

Hidden blood loss in patients undergoing segmental pedicle screw instrumentation for syndromic scoliosis and predictors for bleeding: a case-control study

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Introduction

Syndromic scoliosis (SS) is associated with an underlying condition and the incidence of scoliosis in this group is significantly higher than in the general population. Patients with SS typically have large, progressive curvatures that often require surgery. SS is associated with larger blood loss during deformity correction with segmental pedicle screw instrumentation compared to adolescent idiopathic scoliosis (AIS). Total blood consists of measured i.e. intraoperative or drain output, and blood loss not visualized (defined as hidden blood loss). The latter represents up to 30% of the total blood loss in patients undergoing instrumented posterior spinal fusion for AIS while evidence for SS is lacking. We aimed to investigate the total and hidden blood loss for SS and potential predictors for blood loss.

Materials and Methods

A retrospective case-control study in children undergoing segmental pedicle screw instrumentation for SS between 2009 and 2025. For each SS patient, 2 controls with AIS were matched for sex and age. All patients were identified in the institutional pediatric spine register.

Results

62 SS patients (median age 14.9 years [IQR 2.8]) and 124 AIS patients (15.1 years [3.0]) were included. 38 SS patients were female (62%). Total bleeding and measured blood loss were larger for SS (1520 ml [IQR 950] vs. 1050 ml [480], $p < 0.001$ and 1190 ml [770] vs. 940 ml [600], $p = 0.006$, respectively). No difference was evident regarding HBL (170 ml [650] vs. 80 ml [470], $p = 0.118$). Operative time and number of levels fused were larger in SS ($p < 0.001$). No significant difference was observed when adjusting total, hidden or measured blood loss for operative time ($p = 0.17$, $p = 0.24$ and $p = 0.70$ respectively). Longer operative time, older age and larger size of erythrocytes were associated with larger total blood loss in SS ($p < 0.05$ for all correlations). Hidden blood loss was inversely correlated with longer operative time ($r_s = -0.47$, $p < 0.001$).

Conclusion

Total and measured blood loss was higher in SS compared to AIS. Hidden blood loss was similar in the study groups and represented 11% of total bleeding in SS. Longer operative time, older age, and larger erythrocyte size were associated with larger total blood loss.

Characteristics	Syndromic Scoliosis (n=62)	Adolescent Idiopathic Scoliosis (n=124)	P-value for difference between groups
Age, years	14.9 [2.8]	15.1 [3.0]	0.288
Weight, kg	41.3 [25.1]	55.9 [15.6]	< 0.001
Body Mass Index (BMI), kg/m2	19.2 [7.51]	20.0 [4.0]	0.173
Operative time, hours	3.8 [1.2]	2.9 [1.1]	< 0.001
Levels fused, n	15.5 [4.0]	11.0 [2.0]	< 0.001
Total blood loss, ml	1520 [950]	1050 [480]	< 0.001
Estimated blood volume, ml	2860 [1470]	3730 [1100]	< 0.001
Measured blood loss, ml	1190 [770]	940 [600]	0.006
Hidden blood loss, ml	170 [650]	80 [470]	0.118
Calculated blood loss, ml	1200 [730]	950 [480]	0.015
Blood loss adjusted for operative time, ml/hour			
Total	400 [230]	350 [180]	0.173
Measured	340 [210]	310 [160]	0.698
Hidden	50 [170]	30 [180]	0.244

Table 1. Patient characteristics. All values are median [IQR]

Syndrome:	Number of patients (n)
Neurofibromatosis Type 1	5
Arthrogryposis	4
CATCH-22	4
Angelman syndrome	4
Down syndrome	3
Rett syndrome	3
Osteogenesis imperfecta	2
Ehlers-Danlos syndrome	2
Prader-Willi syndrome	2
Marfan's syndrome	2
Charcot-Marie-Tooth	2
Other	29

Table 2. Most common syndromes in patients with syndromic scoliosis (n=62)