The Role Of Preoperative Vascular Embolization in Surgery for Spinal Metastases

A/Professor Naresh Kumar
Dr. Barry Tan
Dr. Priyanka Gahlot
Dr. Aye Sandar Zaw
Dr. Anil Gopinathan
Prof. HK Wong
Prof. Lenny Tan
Introduction

- The spine is the most common site of osseous metastases
- Between 5-10% of cancer patients develop spinal metastases
- Metastatic vertebral lesions can severely reduce the quality of life in terms of tumor-associated pain, pathologic fractures and the risk neurological deficit including paraplegia
- Surgery in spinal metastases is utilized for decompression of neural elements, preserving neurologic function and stabilization of the spine
- However, a limitation of radical surgical therapy is the significant vascularity of some metastases, such as those from renal cell carcinoma
- With hypervascular metastases, there is a risk of extensive intraoperative blood loss and increased morbidity and mortality
- Pre-operative vascular embolization has been associated with decreased perioperative blood loss, decreased surgical complexity, and improved surgical outcome
Aim

- To determine the effect of pre-operative vascular embolization in surgery for spinal metastases

- To compare the degree of blood loss between embolized and non-embolized cases, with matching of cases in tumour type and type of surgery utilized

- To identify risk factors and determinants of blood loss in surgery for spinal metastases
Materials and Methods

- A retrospective study analyzing operated cases in a tertiary hospital for spinal metastases over 5 years

- Embolized & Non-embolized cases were stratified into primary tumor type (Renal Cell, Pulmonary, Colorectal, Lymphoma/Myeloma, Breast, Others)

- Cases were also stratified by surgery type
  - I: Cervical Corpectomy & Stabilization
  - II: Thoracolumbar Laminectomy/Tumorectomy Decompression & Instrumentation
  - III: Thoracolumbar Corpectomy & Stabilization

- Peri & intraoperative blood loss was quantified by:
  - Hemoglobin concentration drop with consideration of blood units transfused
  - Estimated blood loss by operating surgeon

- In addition, Duration of Surgery and Length of Stay were compared between cases

- The influence of Race and Age were also analysed
Results

- Total - 98 cases
  - 36 cases – embolized
  - 62 cases - non-embolized

- Median age – 60 yrs (17 yrs - 84 yrs)

- Increased age resulted in a borderline significant increase in hemoglobin concentration drop (0.03, p=0.06).
Results

Mean difference in blood loss and Hb drop between embolized vs non-embolized groups, stratified by tumour types

<table>
<thead>
<tr>
<th>Tumour Type</th>
<th>Renal</th>
<th>Lung</th>
<th>Colon</th>
<th>Myeloma</th>
<th>Breast</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blood loss</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Diff</td>
<td>1225 ml</td>
<td>202 ml</td>
<td>166 ml</td>
<td>1317 ml</td>
<td>350 ml</td>
<td>391 ml</td>
</tr>
<tr>
<td>P - value</td>
<td>0.7</td>
<td>0.4</td>
<td>0.7</td>
<td>0.02</td>
<td>0.4</td>
<td>0.3</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
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<th>Breast</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Haemoglobin drop</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Diff</td>
<td>0.7</td>
<td>0.8</td>
<td>1.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td>P - value</td>
<td>0.6</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
<td>0.7</td>
<td>0.8</td>
</tr>
</tbody>
</table>
Results

Mean difference in length of stay and duration of surgery between embolized vs non-embolized groups, stratified by tumour types

<table>
<thead>
<tr>
<th>Tumour Type</th>
<th>Length of Stay</th>
<th>Duration of Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Renal</td>
<td>Lung</td>
</tr>
<tr>
<td>Mean Diff</td>
<td>10 days</td>
<td>7 days</td>
</tr>
<tr>
<td>P - value</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>12 mins</td>
<td>123 mins</td>
</tr>
<tr>
<td>P - value</td>
<td>0.8</td>
<td>0.009</td>
</tr>
</tbody>
</table>
## Results

### Mean difference in blood loss and Hb drop between embolized vs non-embolized groups, stratified by type of surgery

#### Blood loss

<table>
<thead>
<tr>
<th></th>
<th>Type I surgery</th>
<th>Type II surgery</th>
<th>Type III surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Diff</td>
<td>124 ml</td>
<td>460 ml</td>
<td>118 ml</td>
</tr>
<tr>
<td>P – value</td>
<td>0.8</td>
<td>0.09</td>
<td>0.7</td>
</tr>
</tbody>
</table>

#### Haemoglobin drop

<table>
<thead>
<tr>
<th></th>
<th>Type I surgery</th>
<th>Type II surgery</th>
<th>Type III surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Diff</td>
<td>0.2</td>
<td>0.2</td>
<td>1</td>
</tr>
<tr>
<td>P - value</td>
<td>0.9</td>
<td>0.7</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Results

Mean difference in length of stay and duration of surgery between embolized vs non-embolized groups, stratified by type of surgery

<table>
<thead>
<tr>
<th>Type</th>
<th>Length of stay</th>
<th>Duration of surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type I surgery</td>
<td>Type II surgery</td>
</tr>
<tr>
<td>Mean Diff</td>
<td>5 days</td>
<td>10 days</td>
</tr>
<tr>
<td>P – value</td>
<td>0.3</td>
<td>0.02</td>
</tr>
<tr>
<td>Mean Diff</td>
<td>66 mins</td>
<td>99 mins</td>
</tr>
<tr>
<td>P - value</td>
<td>0.09</td>
<td>0.02</td>
</tr>
</tbody>
</table>
Results

Combined stratification by tumor and surgery type

Myeloma patients with type II surgery

   Embolization $\rightarrow$ significant decrease in blood loss

   (mean diff = 2985ml, P<0.01)
Several studies have shown that preoperative embolization decrease risk of intraoperative hemorrhage, but most only identify renal cell carcinoma metastases as a suitable target.

Other studies have identified thyroid carcinoma spinal metastases as a viable target for pre-operative embolization, as they are deemed hypervascular as well.

We postulate that this may be due to intrinsic properties of myelomas/lymphomas due to their hematologic origin.

In addition, the first line treatment for myelomas/lymphomas is usually radiotherapy, hence cases who proceed on to require further surgical fixation may be cases which are more radio-resistant, possibly because of underlying high metabolic/replication rates with increased vascularity.

This in turn would put such cases as susceptible to preoperative embolization.
Discussion

- Our study demonstrates that preoperative vascular embolization in cases of myeloma/lymphoma diseases requiring spinal surgery may be a useful modality.

- A significant decrease in blood loss, particularly in cases of thoracolumbar laminectomy/tumorectomy decompression and instrumentation, along with a decrease in duration of surgery, was seen in embolized cases.

- This represents a novel clinical observation.

- Preoperative embolization, in our study, was also shown to be useful in reducing duration of surgery in cases of colorectal carcinoma and lung carcinoma metastasis.

- Additionally, length of stay was also reduced in cases of colorectal carcinoma.
Limitations

- Retrospective study
- Case numbers not large for all the types of tumor
- Limited analysis based on subtypes of embolization techniques
- Could further analyse with:
  - Other comorbidities
  - Number of surgical levels
  - Surgical complications
Future directions

- Co-operative analysis with interventional radiologists looking at type of embolization technique
- Further analysis with comorbidities, levels of surgery and surgical complications
- Expanding database with nation-wide collaboration

- None of the authors has any potential conflict of interest