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A clinical study regarding the outcomes of symptomatic spinal epidural haematoma after adult spinal deformity surgery

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Abstract

Symptomatic spinal epidural haematoma (SSEH) is a rare but serious postoperative complication. This study aimed to assess the prevalence, causes and treatment of SSEH after adult spinal deformity (ASD) surgery. The patients admitted from August 2012 till August 2016 were retrospectively reviewed using case notes. During these four years, 102 patients were admitted with adult spinal deformity, out of which 3 (2.9%) developed post-operative SSEH. The duration between surgery to onset of SSEH was 10-13 hours (average 11.7 hours) post-operatively. Three patients were treated by haematoma evacuation at 8.5-14 hour (average 11.4 hours) after the symptoms appeared. One patient had improved by 2 Frankel grades, and two patients had improved by1 Frankel grade at the last follow-up. The results concluded that post-operative SSEH occurred in 2.9% of ASD patients who underwent corrective spinal procedures. Improvement in neurological deficits can be achieved by early haematoma evacuation.

Keywords: symptomatic spinal epidural haematoma; postoperative complication; adult spinal deformity; treatment

Introduction

Different degrees of epidural haematoma can be identified by computed tomography (CT) scans and magnetic resonance imaging (MRI).The prevalence of asymptomatic epidural haematoma has been reported in the literature as 33-100%.[1-3] Most post-operative epidural haematomas are clinically asymptomatic and do not require surgical intervention. However, symptomatic spinal epidural haematoma (SSEH) following spine surgery is a serious post-operative complication which can result in fatal neurological deficits, including bowel and bladder incontinence, saddle anaesthesia, sciatica and motor weakness of the extremities and reduced sexual performance. The prevalence rate is 0.1-1.0% for SSEH, which requires immediate surgical evacuation of the haematoma.[4-9] Risk factors, such as multilevel procedures, substantial blood loss and advanced age, have been identified for the development of SSEH after spine surgery.[1,7,10] Usually, these risk factors are associated with adult spinal deformity (ASD). However, the prevalence, risk factors and proper management of SSEH in ASD patients undergoing corrective spinal procedures is unknown. Thus far, only a few cases of SSEH after adult spinal deformity surgery have been reported.[11] The aim of this study was to assess the prevalence, causes and outcomes of SSEH after ASD surgery.

Case Series

A retrospective search for post-operative SSEH was conducted on patients presenting with adult spinal deformity in Fuzhou Second Hospital affiliated to Xiamen University, China, from August 2012 till August 2016. Adults with spinal deformity who underwent corrective spinal procedures for scoliosis, kyphosis, or kyphoscoliosis at this institution were included. The preoperative diagnosis included degenerative scoliosis in 58 cases, post-traumatic scoliosis in 24 cases, ankylosing spondylitis kyphotic deformity in 5 cases, idiopathic scoliosis in 11 cases, congenital scoliosis in 3 cases and neuromuscular scoliosis

in l case. Those with infective spondylitis, epidural abscess and spinal trauma were excluded.

The diagnosis of SSEH was made on the basis of the development of neurological deficits and was confirmed by CT scans, MRI assessment or a surgical finding. Once an SSEH had been identified on CT or MRI, the patient was treated with emergent haematoma evacuation. Meanwhile, intravenous Methylprednisolone, 30 mg/kg over 15-30 minutes, was started, followed by maintenance infusion of 5.4 mg/(kg/hr) for another 23 hours, even after haematoma evacuation.

Study data and medical records, including patients' demographics, neurological examination, intraoperative variables, symptoms of the post-operative epidural haematoma, duration to onset, duration from onset to evacuation, recovery rate (Frankel grade), and neurological outcomes, as well as plain radiographs, MRI and CT, of patients who developed SSEH after ASD surgery, were collected. For this study, we only used information from patients' records.

Results

In total, 102 patients were included in the study, and 3 (2.9%) patients were identified with post-operative SSEH, of which two were males and one female. The average age of the patients was 56.3±9.3 years (range 50 to 67). Their original diagnoses, for which the first operation was performed, were degenerative scoliosis, post-traumatic kyphoscoliosis and idiopathic spinal scoliosis. The operation sites were all located in the lumbar spine. Preoperative prothrombin times and blood platelet counts were all within normal limits.(Table 1).

None of the patients had symptoms in the immediate post-operative period, and the duration to onset of symptom was 10-13 hours (average 11.7 hours). All patients showed motor weakness and sensory loss in the lower extremities. One patient experienced severe radicular pain, and one patient had incisional pain.

