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Original Article

Prevention of CSF leak from the spinal operation site due to traumatic or iatrogenic Dural injury

DOI: https://doi.org/10.32007/jfacmedbagdad.612918.

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J Fac Med Baghdad
2019; Vol.61, No .2
Received April, 2019
Accepted Sep., 2019
Published: Dec. 2019

Abstract:

Background: Cerebrospinal fluid leak is a relatively common problem ranging from 0.5% to 18% with traumatic or incidental injury to the Dura intra-operatively[1, 2]. Traumatic injury mostly occurs due to mechanical trauma with subsequent thecal sac laceration mainly in the thoracolumbar region. Incidental Dural injury commonly happens in patients undergoing spinal surgery for any reason.

Objective: Introduce a maneuver to be used during operations when the patients have either traumatic or iatrogenic injury to the Dura which would prevent CSF leak post-operatively.

Method: A case series study conducted in Baghdad, medical city, between June 2014 and March 2018 on 250 patients (45 females and 205 males) who had either traumatic or iatrogenic injury to the Dura. The operative technique introduced by Perry was used as a reference[1]. The maneuver used in this study to manage CSF leak intra-operatively described here in this study for comparison with other articles.

Results: In this study 250 cases out of 2500 spinal surgery cases, were diagnosed intra-operatively to have Dural injury either post-traumatic or incidentally during surgery. Dural injury occurred in 70 electively operated cases either incidentally or in cases of Dural exploration for different spine pathologies, of whom 13 patients (5.2%) had spinal surgery at the same site previously.

Conclusions: Proper identification of intraoperative CSF leak is crucial for prevention of post-operative complications. CSF leakage can be prevented by applying and reinforcing all surgical field layers with watertight sutures.

Key words: CSF leak, Spine, Dura, Trauma, Iatrogenic.

Introduction:

Cerebrospinal fluid leak is a relatively common problem ranging from 0.5% to 18% with traumatic or incidental injury to the Dura intra-operatively1, 2. Traumatic injury mostly occurs due to mechanical trauma with subsequent thecal sac laceration mainly in thoracolumbar region. Many studies have shown that this injury is mostly associated with neurological deficit either due to neural element laceration or avulsion. Incidental Dural injury commonly happens in patients undergoing spinal surgery for any reason with increasing incidence in older patients and in revision surgery. They can occur in any region of the spine. Diagnosis can be made directly intraoperativly by observing clear fluid leaking directly from the thecal sac or indirectly when excessive epidural bleeding with or without thecal sac collapse3. As a result the patients may have symptoms referred to as Intracranial Hypotension manifested by postural Headache, nausea, vomiting, vertigo, cranial nerve disorders, photophobia and radiculopathy. In addition to the clinical picture, magnetic resonance imaging is the main diagnostic tool2, 3. During surgery, the Dura is opened through the dorsal midline and can be sutured directly with a low risk of leak post-operatively. Problems occur when the injury is situated either far laterally or ventrally. In this case, some surgeons use a fat graft applied over the injury site of the Dura in addition to fibrin glue directly over the fat to give more strength1. The most common complication resulting from this leak is bacterial meningitis which may cause significant morbidity. In addition, as a result of scarring, which anticipated post-operatively, significant neurological deficit and fistula may occur as a complication. Pseudomeningocele, where patients experience a fluctuant cyst at the site of the surgical wound postoperatively, may also be a complication. This happens when CSF collects subcutaneously and is later surrounded by a fibrous capsule4.

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Method:

A case series study was conducted between June 2014 and March 2018 on 250 patients (45 females and 205 males) with either traumatic or iatrogenic injury to the Dura. Only patients who had intraoperative CSF leak

were included in this study regardless of their age. Preoperative evaluation was done for all patients. The operative technique introduced by Perry was used as a reference with some modification applied[1]. The maneuver used in this study to manage CSF leak intra-operatively described here in this study for comparison with other articles. Patients were followed post-operatively for at least six months for detecting any related complication. No statistical analysis was applied because the reference research did not use statistical analysis. Operative maneuver applied in this study: Once CSF injury was diagnosed Intra-operatively, the flowing steps were taken: All margins of the dorsal Dural defect were identified and sutured if possible. A fat graft in sufficient amount was taken from the patient's operation site if available, otherwise abdomen or thigh provide good sites for donation. The fat graft is spread over the Dural defect and its surrounding with no need for suturing it to the Dura. In case of lateral defects and when it is close to the nerve root a small piece of fat (about 5-6mm) was placed over it to prevent root traction or scarring. In case of ventral Dural defect, a large fat graft was placed inside the disc space. If a closed drain needs to be inserted, it should be placed and sutured intramuscular, no negative pressure applied, and its opening on the skin is secured with purse string suture so that after removal of the drain, the skin closes tightly and no leak is allowed. When closing the surgical field, all layers including the skin should be closed in watertight suture to prevent CSF from making a tract through these layers. The treatment regimen should include the use of Acetazolamide 250 mg twice daily. No Duracell or Dural fibrin glue was used, to avoid post-operative complications. All patients were advised to lie supine for at least one week after operation, with minimal ambulation when necessary. All study participants provided informed consent.

