



Case Report

Blood preservation techniques in complex spine surgery: Illustrative case and review of therapeutic options

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ABSTRACT

Background: Complex spine surgery predisposes patients to substantial levels of blood loss, which can increase the risk of surgical morbidity and mortality.

Case Description: A 29-year-old achondroplastic male required thoracolumbar deformity correction. However, he refused potential allogeneic blood transfusions for religious reasons. He, therefore, underwent pre-operative autologous blood donation and consented to the use of the intraoperative cell salvage device. Immediately prior to the incision, he underwent acute normovolemic hemodilution. Throughout the case, we additionally utilized meticulous hemostasis. Postoperatively, he was supplemented with iron and erythropoietin and recovered well. When he required a revision procedure 3 months later, similar strategies were successfully employed.

Conclusion: Numerous strategies exist pre-operatively, intraoperatively, and post-operatively to optimize blood loss management for patients who refuse blood transfusions but warrant major spinal deformity surgery.

Keywords: Achondroplasia, Blood loss, Deformity, Spinal fusion, Transfusion

INTRODUCTION

Reconstructive spine surgery often results in significant blood loss.^[8] Allogeneic blood transfusion is often used to prevent these complications, but some patients refuse such transfusions. There are many specialized measures to supplement/supplant greater than anticipated blood loss for spinal deformity surgery. These include red blood cell augmentation with erythropoietin (EPO), plasma volume expansion, cell salvage, and autologous blood transfusions. Here, we present how a patient with achondroplasia successfully underwent extensive thoracolumbar kyphotic deformity surgery utilizing several of these measures.

CASE REPORT

A gentleman with achondroplasia presented to our clinic with worsening mechanical back pain and myelopathy attributed to a progressive T12/L1 kyphosis. Magnetic resonance/Computed tomography (MR/CT) imaging documented a severe thoracolumbar kyphotic deformity with

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the apex at T12-L1. Additionally, the Cobb angle was nearly 90 degrees, with associated draping of the neural elements over the spinal column [Figure 1]. The patient was informed that he required correction of the kyphotic deformity with T12 and L1 transpedicular corpectomies and a T10-L3 decompression with posterior instrumentation and fusion.

Blood product/adjuvant therapy management

For religious reasons, the patient refused heterologous blood transfusions for this surgery. His pre-operative hemoglobin was 14.3 g/dL, and 2 units of autologous blood were harvested from the patient immediately before surgery. He underwent preoperative acute normovolemic hemodilution (PANH) and consented to using an intraoperative cell salvage device. Transpedicular vertebral column resections were performed at the T12 and L1 levels, resulting in circumferential decompression of the thecal sac, and an expandable cage filled with autograft bone was placed between the inferior endplate of T11 and the superior endplate of L2.

Intraoperative blood loss and resuscitative measures

Estimated blood loss during the surgery was approximately 1 l. Intra-operatively, he received the two units of his autologous blood, 600 cc of his own blood products from the cell salvage device, and approximately 2 l of crystalloid/colloid fluid resuscitation. The immediate post-operative hemoglobin was 6.5 g/dL, and he received iron and EPO supplements. He remained neurologically and hemodynamically stable.

Postoperative course

Post-operatively, the patient's neurological exam remained unchanged. Imaging demonstrated expected post-surgical changes, adequate instrumentation placement, and improvement of the kyphotic deformity at T12/L1. 1 month later, the patient represented to with progressive paraparesis and urinary retention. Standing thoracolumbar X-rays revealed a worsening kyphotic deformity [Figure 2]. The CT Myelogram demonstrated severe stenosis with a near-complete myelographic block from T11-L1 with proximal junctional kyphosis and stenosis.

Second surgery and hematological management

For 3 days prior to the second spine operation consisting of extension of the fusion to the T9 level, the patient underwent EPO supplementation, PANH, with intraoperative utilization of the cell salvage device. Blood loss was approximately 500 cc. Post-operatively, he restarted EPO and iron supplementation and was ultimately discharged home. His hemoglobin on postoperative day 30 recovered to 11.8, and his EPO was

