provides additional stability inside the weak bone.5,7–13 Due to increased reliability of the implant after operative treatment, early mobilisation is possible. This is crucial to ensure further recovery in these fragile patients. Gaining pre-existing independency (achieving status quo) ante after fracture treatment should be the goal of the attending physician.

References
Unstable Fracture

- Fracture comminution
- Reduced bone mass in cancellous bone
- Construct strength

Unstable fracture pattern occurs more commonly with increased age and low bone mineral density. The unstable fracture can be difficult to manage, particularly in the noncompliant patients. In addition, present severe fracture comminution often hinders fracture fixation. Metaphysal bone and head-neck fragment are frequently affected and are thus cancellous bone, which is the main problem in construction failures in osteoporotic bone. Unstable fractures and reduced bone mass in cancellous bone at the fracture side lead to small bone/implant contact, thereby decreasing holding power of implants. Implants, which provide high stability, are eligible. To support construct strength, supplementary augmentation in these unstable fractures provides the additional required stability.

References
References
