

경추 손상 후 뇌척수액 유출에 대한 관리

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- Abstract -

Management of Cerebrospinal Fluid Leak after Traumatic Cervical Spinal Cord Injury

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Purpose: Traumatic cervical SCI is frequently accompanied by dural tear and the resulting cerebrospinal fluid (CSF) leak after surgery can be troublesome and delay rehabilitation with increasing morbidity. This study evaluated the incidence of intraoperative CSF leaks in patients with traumatic cervical spinal cord injury (SCI) who underwent anterior cervical surgery and described the reliable management of CSF leaks during the perioperative period.

Methods: A retrospective study of medical records and radiological images was done on patients with CSF leaks after cervical spine trauma.

Results: Seven patients(13.2%) were identified with CSF leaks during the intraoperative period. All patients were severely injured and showed structural abnormalities on the initial magnetic resonance image (MRI) of the cervical spine. Intraoperatively, no primary repair of dural tear was attempted because of a wide, rough defect size. Therefore, fibrin glue was applied to the operated site in all cases. Although a wound drainage was inserted, it was stopped within the first 24 hours after the operation. No lumbar drainage was performed. Postoperatively, the patients should kept their heads in an elevated position and early ambulation and rehabilitation were encouraged. None of the patients developed complications related to CSF leaks during admission.

Conclusion: The incidence of CSF leaks after surgery for cervical spinal trauma is relatively higher than that of cervical spinal stenosis. Therefore, one should expect the possibility of a dural tear and have a simple and effective management protocol for CSF leaks in trauma cases established.

Key Words: Spine trauma, Cerebrospinal leakage, Dura tear, Cervical spine

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I. Introduction

Traumatic spinal cord injury (SCI) leads to varying degrees of motor and/or sensory deficits and reduces the quality of life, as well as increases the morbidity and mortality.(1-3) According to extensive literature on descriptive epidemiology of traumatic SCI, the proportion of cervical spinal injuries is increasing, and the average age at injury is also increasing according to an aging general population which is at risk.(3) Traumatic cervical SCI develops from cervical fractures and dislocations, acute intervertebral disc ruptures, vertebral body fractures, and sometimes from spinal stenosis without spinal instability after injury.(4-7) Traumatic central cord syndrome is the most common clinical feature and accounts for up to 70% of all incomplete cervical cord injuries.(8,9) Although there are controversies on the optimal timing of the surgery, surgical techniques and approaches for traumatic cervical SCI have been facilitated by the development of the Subaxial Injury Classification (SLIC) scoring system.(6,10) Traumatic cervical SCI is frequently accompanied by a dura tear; consequentially, a cerebrospinal fluid (CSF) leak after anterior cervical spine surgery can be troublesome and delay rehabilitation with increasing morbidity. Although various techniques have been described to manage CSF leak related complications after surgery for degenerative spinal disease,(11-17) there are no reports describing

the management of CSF leaks after traumatic cervical SCI. Therefore, we reviewed the incidence of CSF leaks after traumatic cervical SCI and described an effective method to manage CSF leaks during the perioperative period.

II. Materials and Methods

A total of 134 consecutive patients who underwent surgery for acute cervical spine trauma between 2004 and 2011 were identified. Among these, patients who were treated with the anterior or the anterior and posterior approach of the cervical spine and whose operative level was C3 and below were further evaluated, and patients with CSF leaks during the intraoperative period identified from the operative records were included. The patients who were treated with only the posterior approach and whose operative level was C1 or C2 were excluded. A retrospective study using medical records and radiological images was carried out for patients with CSF leaks after cervical spine trauma.

III. Results

Fifty-three patients were treated with the anterior or circumferential operative approach after cervical spine trauma with 7 patients(13.2%) having a CSF leak during the intraoperative period according to the operative record. Among the 7 patients, 6

Table 1. Demographics of patients who had CSF leaks

No.	Sex	Age	Injury mechanism	Initial ASIA score	Neurologic level	Operative approach
1	M	57	Fall above 1 m (High energy)	A	C6	Anterior (Corpectomy)
2	F	50	MVA ^a (High energy)	A	C4	Anterior and posterior (ACDF ^b with PSF ^c)
3	M	67	Fall above 1 m (High energy)	A	C5	Anterior (ACDF)
4	M	17	MVA (High energy)	B	C4	Anterior (ACDF)
5	M	22	Fall below 1 m (Low energy)	A	C5	Anterior (Corpectomy)
6	M	40	Striking by heavy something (High energy)	A	C6	Anterior (ACDF)
7	M	60	MVA (High energy)	A	C5	Anterior and posterior (ACDF with PSF)

