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"Does pre-operative embolization reduce the need for perioperative blood transfusion in spine surgery?"

Anesthesia for spine surgery provides many challenges for the anesthesiologist. Considerations include prone positioning, neuromonitoring with compatible anesthetic, acute and chronic pain considerations, in addition to potential large volume blood loss. While blood loss is a common perioperative issue, methods to minimize blood loss are always being explored. One of the goals of such techniques are to reduce transfusion requirements for patients undergoing these procedures. Specifically, patients undergoing oncological spine surgery may have upwards of twice the risk of perioperative complications when receiving transfusion¹. Reduced transfusion not only reduces its inherent risks, but also represents responsible resource stewardship in a public healthcare system. Pre-operative embolization of malignant spine tumours is an intervention used to minimize blood loss.

A common indication for spine surgery is resection of malignant spinal masses. A wide variety of malignancies, metastatic and primary, may affect the spine. Commonly described malignancies of the spine include renal cell carcinoma, myeloma, and cancers of the thyroid, prostate, breast, colon, and lung. A recent retrospective study suggests that roughly a third of oncological spine surgeries require red blood cell transfusion, and when transfusion is required, a mean of 2.75 units of red blood cells are required². Due to the vascular nature of malignancies, presurgical embolization of the lesion is common practice, particularly for highly vascular malignancies like metastatic renal cell carcinoma (RCC). In RCC, embolization is largely considered standard of care³⁻⁶ prior to surgery. While it is intuitive that embolization may reduce blood loss, it's important to consider whether evidence confirms that blood loss is indeed reduced, and furthermore, does that translate into statistically significant reductions in transfusion of blood products. In further risk-benefit analysis, clinicians should also consider embolization complication rates of up to three percent².

There are varying degrees of evidence to support and deny the utility of embolization of spine tumours. There is no denying the theoretically logical benefit of this procedure. As alluded to, RCC is commonly embolized in the body of evidence available and is accordingly considered standard of care³⁻⁶. Despite this, recent studies suggesting that there is not any significant difference in estimated blood loss, nor transfusion of blood products with varying degrees of embolization for RCC^{4,7,8}. Several reasons may be postulated for this. As some level of embolization is common in RCC, one would expect that the higher risk masses on imaging will receive a more extensive embolization and may reduce blood loss and transfusion consequently. Heterogeneity in surgical approaches, technical difficulty, and methods of calculating blood loss may contribute to inconsistent results regarding transfusion and blood loss.

Unsurprisingly, there is also a paucity of evidence supporting the use of embolization in other spinal malignancies, despite attempts with similarly vascular cancers. Multiple recent studies did not find a statistically significant reduction in transfusion or blood loss in any malignancies outside of RCC for any degree of embolization^{4,6,8}. Despite this, two systematic reviews, while recognizing the need for more good quality prospective studies, endorse embolization for RCC

and other vascular malignancies of the spine^{3,9}. This conclusion is multifactorial and may also include considerations such as decreased length of surgery⁸. To achieve statistical significance on reducing blood loss, one study was omitted from the meta-analysis of Luksanapruksha et al³. Similarly in their meta-analysis, Griessenauer et al noted decreasing blood loss over time in studies despite complete embolization rate remaining constant⁹.

Much of the described findings and practices regarding pre-operative embolization of spinal tumours are marred by extremely diverse pathology and surgery. Heterogeneity of surgical approaches required has made well matched studies challenging. Consistently larger blood losses and red cell transfusion requirements are found in corpectomy/vertebrectomy relative to thoracolumbar instrumentation which has greater losses and transfusion requirements than cervical corpectomies independent of the type of malignancy⁶. Additionally, there is heterogeneity of embolization practices with regards to extensiveness of embolization, size of particles used, and agent used in embolization. This variety of practice is not uncommon in such rapidly expanding fields like interventional radiology. Baseline hemoglobin is another well described independent risk of transfusion² that may confound good quality data. A patient without a baseline anemia may tolerate upwards of two liters of blood loss while another anemic patient with the same pathology and extension of disease may only tolerate a third of that blood loss without requiring transfusion, despite pattern of embolization.

Due to such complex pathology, surgery, and embolization techniques, there is not outstanding evidence to either support or deny that transfusion is decreased by pre-operative embolization of spinal tumours. Despite this, the inertia to continue embolizing this patient population will likely continue given the previously described systematic reviews and meta-analyses, sound logic, anecdotal experience, and the multifactorial benefits of embolization outside of transfusion requirements alone.

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