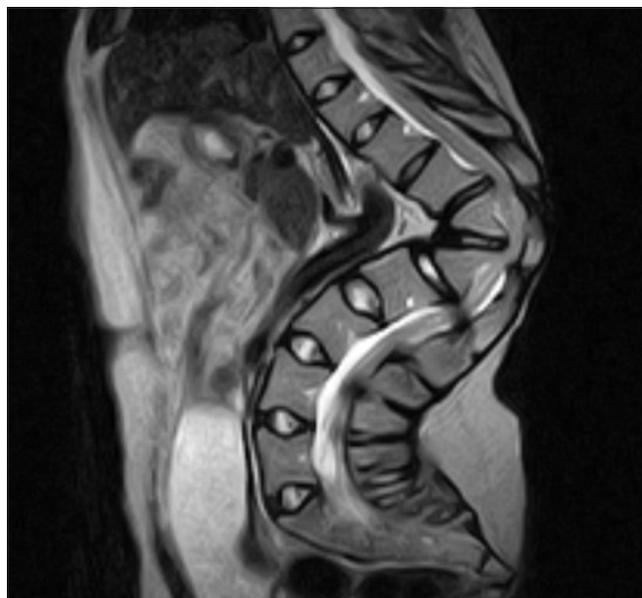


Figure 1: Sagittal magnetic resonance imaging demonstrating a severe kyphotic deformity at the T12-L1 level with impingement of the neural elements at T12-L1.

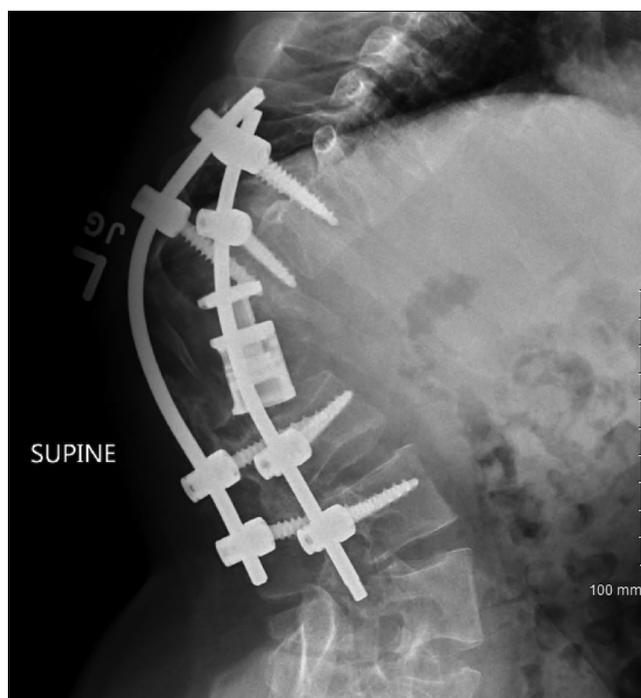


Figure 2: Standing thoracolumbar X-ray demonstrating worsened post-operative kyphosis.

discontinued. 1-year later, his mechanical back pain had improved as had his paraparesis. Figure 3 demonstrates improved alignment after surgical deformity correction. He no longer relies on a wheelchair, is able to ambulate short distances with a cane, and his sphincter function continues to improve.



Figure 3: Standing post-operative thoracolumbar X-ray demonstrating improved alignment after kyphotic deformity correction.

DISCUSSION

Perioperative and intraoperative techniques

For patients who decline autologous blood transfusions for major spinal deformity surgery, the use of immediate preoperative blood donation (PABD) and PANH techniques to support perioperative hemoglobin levels are well known. Our patient underwent PABD and PANH, which minimized his need for postoperative allogeneic transfusions.^[1] PANH is well-suited for young patients with normal preoperative hemoglobin (>11 g/dL) and unimpaired renal, hepatic, and cardiac function,^[7] which is why we employed this strategy. In addition, our patient was amenable to using the cell salvage device, and 600 cc of his blood was reprocessed during the surgery. Cell salvage techniques are most effective for surgeries with extensive soft tissue dissection and bony work, and they are associated with reduced overall cost and blood loss in surgical spine cases with a projected EBL greater than 614 cc.^[5]

Postoperative techniques

Our patient was supplemented perioperatively with recombinant EPO to stimulate endogenous hemoglobin production and facilitate the function of erythroid

precursor cells.^[2] EPO has been shown to increase preoperative hemoglobin levels and decrease transfusion requirements in patients undergoing orthopedic surgery procedures.^[9] Further, while our patient did not receive a postoperative blood transfusion, up to 30% of major spinal procedures warrant one.^[6] A review of 31 clinical trials, including nearly 13,000 participants across multiple surgical specialties, revealed that restrictive transfusion thresholds did not change the risk of 30 day mortality compared to more liberal transfusion thresholds.^[3] However, liberal use of blood transfusion in multilevel spine surgery can be associated with an increased rate of postoperative infection.^[4]

CONCLUSION AND AUTHORS' PREFERRED TREATMENT RECOMMENDATIONS

Blood loss management remains a crucial topic of study in complex spine surgery. Here, thoracolumbar spine deformity correction in a 29-year-old achondroplastic warranted preoperative and postoperative iron and EPO supplementation, immediate preoperative autologous blood donation with PANH, and intraoperative cell-salvage techniques.

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Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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