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Incidental Spinal Durotomies Noted During Spinal Surgery: Incidence and Management

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Abstract

Purpose: Postoperative management of incidental durotomy in spinal operations is not standardized; evidence-based standardization with particular regard to mobility status is overdue. The aim of this study was to assess the incidence of dural tears and the outcomes of different postoperative mobilization protocols with regards to cerebrospinal fluid leak rate.

Methods: A retrospective analysis of all spinal surgery over a four-year period at one institution. A review of operation, and case notes to assess the intra- and post-operative management of patients suffering a dural tear and their outcomes.

Results: 3361 patients underwent invasive spinal intervention over four years. The age range was 17 to 94. The dural tear rate was higher in lumbar surgery (7.8%) compared with cervical (1.4%) and thoracic (3.8%); (p=0.000) and also in revision surgery (13.5%) compared with primary (4.8%) (p=0.000). When looking at all dural tears there was no significant difference in outcome between varying methods of dural repair and no repair at all (p=0.790). The persistent leak rate was higher in those kept in bed (17.2%) compared to those mobilised immediately (10.5%), this wasn't statistically significant (p=0.320).

Tears occurred in 42 lumbar microdiscectomies; 93% were mobilised immediately and 79% had no dural repair, one patient developed a persistent leak. There was no difference between different repairs (p=0.964) and mobilization regimes (p=0.929). In patients undergoing bony lumbar decompression, there was a difference between suture repair of the dura (9.5%) and non-suture (18%), this was not significant (p=0.304).

Conclusions: We advocate that patients who suffer an intra-operative dural tear should be mobilised immediately. In minimally invasive surgery such as microdiscectomy a watertight layered closure is sufficient, however, tears occurring during more invasive decompression procedures should all undergo a primary suture repair.

Keywords: Incidental spinal durotomy, Spinal surgery, Complication rates

Introduction

An incidental durotomy or dural tear is defined by ICD-10 as an accidental puncture or laceration of dura during a procedure [1]. These procedures include spinal surgery [2] and interventional procedures such as epidural injection [3]. The published incidence of incidental durotomy varies in the literature and is dependent on the procedure being performed, the experience of the surgeon, and patient factors but can range from 1% to 17% [4]. The consequences of a dural tear to a patient can vary from nil to patient death; for example, if cerebrospinal fluid (CSF) infection [5] leads to sepsis [6]. The most common manifestations of dural tear to the patient are headache, and symptoms of meningism, which are usually self-limiting [7]. They are caused by a drop in CSF pressure leading to caudal displacement of the intracranial contents [8]. The dural tear itself is usually healed within 10 days [9], unless a persistent leak develops usually indicating a CSF fluid fistula, which may result in a pseudomeningocele [10]. It is also the second most frequently named occurrence in medical practice cases involving surgery of the lumbar spine [11].

The purpose of our study was to evaluate the incidence of incidental durotomies in our practice over a 4-year period, and to clarify outcomes and differences in management.

The principles of dural tear treatment has changed very little over the course of the last four decades. This consists of a primary repair; testing via trendenlenburg; watertight layered closure of muscle and fascia; and keeping the patient supine on bed rest for 4-7 days [12]. Recent literature advises similar practice [4,13-16].

The prolonged recumbent period itself leads to increased risk of complications such as venous thromboembolic event [17] and infection, as well as increased cost either to patient or hospital dependent on how treatment is financed. This is critically important as immediate mobilization has the potential for great benefits to both patient and hospital provider.

Methods

A retrospective study of all patients who underwent invasive surgical spinal intervention in a single centre recorded on MD Analyze system (Medtech Global, Australia) from January 2007 to December 2010. MD Analyze is an integrated surgical audit and outcomes database that provides prospective data tracking from diagnosis to final outcome; and allows retrospective audit. A keyword search was performed for operation name/ description to identify all spinal cases. The operation notes were then searched for several keywords to identify cases in which durotomy occurred. These operation notes were then individually reviewed to ascertain which of these were incidental durotomies. A case note review was then performed to obtain the demographic and details of surgery. Specifically, the age and gender of the patients, whether surgery was elective or emergent; primary or revision; and what, if any repair was performed. Also assessed from the case notes, was the post-operative management; the length of hospital stay; any persistent leak or other complications; and any additional intervention required. The department was made up of twelve consultants, whilst they all had varying levels of experience all had been trained by the same senior consultant.

To ensure that ages of patients were taken at a standardized point; age recorded for purposes of the study were that at the day of surgery. Electivity of surgery was defined by planned admission via waiting list. Method of repair was classified simply as glue; suture or both. Complications accepted were documented persistent leak; pseudomeningocele or evidence of deep infection. Surgical site infection in the absence of CSF leak or MRI confirmed deep infection was not counted as a complication. Low pressure headache requiring no additional intervention was not counted as a complication as it was difficult to accurately quantify retrospectively and is somewhat subjective. Additional intervention was classified as any post-operative additional sutures; drains or revision surgery.

Statistical analysis of the data was then performed to assess the incidences of dural tears in various groups and compare outcomes by Fisher's Exact Test or Pearson Chi-Square Test.