Results:

Out of a total of 2500 spinal operations cases during the period of the study, 250 cases (45 females and 205 males) were included in the study, table 1. They were diagnosed intra-operatively to have Dural injury either post-traumatic or incidentally during surgery. Dural injury occurred in 72 electively operated cases, either incidentally or in cases of Dural exploration for different pathologies of the spine, of whom 13 patients (5.2%) had spinal surgery at the same site previously. Twenty patients had Dural injury in the cervical region, 67 in the thoracic or thoraco-lumber region, and 163 in the lumbosacral region, table 2.

Table 1: Distribution of cases according to type of leak

Type of leak	No.	Percentage from	
		All leaks (250)	All surgeries (2500)
Traumatic	178	71.2	7.12
Incidental	72	28.8	2.88
Total	250	100	10

Table 2: Distribution of cases according to spinal region affected

Spinal region affected	No. and (%) of cases
Cervical	20 (8.0)
Thoracic and Thoracolumbar	67 (26.8)
Lumber and Lumbosacral	163 (62.2)

In all patients, the operative maneuver described above was used to prevent CSF leak post-operatively. Spinal drains were used in 25 patients only. A single antibiotic (commonly ceftriaxone) was used routinely for at least one week after surgery to prevent bacterial meningitis. When the patients are at high risk (17 patients with traumatic dirty wound), two antibiotics (commonly ceftriaxone with metronidazole) were used for ten days. In addition, all patients were given Acetazolamide (250 mg twice daily) for two weeks postoperatively, table 3.

Table 3: Distribution of patients according drug used

Drug used	No. and (%) of cases
Single antibiotic	250 (100)
Two antibiotics	17 (6.8)
Acetazolamide	250 (100)

None of the patients had post-operative CSF leak. Only one patient had drops of CSF come out of the wound while removing stitches which stopped spontaneously without interference. Bacterial meningitis developed in five patients which respond to treatment with antibiotics. Pseudomeningocele occurred in two patients which resolved with transcutaneous aspiration of CSF under sterile conditions. Surgical re-exploration was not needed at all, table 4.

Table 4: Distribution of patients according to complications

Complications post-operative	No. and (%) of cases
Bacterial meningitis	5 (2.0)
Pseudomeningocele	2 (0.8)
CSF leak	1 (0.4)
Total	250 (100.0)

Discussion:

This study used Perry Black's method as a reference with some modification, where a fat graft is used to seal the spinal CSF leak (which has the advantages of less scarring and efficiently hardens the Dura against water leakage)1. In the current study, the graft was reinforced by watertight stitching of all layers of the surgical field starting from the muscular layer up to the skin. When a surgical drain was used, no negative pressure was applied with its site closed tightly after removal. No other substance was used, such as fibrin glue, Surgicel or Gelfoam to prevent leak. Perry et al used Mayfield 3 in addition to tightly suturing the graft to the Dura with the application of a sealing substance 1. Jeswani et al and Alhemiary et al used the same technique of Black2, 10, while Osun et al, treated their patients by subfascial drain inserted for 15 days after operation5. In the few cases, where it is not possible to approach the Dura for suturing, this technique effectively prevents leakage and

subsequent complications. The maneuver used in this study proved to be cost-effective, with shorter hospitalization up to one day in many patients.