MVA^a: motor vehicle accident, ACDF^b: anterior cervical discectomy and fusion, PSF^c: posterior screw fixation

were men and the mean age at the time of operation was 49.12 ± 18.15 years (range, 17~67). The injury mechanism was mostly from a high energy source: motor vehicle accident for 3 patients, a fall above 1 m for 2 patients, and being struck by something heavy for 1 patient. Only 1 patient had a low energy injury mechanism: a fall below 1 m (Table 1).⁽¹⁸⁾ The initial American Spinal Injury Associate (ASIA) score was A in 6 patients and B in 1 patient. The neurological level was C4 in 2 patients, C5 in 3 patients and C6 in 2 patients.

1. Preoperative imaging

All patients were preoperatively evaluated using X-ray, computed tomography (CT) and magnetic resonance imaging (MRI). The cervical lateral X-ray



Fig. 1. Preoperative MRI of a traumatic cervical spine at C6-7. Sagittal T2-weighted image shows the disruption of the ALL (A) and intervertebral disc. The disruption of the PLL is shown (B) as well as the disruption of the ligamentum flavum (C). This patient's dural tear and resulting CSF leak were identified during the operation

and CT showed a facet fracture and dislocation in 5 patients and a vertebral body fracture in 2 patients. All patients showed disruption or displacement of the anterior longitudinal ligament (ALL) and posterior longitudinal ligament (PLL), a high signal intensity of the intervertebral disc and spinal cord, and disruption of the ligamentum flavum on the initial cervical spine MRI (Fig. 1).

2. Intraoperative findings

After the standard anterior cervical approach, ALL injury was found in 4 patients and intervertebral disc injury was found in 7 patients. During discectomy, PLL injury and simultaneous dural tear were found in 7 patients. A resulting CSF leak from the dura tear was noted in all patients. Primary repair of the dural tear was not attempted because of severe laceration of the dura. Fibrin glue (Green plast[®], Green Cross, Seoul, Korea) was applied to the dura in all cases. Among these cases, 2 of them received the TachoComb[®] in addition to fibrin glue (Torii Pharmaceutical, Tokyo, Japan). There were no confirmed persistent CSF leaks on the operated site. Then, one level anterior cervical discectomy and fusion (ACDF) and corpectomy using autologous iliac bone graft and anterior plating was performed in 5 patients and 2 patients, respectively. At closure, one submuscular Jackson-Pratt (JP) drainage was inserted and the wound was closed layer by layer. Additionally, 2 patients who did not achieved reduction of the facet dislocation in the anterior approach had lateral mass screw fixation performed. Postoperative lumbar CSF drains were not inserted in all the patients.

3. Perioperative management

After the operation, the patients kept their heads in an elevated position and were allowed to do any activities they could manage. The JP drainage was removed within the first postoperative day and the drainage amount was 70.6 ± 51.7 cc (range, 31~160). Rehabilitation started as soon as possible.

4. Hospital course

The perioperative complications developed including pneumonia in 4 patients, urinary tract infection (UTI) in 1 patient, and bacteremia and sepsis in 1 patient. None of the patients developed complications related to their CSF leak such as wound dehiscence, meningitis, and pseudomeningocele. ASIA score at discharge was A in 4 patients, B in 2 patients and C in 1 patient.

IV. Discussion

Traumatic cervical SCI is frequently accompanied by dural tears and the resulting CSF leak after anterior cervical spine surgery can be troublesome, delay rehabilitation and increase morbidity. Although direct repair is the optimal treatment modality in most cases of dural tears in all spinal regions, primary dural repair is difficult in trauma cases.(11-13) Moreover, although various techniques have been described to manage CSF leak related complications after surgery for degenerative spinal diseases,(11-13) there are no reports on cervical spine trauma. Thus, the authors of this study suggest a simple, effective method to manage CSF leaks during the perioperative period.