Results

3361 patients underwent invasive spinal intervention over four years. The age of patients ranged from 17 to 94 and was normally distributed. The median patient age was 53 years old. Of the 3361 interventions, 33.3% (1120 patients) were at the cervical level, 58% (1951 patients) at the lumbar level, and 8.6% (290 patients) at the thoracic level (Table 1). The vast majority were primary procedures, with under 6% revision procedures (Table 2). The incidence of dural tear was noted to be 5.3% (Table 3).

		Frequency	Percent
Valid	Cervical	1120	33.3
	Lumbar	1951	58.0
	Thoracic	290	8.6
	Total	3361	100.0

Table 1: Spinal operations performed at each vertebral level.

		Frequency	Percent
Valid	Primary	3168	94.3
	Revision	193	5.7
	Total	3361	100.0

Table 2: Primary vs Revision procedure frequency.

		Frequency	Percent
Valid	No	3182	94.7
	Yes	179	5.3
	Total	3361	100.0

Table 3: Frequency of intra-operative dural tears.

The dural tear rate in revision procedures was found to be 13.5% vs 4.8% in primary procedures, this was statistically significant with a p value of 0.005 by Fisher's Exact Test (Table 4). The rate of dural tear varied dependent on level operated on with cervical surgery the lowest at 1.4%, followed by thoracic 3.8% and the highest rate was 7.8% in lumbar surgery. This was statistically significant by Pearson Chi-Square Test with a p value of 0.005 (Table 4).

Risk Factor	**% Dural Tear**	***p* Value**
Primary Procedure	4.8%	0.005
Revision Procedure	13.5%	
Cervical Level	1.4%	0.005
Thoracic Level	3.8%	
Lumbar Level	7.8%	

Table 4: Dural tear rate in procedures compared.

Having established that the incidence of dural tear was most common in revision and lumbar procedures, we then analysed the difference in outcome dependent on intra- and post-operative management. Of the 179 patients who suffered a tear intra-operatively, the complete case notes were retrieved for 134.

Intra-operatively 32.8% (44 patients) of the patients had glue alone of varying brands applied, 16.4% (22 patients) had a dural repair with glue and suture. Only 5.97% (8 patients) had a suture repair. 44.8% (60 patients) had no repair of the dura. No patients had patch repairs, or drains inserted.

Post-operatively out of 134 patients; 29 were kept on bedrest from periods of 24-120 hours, the other 105 were mobilized immediately, for the purposes of this study that was regarded as within 24 hours from surgery. The delayed mobilization group had a higher leak rate with 17.2% developing post-operative leaks, while only 10.5% of the immediately mobilized group had a persistent leak (Table 6). This was not a statistically significant difference (p=0.320).

Of the patients suffering dural tear intra-operatively 11.9% went on to develop a complication of persistent CSF leak and 9.7% required further intervention to stop this. The percentage developing persistent leaks varied from 15.9% in those glued alone, 9% in those glued and sutured, 12.5% in those sutured alone, and 10% in those with no direct dural repair. All patients had watertight layered closure of the layers above the dura. There was no significant difference (p=0.790) in occurrence of persistent CSF leak between differing methods of closure or indeed no closure at all (Table 5).

Repair * CSF leak Crosstabulation				
Count				
		CSF leak		Total
		NO	YES	
Repair	Glue	37	7	44
	Glue & Suture	20	2	22
	No repair	54	6	60
	Suture	7	1	8
Total		118	16	134

Table 5: Complication Rate in Different Methods of Dural Repair.

MOBILISATION * CSF leak Crosstabulation					
			CSF leak		Total
			NO	YES	
MOBILISATION	DELAYED	Count	24	5	29
		% within	82.8%	17.2%	100.0%
	IMMEDIATE	Count	94	11	105
		% within	89.5%	10.5%	100.0%
Total		Count	118	16	134
		% within	88.1%	11.9%	100.0%

Table 6: Leak rate in immediately mobilized compared with delayed mobilization.

We then analysed the lumbar spinal operations individually. As mentioned previously this was by far the most common level for dural tears to occur. 152 tears were recorded intra-operatively to have occurred at this level and the complete case notes were retrieved for 113 of these. Once more it was seen that there was no significant difference between complications and method of intra-operative repair. Those repaired with glue alone had a 15% complication rate, 5% in those repaired with glue and suture, 14% in those sutured alone and 9% in those undergoing no direct dural repair (Table 7).

Repair	CSF Leak		Total
	No	Yes	
Glue	29	5	34
Glue + Suture	17	1	18
Suture	6	1	7
No Repair	49	5	54
Total	101	12	113

Table 7: CSF leak complications in lumbar spine surgery depending on method of dural repair.

Once again post-operatively there was no significant difference in outcome between the immediately mobilised (9%) and those kept on bed rest (15%) (Table 8).

Finally, we subdivided the lumbar surgery into those patients who had a dural tear during micro-discectomies, and those who had tear during more invasive procedures involving boney decompression.

