Preoperative Embolization in Surgical Treatment of Spinal Metastases:
Single-blind, randomized controlled clinical trial of efficacy in decreasing intraoperative blood loss

Lars Lonn on behalf of my co-authors
Caroline Clausen, Benny Dahl
S. C Frevert L.V. Hansen, MB Nielsen

Department of Cardiovascular Radiology
Department of Orthopedic Surgery, Spine Unit
National Hospital
University of Copenhagen DK
Lars Lonn, M.D.

• No relevant financial relationships disclosed
In Denmark 30,000 per year are diagnosed with cancer (www.ssi.dk)

Life expectancy with advanced cancer has increased (www.sundhedsstyrelsen.dk)

A common complication of advanced cancer is bone tissue metastases especially to the spine

5-14% experience symptomatic compression of the spinal cord or cauda equina (Patchell 2005, Klimo 2004)

Symptoms (Cole 2008):
- pain
- impaired motor, sensory and autonomic functions
- mechanical instability of the spine
Background

• An increased number of patients undergo surgery for symptomatic spinal metastases

• Intra-operative blood loss a cause of operative morbidity

• Pre-operative embolization
Treatment options

Individually planned according to stage of disease, surgical risk and prognosis:

• Corticosteroids, analgesics and sometimes chemotherapy

• Combined with:
  – open surgery followed by radiotherapy
  – radiotherapy alone
Open surgery followed by radiotherapy


• Associated with significant blood loss and a risk of catastrophic blood loss (Chen 2013 – Meta-analysis)

  – 18 papers, 760 patients
  – Mean 1828 mL
  – 12% >5500 mL
Background

Previous studies:

- Retrospective
- Long study periods
- Conflicting conclusions
- Renal and thyroid cancer
- Hypervascularity is found in metastases not generally considered hypervascular
- Approximately 50:50; effect: no effect*

Aim of Study

To assess whether pre-operative embolization of spinal metastases regardless of primary cancer reduces:

1. Intra-operative blood loss
2. Blood transfusions
3. Surgery time

• The frequency of hypervascular metastases
Reduction of intraoperative blood loss

- **Antifibrinolytic agents** (Elwatidy 2008)
- **Controlled perioperative hypotension** (Dutton 2004)
- **Intraoperative cell salvage combined with a leucocyte depletion filter** (Yuan 2013)
- **Development of less invasive percutaneous techniques**
- **Preoperative arteriography and embolization**
  
  – Aiming to reduce the vascularity prior surgery
Inclusion criteria

- >= 18 years
- Symptomatic metastatic compression of the spinal cord or cauda equina
- No contraindication to surgery
- Decompression and posterior thoracic and/or lumbar spinal instrumentation
Design

- Randomized controlled trial
- The CONSORT Statement

- Blinded:
  - Surgeons
  - Anesthesiologists assessing outcomes

- Pre-registered at www.ClinicalTrials.gov (NCT01365715).
- Danish Committee on Biomedical Research Ethics (ID number H-2-2011-024).
- Danish Data Protection Agency (ID number 2008-41-2128).

Embolization group
- Angiography and embolization

Control group
- Angiography
Angiography and embolization

Angiography and embolization

- Affected vertebra and two levels above and below
- PVA

No hypervascularity

Moderate hypervascularity

Pronounced hypervascularity

Post embolization
**Embolization**

- 300 μm PVA foam particles - preferred choice
- 500 μm PVA foam particles - larger caliber vessels
- Gelatin sponge, micro coils
- Endpoint: complete exclusion of all arterial feeders
Angiography and embolization

- 0-48 hours before the scheduled surgery
- Vascularity: Tumor blush intensity

No Hypervascularity (Grade 0)

Moderate Hypervascularity (Grade 1)

Pronounced Hypervascularity (Grade 2)
Statistical analyses

- **By intention-to-treat**
- The Independent t-test for comparison of continuous outcomes
  - when the assumptions of normality and homogeneity of variance were met
- The Mann-Whitney test when not
- Categorical outcomes: Chi-square test
- Fisher’s exact test
  - if numbers of expected values were less than five
- P value < .05 (two-tailed) statistically significant
- Effect sizes were stated with 95% confidence intervals (CI)
Enrollment:
May 2011-March 2013
Results

Embolization did not significantly reduce intra-operative blood loss:

- 620 mL (SD, 282 mL) vs. 740 mL (SD, 415 mL)
- Mean difference -120 (95% CI: -330 – 95)
- \( P = .270 \)
Results

- No. of patients who received blood transfusions not significantly reduced in embolization group:
  - 2 (9%) vs. 5 (23%)
  - \( P = .243 \)

- 25% reduction of surgery time in embolization group:
  - Reduced 35 min
  - Median 90 min (range, 54-252) vs. 125 min (range, 80-183)
  - \( P = .031 \)

- 34 of 45 metastases were hypervascular (76%)
Results

Blood loss significantly reduced in hypervascular metastases:

• 650 mL (SD, 289) vs. 900 (SD, 416).

• Mean difference -250 (95% CI: -502 - -11).

• $P = .041$
Conclusions

- Intra-operative blood loss and RBC transfusion not significantly reduced
- 25% reduction in surgery time
- Intra-operative blood loss significantly reduced in hypervascular metastases
Thank you