

DURAL TEAR, A FEARED COMPLICATION OF SPINE SURGERY

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INTRODUCTION

Three meninges cover the layers of the brain and spinal cord: dura, arachnoid, and pia mater.^{1,2} Vandenaabeele et al.³ studied the dura layer with an electron microscope having a longitudinal arrangement. Human Dural stress is significantly higher when stressed longitudinally than transversely or circumferentially.⁴ This study suggests that the fibres of the dura mater run longitudinally. cerebrospinal fluid (CSF) is produced by the choroid plexus produced in the third, fourth, and lateral ventricles of the brain, which is subsequently modified by various transporters and channels.⁵ The epidemiology of dura tears reported by Cammisa et al.⁶ indicates a 3.1% incidence. However, the incidence varies from 1% for cervical surgeries and 7.6% for primary lumbar surgeries and 15.9% for revision lumbar surgeries.⁷ Many studies reported that revision surgery of the spine has a higher percentage of 8.1%⁶ to 15.9% of lumbar dura tears.^{8,9} Among the procedures for managing dura mater repair reported in the orthopaedic literature, Eismont et al.¹⁰ highlighted the primary repair of dura tears. This advantage

prevents complications, including CSF fistula or pseudocyst formation, which will put the patient at risk of additional complications such as meningitis, nerve root entrapment; cranial nerve palsy; and mass effect.¹¹ Another reason for repair is the prevention of fluid build-up, which can prevent wound healing. Spinal Cord Injury (SCI) is an orthopaedic emergency if it is not handled correctly and often results in a poor prognosis and causes irreversible nerve damage.¹² Under 30 years of age Spinal Cord Injury (SCI) have an impact on quality of life, as disability results in the loss of productive years of life and, therefore, increases morbidity and mortality.¹³ The current study investigates the ratio of Dural tears associated with spine surgery and gives insight into complications in patients with Dural tears. The study also provides some insights to study more effective clinical treatments to prevent post-injury complications.

METHODOLOGY

A one-year prospective case-control study with a consecutive series of patients with lumbar spine surgery between January 2019 and December 2019

ABSTRACT**OBJECTIVES**

To investigate the incidence, risk factors and clinical presentation of complications in patients undergoing spinal surgery with and without Dural Tear.

METHODOLOGY

A one-year prospective case-control study was conducted in the department of orthopaedics and spinal surgery at the Hayatabad Medical Complex (HMC) and Rahman Medical and surgical centre Daggar Buner. The spine surgeon used a discrete surgical approach. The questionnaire was used to collect patient demographic data, surgical information, and data on perioperative and postoperative complications. SPSS version 21.0 statistical software was used for all statistical analyses.

RESULTS

Dural tears were observed in 3.4% of the patients, among whom 20% experienced a Dural leak. After controlling for potentially confounding variables of age, sex, primary disease, and type of procedure, the surgery-related complications that were more likely to occur in the Dural Tear group than in the non-Td group were surgical site complications OR 2.69 and postoperative neurological defect O 3.28. The proportion of postoperative delirium OR 3.22 was significantly high in the Dural Tear group as perioperative complications.

CONCLUSION

A higher proportion of surgical site infections, postoperative neurological defects and delirium in the Dural Tear group are due to direct complications, such as Dural leakage.

KEYWORDS: Dural Tear, Spine Surgery, Defects, Neurology

was carried out in the Department of Orthopedics and spine Surgery Hayatabad Medical Complex Peshawar and Rahman medical and surgical centre dagger Buner Khyber Pakhtunkhwa Pakistan. Ethical approval was obtained from the hospital's Ethical committee. The spine surgeon used a discrete surgical approach. All patients undergoing spine surgery between study intervals were included in the study. Only those patients having insufficient demographic data were excluded from the study. The questionnaire was used to collect patient demographic data, surgical information, and data on perioperative and postoperative complications. Data for each patient were entered into the database immediately after the patient was discharged by the spine surgeons responsible for data entry into the database. The database classified spine surgeries into 11 categories: primary degenerative cervical spine, primary degenerative thoracic spine, primary degenerative lumbar spine, tumours, infection, osteoporosis, dialysis-associated spondylosis, deformity, revision, and others. Among the surgical procedures, a discectomy was excluded to avoid multicollinearity, as this procedure was performed only for patients with the herniated soft disc. The initial spinal disease was classified into five categories: spinal canal stenosis, degenerative lumbar spondylolisthesis, herniated soft disc, isthmic spondylolisthesis, and degenerative scoliosis without the intention of performing spinal correction. Surgical procedures were classified as follows: lumbar interbody fusion, including posterior lumbar interbody fusion or transforaminal lumbar interbody fusion; decompression only, such as laminectomy or laminotomy; discectomy only; and others. SPSS version 21.0 statistical software was used for all statistical analyzes. The chi-square test was used to show the relationship between DT and other perioperative complications. The means of the continuous variables were compared using the t-test. DT was analyzed as a risk factor for other complications for which there were statistically significant differences between groups. The multivariate logistic regression test calculated odds ratios (OR) with 95% confidence intervals (CI).