Of the 42 microdiscectomies who suffered a dural tear, only 1 developed a complication (persistent CSF leak). 93% of these were mobilised immediately, and 79% had no formal dural repair. There was no significant difference in outcome between the different repairs or mobilization regimes. Of the 71 patients who suffered a tear during more invasive procedures, once more there was no significant difference between method of repair or mobilization. There was, however, a difference between those who were sutured (9.5%) and those who weren't (18%) this did not reach statistical significance (p=0.304) (Table 9).

Suture * CSF leak Crosstabulation[a]				
Count				
		CSF leak		Total
		NO	YES	
Suture	NO	41	9	50
	YES	19	2	21
Total		60	11	71
a. Cervical or Thoracic or Lumbar = Lumbar				

Table 9: CSF leak complication dependent on suture repair of dura in lumbar spine cases undergoing bony or ligamentous decompression.

Discussion

Our dural tear incidence was comparable with that shown in a prospective UK multicenter trial which also revealed that surgeons generally underestimate the regularity with which these occur [18]. Given the aforementioned regularity of these in medicolegal cases, it is imperative that patients are accurately consented pre-operatively [1[1].

We were able to confirm what has been previously shown that the frequency of dural tears is higher in revision procedures when compared with primary procedures [16,19-21]. The rate of dural tear was seen to be higher in lumbar spine surgery and the cervical tear rate of 1.4% in our cohort is comparable with the 1% rate seen in the series reported by Hannallah et al. [22].

MOBILISATION * CSF leak Crosstabulation[a]				
Count				
		CSF leak		Total
		NO	YES	
MOBILISATION	DELAYED	22	4	26
	IMMEDIATE	79	8	87
Total		101	12	113
a. Cervical or Thoracic or Lumbar = Lumbar				

Table 8: Leak rate in immediately mobilized compared with delayed mobilization.

Of greater importance was the finding that delayed mobilization and primary repair which was initially suggested by Eismont et al. in a series of only 5 patients is not as important as once believed [12]. Most large studies since then have also advocated mandatory bed rest and primary repair with glue, suture, patch or a combination [4,14-16,23]. The importance of primary repair is felt to be so great that methods have been described for performing primary suture repair during microdiscectomy as this is technically difficult to achieve [24]. There have been some small studies which have looked at early mobilization following dural tear and have all reported good results, these have, however, been relatively small [25,26]. Khan et al. instigated a protocol of early mobilization and deemed this to be safe and effective in the treatment of dural tears [13].

Ours is the first study which has directly compared early versus delayed mobilization and differing methods of repair albeit retrospectively. The results clearly show there is no benefit of mandatory bed rest following dural tear, and a despite not reaching statistical significance it would appear to show that prolonged bed rest would actually appear to be detrimental and increase the risk of persistent CSF leak complications. Also, we can see that in cases of minimally invasive spinal surgery a good, watertight layered closure is sufficient without the need for direct dural repair.

Finally, in cases which are more invasive and bony decompression has been performed there would appear to be a benefit from direct primary suture repair of the tear. Despite not reaching statistical significance it would also appear to show that the use of glue is not a substitute for direct suturing of the dura.

Our study followed up patients for up to one year post-operatively; after this no patients presented within the 4-year time year period with later complications. It is also unlikely that patients within the study could have presented to other hospitals as geographically this was the only neurosurgical centre in the entire region.

However there remains very little data on the long-term sequelae of dural tears as a result of spinal surgical procedures. Therefore, further studies are required to assess long term outcomes following dural tears. For example, a retrospective study of patients with incidental durotomy at 10-year follow-up found that they had worse clinical outcomes in comparison to a control group [27]. In contrast four other comparable series to this study 189 incidental durotomies were investigated with a follow-up period from weeks to less than 5 years and no sequelae were found when the patients were treated successfully for incidental durotomies [6,12,15,28]. Therefore, further studies should aim to identify prevalence of long-term sequelae and their dependence on the method of dural tear repair and mobilization status.

Currently there is no true consensus regarding the treatment of incidental durotomies; with treatment widely varying on a surgeon by surgeon basis. Treatment modalities include primary repair with sutures, glue, muscle, fat or fascial grafts, blood or fibrin patches. Future trials should aim to randomize patients with incidental durotomies into treatment categories and then further randomize to immediate or delayed mobilization. Such trials would perhaps provide statistical clarity with regards to the gold standard treatment of incidental durotomies and mobilization status.

Limitations of this study include a limited follow-up range, absence of clinical assessment with a validated score and surgeon-to-surgeon procedural variability.

Conclusion

We would advocate that patients experiencing dural tear intra-operatively can be mobilized immediately and a primary suture repair of all tears occurring as a result of invasive spinal surgery is undertaken. We also believe that in minimally invasive procedures, a good layered closure is adequate and there is no benefit to technically difficult suture repair.

There are significant discrepancies between our findings and the commonly practiced approach to warrant a prospective multi-centre trial assessing early versus delayed mobilization.

Conflicts of Interest

All authors declare they have no conflicts of interest.

Funding

This study received no funding.

Ethical Statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent was obtained from all individual participants included in the study.

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