The current study found that CSF leak (either incidental or traumatic) occurred in 10% of patients operated on for any spinal problem, while Liu et al had 7.1% and Black et al had 1.6% of cases developing CSF leak 6, 1. The incidence of Dural tears during the spinal surgical manipulation by Mayfield review in Black P. was 5.9%1. The higher incidence in our series may be attributed to the high rate of war injuries resulting in severe trauma to the spine. In the current study, 5.2% of Dural injuries occurred in revision operations at the same previous surgical site, whereas Jeswani et al found 3-5% duratomy in revised cases2. Post-operative meningitis occurred in 2% of our cases, while Lin et al reported it in only 0.1% of total cases7. There is very little work published on this complication due to its low incidence. Little patients presented after operation with clinical triad of fever neck rigidity (stiffness) and disturb level of consciousness, although some patients may have headache, seizure, abnormal behavior, and focal neurological deficit7. In our study we treated this complication by double antibiotics for at least two weeks with good results comparable to Lin et al, who used antibiotics for two week also without significant mortality and morbidity post-operatively and during follow up. Pseudomeningoceles manifest as postural headache, localized back pain and when roots are attached to the edge of the pseudomeningocele, radicular symptoms can be felt. Symptom can occur several weeks or months postoperatively which can present in the same manner as a displaced lumbar disc. The psudomeningocele cannot be palpable clinically unless the CSF is tracked into the subcutaneous tissue resulting in palpable mass at the surgical wound. In the cervical and thoracic regions it can be felt as a boggy swelling 8. Campbell et al tried abdominal belt and focal compression as a preventive / conservative approach4. Swanson and Fincher had 0.068% incidence of pseudomeningocele in their 1700 cases operated for explorative laminectomies as a complication11, while Schumacher et al had an incidence of less than 0.1% in 3000 patients12, and about 2% reported by Teplick et al13, while the incidence of pseudomeningocele was 0.8% in Kalfas IH et al.study8. In our study we reported 0.8% which is comparable to other studies. Post-operative CSF leak occurred in one case only (0.4%) in our series, which is simply stopped by adding additional stiches, In Kalfas IH et al. review of 1408 laminectomies, the incidence of CSF fistula requiring reoperation was 0.3% and Black had one case (0.7%)1, 8. Of the total patients operated on in our series, no patient needed re-exploration, while El Husseini et al reported a need for re-exploration in 10-20%9.

Conclusions:

Proper identification of intraoperative CSF leak is crucial for prevention of post-operative complications. Postoperative CSF leakage can be prevented by applying and reinforcing all surgical field layers with watertight sutures. Intraoperative management of CSF leakage prevents serious complications postoperatively. If any complications happen as a result of CSF leakage, it can be managed by proper conservative manner without the need for revision surgery in most of the cases.The described maneuver reduced hospital stay and is cost effective.

Author's contribution:

Dr. Hayder Alhemiary and Dr. Saad Almasoudy: collection of cases and take decision for surgery according to clinical and radiological evaluation and then follow up of the patients.

Dr. Dhuha Almayoof: Radiological evaluation preoperatively and during the follow up period.

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منع نضوح السائل الشوكي من جرح العملية لأسباب ناتجة عن شدة خارجية أو فتح الاغشية السحائية عرضيا اثناء العملية

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الخلاصة:

المقدمة:

يعتبر نضوح السائل الشوكي مشكلة شائعة نوعا ما تتراوح ما بين 0.5% الى 18% وتنتج عن تمزق الاغشية السحائية اما بسبب شدة خارجية أو تمزق الاغشية السحائية عرضيا أثناء العملية. ينتج تمزق الاغشية الناتج عن شدة خارجية في معظم الاحيان عن شدة ميكانيكية وبالتالي تمزق الاغشية السحائية، وفي الاغلب في المنطقة الصدرية القطنية.

ألهدف من البحث:

يهدف البحث إلى إيجاد طريقة للتدخل خلال العملية الجراحية، وفي حالة حدوث نضوح السائل الشوكي تمنع هذه المشكلة من الاستمرار بعد العملية.

طريقة البحث:

يشمل البحث عينة من 250 مريض (205 من الذكور و45 من الاناث) حدث لديهم تمزق في الاغشية السحائية اما لأسباب عرضية اثناء العملية أو بسبب شدة خارجية. جمعت الحالات من كانون الثاني 2014 الى آذار 2018. اعتمدت طريقة العملية المقدمة من قبل العالم بيري بلاك كمرجع مع اضافة بعض التعديلات وقد سجلت الطريقة التي اعتمدت في هذا البحث.

النتائج:

في هذا البحث أخذت عينة من 250 شخص من مجموع كلي 2500 مريض أجري لهم تداخل جراحي في العمود الفقري، وقد شخص ان لديهم نضوح السائل الشوكي أما بسبب شدة خارجية أو عرضيا حدث تمزق للأغشية السحائية اثناء العملية.

حدث تمزق الاغشية السحائية عند 70 مريض اجري التداخل الجراحي لهم أما عرضيا او في بعض حالات استكشاف الاغشية السحائية لمختلف امراض العمود الفقري والنخاع الشوكي. من هؤلاء 13 (5.2%) اجري التداخل في نفس المكان المجرى فيه تداخل سابقا.

الاستنتاجات:

التشخيص الدقيق لنضوح السائل الشوكي اثناء العملية ضروري لمنع حدوثه بعد التداخل الجراحي. بالامكان منع النضوح بواسطة اضافة وتقوية كل طبقات جرح العملية وبواسطة خياطة محكمة غير نافذة للماء.

مفاتيح الكلمات:

نضوح السائل الشوكي، الفقرات، الغشاء السحائي، الشدة الخارجية، تضرر اثناء العملية.