Vascular Injuries From Orthopedic Operations: How to Prevent Catastrophes: Beware the Danger of Orthopedic Cement

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Nothing to Disclose

I have no relevant financial relationship(s) with any proprietary entity producing health care goods or services related to the content of my talk

Vascular Problems and Types of Injury

- Traumatic
- Compressive
- Occlusive
- Tumoral (malformation)
- Vasospastic

Thoracoscopic Resection of Fractured Ribs to Prevent Descending Aorta Injury in Patient With Chest Trauma

- Especially left posterior site near descending Aorta
- Consider rib deformity in fracture site
- Patient position changes or mechanical ventilation could cause delayed aortic injury
- Immediate or delayed injury

Soichiro Funaki, MD, PhD, Masayoshi Inoue, MD, PhD, Masato Minami, MD, PhD, and Meinoshin Okumura, MD, PhD. Video-Assisted Thoracoscopic Resection of Fractured Ribs to Prevent Descending Aorta Injury in Patient with Chest Trauma. Ann Thorac Cardiovasc Surg. 2014; 20: 173-174.

Conditions That Cause Aortic Migration

<table>
<thead>
<tr>
<th>Condition</th>
<th>Aorta Migration</th>
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<tbody>
<tr>
<td>Body posture</td>
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<tr>
<td>Supine</td>
<td>More posterolateral</td>
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<tr>
<td>Prone</td>
<td>More anteromedial</td>
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<tr>
<td>Hypo&amp; hyperkyphosis</td>
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<td>Hypokyphosis</td>
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<tr>
<td>Hyperkyphosis</td>
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<tr>
<td>Aorto-vertebral angle</td>
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<tr>
<td>78°-92°</td>
<td>Posterolateral (at T₅-T₁₀, preoperative)</td>
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<td>62°-16°</td>
<td>Anteromedial (at T₁₁-L₂, postoperative)</td>
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<tr>
<td>Operation method</td>
<td></td>
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<tr>
<td>Posterior instrumentation</td>
<td>Non-displaced</td>
</tr>
<tr>
<td>Anterior curve correction with pleural closure</td>
<td>Anteromedial</td>
</tr>
<tr>
<td>Posterior pleural chest</td>
<td>Away from the vertebral body</td>
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<td>Segmental vessel ligation</td>
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Risky Screws

• Within 1-3 mm proximity to aorta or other adjacent tissues (6.8 - 15.2%)
• Vertebral artery loop or tortuosity is congenital or acquired anomaly (0.6 - 7.5%)
  -- Especially at V3 segment (90.5%); V1 (7.6%); V3 (1.9%)
  -- Predominantly in females in 5th or 6th decades
  -- Radicular and/or neck pain
  -- Overall incidence of injury 0.07%
• Instrumentation upper cervical spine 32%, anterior corpectomy 23%, posterior exposure 12%


Risky Screws

• Left subclavian artery injury from excessively long thoracic pedicle screws placed in proximal thoracic regions of scoliosis patients
• Clavicle osteosynthesis high neurovascular injury – plunge depth beware especially medial clavicle
• Safe zone along medial shaft femur for SFA


Rajpal S. Narulla, Andrew J. Kanawati. Safe zone for the superficial femoral artery demonstrated on computed tomography angiography. Injury, Int. J. Care Injured 47 (2016) 748-751

Stretch or Retraction Injury

• Careful preoperative radiologic evaluation of major vessels and intraoperative care are important
• Lateral transpsoas approach
• Midline anterior approach from right side to the lumbar spine for interbody fusion and total disc replacement
• Anterior tibial artery in posterior lateral approach to tibia plateau
• All inside meniscal repair technique (lateral geniculate artery)

Toshinori Sakai, MD, PhD, Fumitake Tezuka, MD, Kazuma Wada, MD, Mitsunobu Abe, MD, Kazuta Yamashita, MD, Yoichiro Takata, MD, PhD, Kosaku Higashino, MD, PhD, and Koichi Sairyo, MD, PhD. Risk Management for Avoidance of Major Vascular Injury due to Lateral Transpsoas Approach. Spine 2016;41:450-453.


