Editorial

Blood loss after total *en bloc* spondylectomy

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Comment on: Smith I, Bleibleh S, Hartley LJ, *et al.* Blood loss in total *en bloc* spondylectomy for primary spinal bone tumours: a comparison of estimated blood loss versus actual blood loss in a single centre over 10 years. J Spine Surg 2022;8:353-61.

Submitted Sep 29, 2022. Accepted for publication Oct 18, 2022.
doi: 10.21037/jss-22-87
View this article at: https://dx.doi.org/10.21037/jss-22-87

First described by Tomita *et al.*, total *en bloc* spondylectomy (TES) refers to a surgical technique used in oncological spine surgery to remove an entire vertebral body and posterior elements as single pieces with the goal of obtaining negative margins (1). *En bloc* removal of primary aggressive and malignant bone tumors such as chordoma, chondrosarcoma, and giant cell tumor allows for improved local tumor control and survival. Occasionally, patients with metastatic disease may also benefit from this approach. This technique differed from the initial description by Lièvre and Stener, in which removal of the diseased vertebral body was done in a piecemeal fashion (2,3). Given the need for extensive tissue dissection, bone work, and prolonged operative time, TES is associated with significant blood loss (4).

In the current issue of *Journal of Spine Surgery*, Smith *et al.* describe their 10-year experience with TES and compare estimated blood loss (EBL) versus actual blood loss (ABL) (5). ABL was calculated based on Gross's formula with the addition of blood transfusion. The study was a retrospective review of 21 patients who underwent TES at a single center between 2005 and 2015. Authors reported data and outcomes on 11 men and 10 women with a median age of 40 years. The three most common tumor types were chondrosarcoma in 43% of patients (9 of 21), chordoma in 33% (7 of 21), and Ewing's sarcoma in 10% (2 of 21). The mean total ABL was 3.3 L for all patients. Compared to ABL, EBL was underestimated in 59% of patients by an average of 78% volume; in the remaining 41% of patients, EBL was overestimated by 43%. Although there was an observed difference between ABL and EBL, these results were not found to be significantly different (P=0.373) (5). Authors concluded that ABL did not differ based on age groups, gender, tumor type, size, or operative stages. On the other hand, operative duration was positively associated with higher ABL.

Strategies to reduce and manage blood loss in TES can be divided into preoperative, intraoperative, and postoperative tactics. Preoperative strategies include careful planning, consultation with appropriate teams (such as thoracic or vascular surgery), preoperative embolization, and preoperative optimization of hemoglobin/hematocrit and any coagulopathies (*Table 1*). Preoperative embolization of vascular tumors (such as giant cell tumor or aggressive hemangiomas) with particles or coils can reduce blood loss, as well as the use of tranexamic acid (6). The anesthesia team should reduce mean arterial pressure intraoperatively to avoid excess blood loss during exposure/access as well as ensure adequate intravenous access for resuscitation.

Intraoperatively, careful hemostasis and surgical technique are also fundamental, as extensive tissue dissection around the tumor and bone work (particularly osteotomies) can result in rapid blood loss. Hemostatic agents such as thrombin-gelatin hemostatic matrix (Surgiflo®, Ethicon Inc., USA), oxidized cellulose (Surgicel®, Ethicon Inc.), purified porcine skin gelatin (Gelfoam®, Pfizer Inc., USA) with thrombin, bone wax, and microfibrillar collagen hemostat (Avitene™, Medline Industries, Inc., USA) can be used to control focal areas of hemorrhage. At our institution,

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Table 1 Strategies to reduce and mange blood loss during total *en bloc* spondylectomy

Strategy
Consultation with other teams such as vascular or thoracic surgery
Preoperative optimization of hemoglobin/hematocrit, coagulopathy
Preoperative embolization of vascular tumors
Sufficient intraoperative vascular access for fluid resuscitation
Central venous pressure monitoring
Tranexamic acid
Careful hemostatic and surgical technique
Hemostatic agents: thrombin-gelatin hemostatic matrix, oxidized cellulose, purified porcine skin gelatin with thrombin, bone wax, microfibrillar collagen hemostat
Sponges, cottonoids
Dual-attending approach
Postoperative cardiac and hemodynamic monitoring
Repletion with red blood cells and blood products as appropriate

microfibrillar collagen hemostat is mixed with Plasma-Lyte 148 inside a 10 cc syringe and used as hemostatic agent (we call it "Avitene™ slushy"). Larger spaces or cavities should be packed with Surgiflo® and sponges or cottonoids. A dual-attending approach has been also shown to reduce blood loss in oncological spine surgery (7). Although authors did not focus on TES, a dual-attending approach resulted in reduction of mean operative time by 82 minutes, reduced mean EBL by 824 mL, and absolute risk reduction in transfusion risk of 33% (7). Postoperatively, patients should be in a unit with capabilities for close cardiac and hemodynamic monitoring. Routine labs are obtained, and repletion with red blood cells or other blood products should be done as needed.

We commend the authors for their efforts and thank them for sharing their institutional experience. The study, however, does suffer from several important limitations. The small sample size likely accounts for the inability to detect statistically significant differences on the performed analyses, particularly the comparisons between ABL and EBL. Although authors mention that EBL is not a reliable predictor for ABL, this was a no-difference study. The lack of other outcomes such as ischemic complications from blood loss or transfusion-related complications is also an important limitation. Future studies examining ABL and EBL are needed in the form of meta-analyses and multi-center collaborations.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the editorial office, *Journal of Spine Surgery*. The article did not undergo external peer review.

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jss.amegroups.com/article/view/10.21037/jss-22-87/coif). RY serves as an unpaid editorial board member of *Journal of Spine Surgery* from November 2021 to October 2023. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Cite this article as: De la Garza Ramos R, Ryvlin J, Yassari R. Blood loss after total *en bloc* spondylectomy. J Spine Surg 2022;8(4):409-411. doi: 10.21037/jss-22-87