The incidence of cervical dural tears and CSF leaks after anterior decompression procedures have ranged from 0.5% to 3%.(13) For ossification of the posterior longitudinal ligament (OPLL), the incidence is much higher, ranging from 4.3% to 32%.(11,13) The most common cause of CSF leaks is injury to the dura while resecting the posterior longitudinal ligament. Thus, OPLL itself is a risk factor for dural tears and as a consequence, CSF leaks.(19) However in trauma cases, dural tears mostly developed at the moment of injury. In the present study, 7 patients(13.2%) had dural tears. The incidence after cervical spine trauma was as frequent as that in OPLL. All patients who had a CSF leak showed a disruption or displacement of the ALL, PLL and ligamentum flavum and high signal intensity of the intervertebral disc and spinal cord on the initial MRI. Hence, a dural tear by spine trauma could be predicted on the preoperative MRI when it shows

injury of the ligament, intervertebral disc and spinal cord. Additionally, the surgeon should predict the possibility of an intraoperative CSF leak in these cases. If injury to the dura is observed during the surgery, primary repair with microsurgical sutures could be attempted. Although primary repair frequently is not technically feasible, various repair techniques with gelatin foam, fibrin glue, collagen matrix, fat and fascia grafts, biological grafts, synthetic materials, blood patch or microdural stapling have been described to manage dural tears intraoperatively. Additionally, wound drain, lumbar drain, lumboperitoneal or wound-peritoneal shunts, or ventriculostomy have been described to manage CSF leaks during the postoperative period.(13,20-22) The authors' policy for managing CSF leaks consisted of first primary repair of the identified dura tear in spinal surgery for degenerative spinal disease and spinal tumors. However, if primary dural repair was not feasible, duraplasty was attempted and then fibrin glue was applied over the surgical site. Wound drains were not routinely inserted, especially in surgical cases with small incisions or intradural surgery. Although a wound drain was inserted at closure, the drain was removed if CSF appeared in the drain tube or bag, and the tube was clamped and removed regardless of the drainage amount.(23) Additionally, lumbar drainage was not inserted after the operation. Instead, the patients were not allowed bed rest and encouraged to ambulate. If CSF collection under a surgical wound did develop, it would be observed unless the symptoms were related to an airway obstruction. Over time, CSF collection gradually disappears.(23) Besides trauma cases, dural tears and the resulting CSF leaks already existed before the operations accompanied simultaneously by PLL tears. However, it was not an iatrogenic result. PLL is believed to provide stability to the cervical spine and the removal of the PLL could lead to a decrease in cervical stability after surgery.(24) However, the removal of the PLL was helpful in getting more decompression in the anterior approach for cervical spondylotic myelopathy (CSM) although more technically demanding.(25) In the operative procedure, the further resection of the PLL was not meaningful in the trauma cases

because the purpose of the operation was to stabilize the unstable spine. Therefore, if CSF leak was observed during the discectomy, we did not try further resection of the PLL to avoid further dural defect. Primary dural repair was not possible and duraplasty was also not successful due to a wide, rough defect of the dura. Application of fibrin glue was the most useful method. At closure, wound drainage was inserted to evacuate hematoma from the edematous prevertebral soft tissue after cervical trauma. However, it was stopped within the first 24 hours after operation. The most important management protocol was to encourage early ambulation and rehabilitation. During the hospital course, none of the patients developed complications related to their CSF leak such as wound dehiscence, meningitis, and pseudomeningocele. Therefore, we recommend head elevation and early ambulation to decrease intracranial pressure and early removal of wound drains to increase the pressure of the subcutaneous space. The use of CSF diversion through lumbar drainage for the treatment of CSF leaks is well documented.(13,19,20,26) Although effective in treating CSF leaks, the use of lumbar drains is associated with infection, over-drainage of CSF and pneumocephalus with brainstem compression.(26–28) While the standard position of patients with lumbar drainage is bed rest to prevent over-drainage of the CSF, bed rest may increase the risk of postoperative morbidity due to the development of deep venous thrombosis and pulmonary embolism after prolonged immobilization.(29) The present study had a relatively small number of cases and a short follow-up period. However, the authors feel it is important to report on the management of CSF leaks after trauma to the cervical spine.

V. Conclusion

The incidence of CSF leaks after surgery for cervical spinal trauma is relatively higher than that of cervical spinal stenosis. In trauma cases, the surgeon can predict the possibility of dural tears on the preoperative MRI. Intraoperatively, if a dural tear and the resulting CSF leak are observed, then further resection of the PLL may not be attempted to

prevent further damage to the dura. Thus, applying fibrin glue on the operated site is the most useful method. Moreover, the patients should be positioned with their heads elevated and early ambulation should be encouraged as well as rehabilitation without any postoperative lumbar drains.

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