RESULT

Table 1 shows the characteristics of the patients under study (population, male-female ratio, primary age of diseases and surgical approach). The dural tear was found in 14 patients (3.4%, 95% CI) who had the same proportion of male-female (DT group; 50% male and 50% female; mean age, 70 years; range, 20-95 years) compared with patients without Dural Tear (group without DT; N = 370; 55% men and 45% women; mean age, 67 years; range, 11-95 years). The

percentage of female patients in the Dural Tear group was significantly higher than in the group without DT ($p = 0.006$). Considering the age of the patients without a dura mater tear, the group was significantly younger than those in the dura group (70 years vs 68 years, mean, $p < 0.002$). There was variability in the distribution of diseases between subjects and between the surgical procedure between the two groups. For example, the proportions of lumbar canal stenosis and laminectomy in the DT group were higher than in the non-DT group (51% vs 46% and 45% vs 39%).

Table 1: Demographics

Subjects	Dural Tear Group	Non-Dural Tear Group	P-V alue
No. of Subjects n=384	14 (3.4%)	370 (96.6%)	
Male Female Ratio	7:7 50%:50%	203:167 55%:45%	0.006
Mean Age (in Years) Range	70 (20-95)	67(12-95)	0.002
Primary Disease (LSS, DLS, LDH, ILS, LDS)	51%,25%,18%,3%,3%	46%,29%,20%,4%,1%	0.005
Surgical Procedure (PLIF or TLIF, Laminectomy, discectomy, Others	42%,45%,11%,2%	44%,39%,15%,2%	0.005

Table 2: Shows Intraoperative Complications

	Dural Tear Group	Non-Dural Tear Group	P-V alue
Massive Hemorrhage	0.3%	0.3%	0.536
Nerve Injury	0.4%	0.2%	0.103
Screw malposition	0	0.7%	0.628
Graft Dislocation	0	0.2%	0.991
Wrong Site Surgery	0	0.2%	0.991
Vascular Injury	0	0	0.991

Table 3: Shows Systemic Perioperative Complications

	Dural Tear Group	Non-Dural Tear Group	P-V alue
Dural Leak	20%	0.3%	0.002
Surgical Site Infection	02%	0.8%	0.016
Postoperative Neurological Defects	04%	01%	0.002
Hematoma	02%	0.8%	0.087
Wound dehiscence	0.2%	0.2%	0.448
Screw/Rod Failure	0	0.7%	0.346
Graft Failure	0	0.2%	0.621

Table 4: Perioperative Systemic Complications

	Dural Tear Group	Non-Dural Tear Group	P-Value
Cardiovascular Disease	0.3%	0.3%	0.991
Respiratory Disease	0	0.2%	0.991
Gastrointestinal Disease	0	0.2%	0.342
Renal and Urological Disease	0.3%	0.3%	0.991
Cerebro Vascular Disease	0.3%	0.2%	0.387
Postoperative Delirium	01%	0.2%	0.012
Sepsis	0	0.5%	0.991
In Hospital Mortality	0	0	0.991

The postoperative complications discussed in Table 4 show that the dura tear group is directly associated with dura mater leakage and was observed in 20% of patients. Regarding postoperative complications related to surgery other than dura leak, DT was significantly associated with a higher incidence of SSI surgical site infection (2% vs 0.8%, $p = 0.016$) and neurological deficit postoperative (4% vs 1.0%, $p = 0.002$) compared to that in the non-DT group.