To reduce incision bleeding after surgery, haemostatic agents (Hemocoagulase, 1 ku/dose, intramuscular injections at 1 and 2 hours after surgery) were administered in two patients (patients 1 and 3). The total volumes of wound drainage were 800 ml, 470 ml and 615 ml (average 628.3 ml) when symptoms appeared, respectively. After that, the drainage decreased sharply. The drainage volumes were 20 ml, 50 ml and 180 ml (average 83.3 ml) from onset to evacuation. Meanwhile, progressive deterioration of neurological functions was observed. The Frankel grades of the three patients were C, B and C, respectively, with manual muscle test (MMT) scores <3.

Imaging evaluations before haematoma evacuation, such as MRI and/or CT, were performed in these three patients, and all were diagnosed with SSEH. The MRI showed compressed dural sac. The signal characteristics of the lesions included isointense or decreased signal intensity on T1-weighted images and heterogeneous intensity on T2-weighted images. The CT scans showed moderate-to-high density changes in the epidural space.

Haematoma evacuation was performed between 8.5 hours and 14 hours (average 11.4 hours) after the symptoms appeared. The original surgical site of each patient was re-explored, the clot was evacuated, and drainage tubes were reinserted until haemostasis was achieved. All of the patients had drains during the immediate post-operative period. Compression of the dural sac by haematoma was identified intraoperatively in all three patients. Drainage tubes were blocked by clots in two patients who received haemostatic agents, while active bleeding emanating from the anterior internal vertebral venous plexuses was found in patient 2.

The strength of the lower extremities, especially the proximal area, began to improve on the first day after evacuation. MMT scores increased by one grade at one week and 2-3 grades at two weeks. The patients were followed up for 16-23 months (average19.3 months). One patient (patient 2) improved by 2 Frankel grades,[12] while the others improved by 1 Frankel grade at the last follow-up. A

short interval from symptom onset to evacuation seemed to be related to good clinical outcome.

Discussion

After spinal surgery, patients may present with varying degrees of epidural haematoma, most of which are clinically asymptomatic. Post-operative epidural haematoma has been reported to occur in 33% to 100% of patients after spinal surgery,[1-3] while the prevalence of symptomatic epidural haematoma that requires surgical haematoma evacuation is only 0.1% -1.0%.[4-9] In our study population, the overall rate of post-operative SSEH was 2.9%, which was higher than that of previous studies because only ASD patients were included in our study. Postoperative SSEH is a rare but serious postoperative complication that results in increased morbidity, mortality, and worsening of neurologic outcome.[6] Rapid diagnosis of SSEH is critical for the restoration of neurological function. Clinicians should consider a diagnosis of SSEH if there is a change in the patient's neurological status during the first several hours after spinal surgery.[13] The symptoms of SSEH aresevere incisional pain, radicular pain, bladder dysfunction, motor weakness and sensory loss.[14] In our study, all three patients showed motor weakness and sensory loss of the lower extremities. One patient experienced severe radicular pain, and one patient had incisional pain. SSEHs usually occur within 24 hours after surgery, especially 4-6 hours post-operatively.[10,15] As in previous studies, the duration to onset of symptom in our study was 10-13 hours (average 11.7 hours). Therefore, the neurological status of the patients should be carefully and frequently evaluated within 24 hours after spinal surgery.

MRI examination plays an important role in the diagnosis and treatment of SSEH after spinal surgery. Previous studies showed that post-operative SSEH may present as a haematoma extending into non-decompressive segments,[1,14,16]

a haematoma at a site away from the main surgical procedure,[17] or a haematoma with asymmetrical neurological symptoms that differed from preoperative symptoms. MRI can be used to determine the location, extension range of haematoma and the degree of dural compression, and is necessary for surgical localisation and strategy making. T1-weighted images showed SSEH as heterogeneously isointense at the acute stage and markedly hyperintense at the early subacute stage, while T2-weighted images showed SSEH as hyperintense and isointense both at the acute and subacute stages.[18]

Since SSEH may cause fatal neurological deficits, it is particularly important to identify patients at high risk of developing SSEH.[4,9,14] Sokolowskiet al[1] reported that advanced age, multilevel procedures, and international normalised ratio (INR) are independently associated with post-operative haematoma volume in a prospective study. The risk factors of SSEH include advanced age, previous spinal surgery, alcohol consumption greater than 10 units a week, multilevel procedure (>5 operative levels), a haemoglobin level < 10 g/dL, blood loss > 1 L, and an INR > 2.0 within the first 48 hours.[4,7,9,10] The procedure for ASD patients is usually long-segment fusion and typically results in massive blood loss; three patients in our study had an average of 9.3 segments fixed and an average blood loss of 1,967 ml. Two patients were given haemostatic agents, which may be the direct cause of SSEH. It has not been reported whether haemostatic agents should be used in patients with a high volume of incision bleeding after spinal surgery. However, based on the experience of our centre, it is suggested that post-operative haemostatic agents should be used with caution.[19] It is also controversial whether anticoagulant administration after spinal surgery raises the risk of haematoma. Most studies suggest that the prophylactic use of anticoagulants did not increase the incidence of post-operative SSEH, but the treatment dose of anticoagulants increased the incidence of SSEH.[6]