Nima Heidari, MBBS, MRCS(Eng), MSc, FRCS(Tr&Orth), Surjit Lidder, BSc(Hons), MBBS, MRCS(Eng), Wolfgang Grechenig, MD, Norbert P. Tesch, MD, and Annelie M. Weinberg, MD. The Risk of Injury to the Anterior Tibial Artery in the Posterolateral Approach to the Tibia Plateau: A Cadaver Study. J Orthop Trauma 2013;27:221-225.

Beware of “Blue Bumps” in the Elderly: A Late Complication of Particulate Disease

• Case Report
  -- A 75 year old Caucasian female with a complicated past medical history
  -- Total hip replacement in 1992. Underwent revision in 2004 which was complicated by infection
  -- Presented to the office complaining of new “blue bumps” across her abdomen and declining mobility
  -- Worsening lower extremity lymphedema not responding to conservative therapy
• Imaging
  -- Asymmetry of the common femoral vein and a loss of spontaneous and phasic flow on duplex scan
  -- Heterogeneous mass on duplex scan

Figure 3 (below) - CT scan shows abdominal soft tissue masses consistent with collateral flow from iliac vein occlusion

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Figure 1 - CT scan shows a mixed fluid collection (11cm x 12cm x 10cm) adjacent to the right hip prosthesis

Figure 2 (above) - CT imaging shows the heterogeneous mass compressing the iliac vein

Figure 2 (above) - CT imaging shows the heterogeneous mass compressing the iliac vein
Vascular Injuries Associated With Orthopedic Procedures - Beware of the Cement

**Case Report 1**
- The first patient is a 71-year-old male who presented with significant worsening of post-thrombotic syndrome symptoms
- Previous left hip replacement (2011)

![Figure 1: CT scan showing bone cement compressing the region around the left external iliac vein.](image1)

![Figure 2: Venous angiography shows absence of flow through the left external iliac vein with established collaterals. Stenting failed to attain vein patency.](image2)

**Case Report 2**
- The second patient is a 67-year-old female who presented with swelling of the left leg
- Status post total hip replacement (1995)
- No history of DVT

![Figure 3: Venous angiography shows partial occlusion of the left common iliac vein. Bone cement is clearly visualized surrounding the left femoral prosthesis and extending adjacent to the occluded vessel.](image3)

![Figure 4: MR Venography shows partial occlusion of the left common iliac vein in close proximity to the left femoral prosthesis.](image4)

**Discussion**
- Vascular injury occurs across all surgical specialties
  - All procedures carry risk of bleeding inadvertent damage to vessels
- Mechanisms of vascular injury include:
  - Tearing or stretching of vessels
  - Fracturing of calcific plaques
  - Direct penetration
  - Thermal injury
- Types of vascular injury after hip arthroplasty:
  - Thromboembolism (46%)
  - Laceration (26%)
  - Pseudoaneurysm (25%)
  - Arterial venous fistula (3%)

**Discussion**
- Vascular injuries can be recognized in the acute postoperative setting
  - Careful observation required to watch for signs of bleeding or ischemia
  - Arterial lesions are commonly discovered during this time period
- Lesions to vessels not found in the acute postoperative period may come with vague symptoms which may not initially point to vascular injury
- Bone cement injuries have been reported in the literature:
  - Thermal injury, erosion into vasculature, external compression, bone cement implantation syndrome
  - Populations with particularly friable vessels may be at more risk for bone cement injury
Conclusions

• No surgical procedure is immune to the risk for vascular injury
  – Recognizing and managing these injuries are an imperative aspect of morbidity and mortality prevention
• Be aware of signs pointing to acute blood loss.
• Chronic vascular injuries often have a subtler constellation of symptoms, which can make recognition difficult
  – Careful examination for signs of venous stasis, thromboembolism, and claudication should be performed at all follow-up appointments
• Bone cement has proven to be far from a benign substance on multiple occasions
  – Use the substance with caution, especially in the elderly or other populations with more fragile vessels
• Traditional treatment plans may need alteration in the presence of cement

References


Conclusions

• Complications involving aseptic particle-involved degeneration of total hip replacements are described as early as the 1970’s
  – Complex interaction of inflammatory pathways directed against microparticles created through prosthesis wear
  – Polyethylene particles are commonly implicated
• Three stages: Creation of particles, migration of particles, cellular response to particles
• Local inflammatory and osteolytic reaction can cause vascular injury

References