Table 5: Logistic Regression Analysis of Dependent and Independent Variable

Dependent Variable	Independent Variable	P-Value	Odds Ratio
Dural leak	Dural tear	0.002	111.2
	Massive Hemorrhage	0.003	20.5
Surgical Site Infection	Dural Tear	0.001	02.69
Postoperative Neurological Defect	Nerve Injury	0.002	156.2
	Graft dislocation	0.002	38.7
	Screw Malposition	0.002	37.5
	Dural Tear	0.003	03.28
Postoperative Delirium	Cardiovascular Disease	0.004	09.92
	Dural Tear	0.009	03.22

The statistical analysis of the multivariate logistic regression test showed the degree of association between Dural Tear and the four complications identified. The confounding factors were controlled age, sex, primary disease, and type of procedure. Table # 5 shows that Dural Tear patients had a relatively higher odds ratio of experiencing the other four complications. Apart from Dural leak, which is directly related to the tear of the dura mater, it was associated with a higher probability of SSI (OR = 2.69, 95% CI, $p = 0.001$), postoperative neurological deficit (OR = 3, 28, 95% CI, $p = 0.003$) and

postoperative delirium (OR = 3.22; 95% CI, $p = 0.008$). In the predictive model of postoperative delirium, advanced age (per decade) was identified as a confounding factor (OR = 2.87, 95% CI, $p < 0.001$).

DISCUSSION

Study results show that dura mater tear is associated with many complications as it is directly associated with dura mater leakage leading to postoperative neurological deficit and delirium. Demographic analysis shows significant variability between the two groups regarding patient demographics, such as gender, age, disease distribution, and procedure distribution. A previous study at the national level shows that the tear of the dura mater in spinal surgery had a significantly higher proportion of women than in the group without TD (53.6% vs 50.7%, $P = 0.001$).¹⁴ These findings are consistent with the results of the present study. However, some literature shows no significant gender differences between these two groups.^{15,16} This gender difference could not be explained statistically. Previous studies have shown that patients with a ruptured dura were older than those without ruptured dura.^{14-16,17} The present study's findings are consistent with these studies. In elderly patients, there are degenerative changes in the spinal canal, including a thicker yellow ligament and the formation of osteophytes, which may contribute to being one of the causes of the dura tear in old age.¹⁸ Also, in older people, the dura is more friable, which may be a predisposing factor for tearing the dura.¹⁹ Previous studies show that laminectomy is a high-risk factor for Dural tears. The present study's findings showed that comparing the group without DT, the Dural Tear group had a higher prevalence of laminectomy and a lower prevalence of PLIF or TLIF.¹⁶ While performing laminectomy, a semi-circumferential decompression should be performed than in PLIF or TLIF, which reduces the risk of injury from the dura tear during manipulation and retraction of the nerve. Adogawa et al. studied the effect of dura tears on postoperative complications and found a prevalence of 4% among patients who underwent primary fusion of the lumbar spine.²⁰ However, there were no statistically significant differences in the occurrence of surgical site infection and postoperative neurological deficit between the two groups. However, the results showed that the incidence of SSI was more substantial than our results. These findings were consistent with the present study but did not find a statistically significant association between dura tear and surgical site infection, unlike our results. These differences between the results are due to statistical analysis and power. The present study included a sufficient sample size to analyze the association

between these complications with low incidence. Previous literature shows that older people are at risk of developing postoperative delirium during spinal surgery.^{21,22} The present study also shows that older people have a P 0.002 dura tear, which remained a risk factor for postoperative delirium even after adjusting for confounding variables for age. One study also showed an association between Dural Tear and postoperative delirium in patients with degenerative spondylolisthesis.²³ These results are consistent with the present study. The results can be explained by the need for bed rest, which is necessary after Dural Tear, but more studies can be done to obtain more accurate results. Several limitations of the study were noted, as the study results were limited to a hospital stay, so the actual incidences of complications may have been underestimated. Some reports show that the mean length of hospital stay was 16.9 days, which is much longer and represents an economic burden for the health sector.²⁴ In conclusion, the analysis and interpretation of the results of the present study showed a higher proportion of surgical site infection, postoperative neurological deficit, and postoperative delirium in the Dural Tear group due to direct complications, such as Dural leak. Longer surgical time, the need for additional procedures and longer postoperative bed rest may be related to the higher incidence of apparently unrelated complications in Dural Tear patients.

LIMITATIONS

This study was conducted in a single centre on limited patients. We need to conduct large-scale studies to find the significance.

CONCLUSION

There is a higher proportion of surgical site infection, postoperative neurological defect and postoperative delirium in the Dural Tear group due to direct complications, such as Dural leakage.

CONFLICT OF INTEREST: None

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