Post-operative bleeding in the wound and inadequate drainage are the primary

causes of SSEH.[20] In our study, one patient had active bleeding emanating from the anterior internal vertebral venous plexuses. Therefore, it is necessary to detect the bleeding point and perform accurate haemostasis intraoperatively. Most studies suggested that drainage tubes can drain the blood out of the incision but cannot prevent the occurrence of SSEHs. The size of the incisional haematoma is not related to the diameter of the drainage tube.[21] However, Mirzai et al[22] found that insertion of a drain decreases both the incidence and the size of haematomas on the first postoperative day as detected by MRI. Furthermore, to decrease the occurrence of haematoma, precise decompression, proper use of haemostatic materials and avoidance of excessive destruction of intraspinal venous plexus should be achieved.

Our indications for surgical haematoma evacuation were progressive paralysis (MMT score < 3) and unbearable neurogenic (radicular) pain. For SSEHs with mild paralysis (MMT score=4 or mild pain), the haematoma may be absorbed, and conservative treatment may be considered. For SSEHs with mild paralysis but severe dyspepsia, should be closely observed.[15,23] However, haematoma evacuation was not performed as early as possible in all three patients. In fact, the average time from symptom onset to haematoma evacuation was 11.4 hours, and the average time from imaging examination to haematoma evacuation was 3.7 hours. Based on our experience, for patients with rapidly progressive neurological dysfunction, especially those who cannot receive an MRI examination as soon as possible, it is better to perform haematoma evacuation directly without waiting for imaging evaluation.[13]

It is suggested by most studies that haematoma evacuation should be performed as soon as possible, as the impact of a delayed evacuation can result in disabling catastrophic neurological sequelae.[10,14,24] Yi et al[14] summarised the clinical outcome of nine patients with SSEH and revealed complete recovery in three(33.3%) cases, incomplete recovery in five(55.6%) cases and no change in one(11.1%) case. Normally, neurological and functional outcomes of patients

with SSEH often depend on the severity of the symptoms and the duration from onset to evacuation.[8,13,14,25,26] Patients who underwent surgical evacuation within 12 hours of the onset of initial symptoms were the most likely to make a complete recovery.[27] Amiri et al[10] found that patients who had evacuation surgery within six hours of the onset of initial symptoms improved 2 Frankel grades, and those who had surgery more than six hours after the onset of symptoms improved 1 Frankel grade. Evacuation of an SSEH was performed between 8.5 hours and 14 hours (average 11.4 hours) after symptoms appeared in our three patients; one patient improved by 1 Frankel grade and two patients improved by 2 Frankel grades at the last follow-up. Permanent sphincter dysfunction or paralysis may result if evacuation is performed later than 36 hours.[28]

Conclusion

Post-operative SSEH occurred in 2.9% of ASD patients undergoing corrective spinal procedures. Post-operative haemostatic agents should be used with caution. Improvement in neurological deficits can be achieved by early evacuation of haematomas. However, the major limitations of our study were: 1) the difference of clinical features between SSEH and non-SSEH cases had not been compared; 2) risk factors of SSEH had not been figured out. There is a pressing need for further, large-scale research to confirm and evaluate the risk factors and treatment outcomes of postoperative SSEH after ASD surgery.

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Table1: Patient Profile

No.	Sex/Age	Diagnosis	Fusion levels	Osteotomy	First operation duration (h)	Blood loss (ml)
1	M/67	degenerative scoliosis	T10-S1	partial facetectomy	4.7	1400
2	F/52	post-traumatic kyphoscoliosis	T10-L4	PSO (L2)	7.1	2100
3	M/50	idiopathic spinal scoliosis	T5-L4	VCD (L1)	11.4	2400

PSO, Pedicle Subtraction Osteotomy; VCD, Vertebral Column Decancellation

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Table 2: Summary of Clinical Presentation and Outcome

No.	Symptoms	Duration to onset (h)	Duration from onset to evacuation (h)	Frankel grade			Follow up (m)
				Preoperation	Onset	Last follow-up	
1	motor/sensory, radicular pain	12	14	E	C	D	23
2	motor/sensory	10	8.5	D	B	D	16
3	motor/sensory, incision pain	13	11.8	E	C	D	19