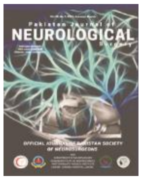

PAKISTAN JOURNAL OF NEUROLOGICAL SURGERY (QUARTERLY) –
OFFICIAL JOURNAL OF PAKISTAN SOCIETY OF NEUROSURGEONS

Original Article (SPINE)

Frequency of SCF Leakage in Post-operative Patients of Tethered Spinal Cord in A Tertiary Care Hospital

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ABSTRACT

Objective: The study aimed to report the incidence of CSF leakage in patients with a tethered spinal cord, post-operatively.

Materials and Methods: A total of 75 individuals aged more than 2 years and of either gender who were hospitalized for surgery for tethered cord syndrome were included. All patients had a preoperative MRI of the spine, and those above the age of 6 had urodynamic tests. Clinical evaluations were performed until hospital release, then again at 3, 6, and 12 months. Urodynamic tests and spine MRIs were redone one year following surgery. Under general anesthesia, all patients had microscopic untethering procedures to release tethering materials and heal the thecal sac.

Results: 52% of patients fall under TCS type 'simple', whereas, 48% of patients found with complex TCS. The frequency of CSF leakage in post-operative patients with a tethered spinal cord was found in 17.33%. No CSF leak was reported in the majority of patients (49%) patients in the age group 2-30 years. 52% of patients with simple TCS reported no CSF leak, whereas, only 13(18%) patients with complex TCS reported CSF leaks. 40% of patients reported no CSF leak who was diagnosed with complex TCS. There existed a significant relationship between the types of TCS (simple/complex) for CSF leak distribution.

Conclusion: This study concluded that the frequency of CSF leakage in post-operative patients with tethered spinal cord was found in 17.33% of patients.

Keywords: Tethered Spinal Cord (TCS), CSF Leakage, Lipomyelomeningocele.

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Date of Submission: 07-05-2022
Date of Revision: 20-06-2022
Date of Acceptance: 28-06-2022
Date of Online Publishing: 30-06-2022
Date of Print: 30-06-2022

DOI: 10.36552/pjns.v26i2.679

INTRODUCTION

Cerebrospinal fluid leakage is a well-known consequence of intra-dural spinal surgery, and it can appear as a pseudomeningocele or as a CSF leak through the skin incision. This can exacerbate poor wound healing and/or wound dehiscence, wound infection, radiculopathy, meningitis, and intracranial hypotension syndrome. TCS is thought to be caused by spinal cord traction, which causes anatomic and metabolic abnormalities that result in the clinical appearance. Spinal cord fixation can arise congenitally (primary TCS) or as a result of various intra-spinal diseases or surgical scarring (secondary TCS). The majority of instances are caused by spinal dysraphism.[1] TCS is a disorder characterized by neurological, gastrointestinal, musculoskeletal, and urinary dysfunction caused by spinal cord traction, with an estimated frequency of 0.25 per 1,000 newborns.[2-6] The symptoms of a congenital tethered chord are most frequent in childhood, yet many individuals may not get a diagnosis until they reach adulthood. Gait deterioration, foot abnormalities, increasing scoliosis, and sphincter incontinence are some of the other symptoms. Young children may have skeletal development abnormalities, such as a difference in leg length. There is little research on the frequency of CSF leakage, a frequent consequence of spinal cord surgery, among pediatric patients in the post-operative period. Knowing the exact burden of a procedure-related complication/morbidity might aid in preventative treatment. CSF leaking might aggravate the incision and the patient's condition. The current study investigated the incidence of CSF leaking in post-operative tethered spinal cord patients at our tertiary care hospital.

Cerebrospinal fluid (CSF) leaks are a feared complication following tethered cord surgery, and they are linked with severe patient morbidity. Even though several treatments for treating postoperative CSF leaks exist, the problem remains challenging, particularly in very young children.[7]

TCS has a wide range of clinical manifestations that vary with age and underlying etiology. The physical examination is crucial in determining TCS diagnosis. Orthopedic abnormalities in the lower extremities should be assessed. Because skip lesions are widespread, motor and sensory tests should be extensively evaluated. Gait analysis is critical because it might be influenced by orthopedic abnormalities or spasticity.[8-10] The development of a scoliotic deformity frequently adds considerably to pain complaints. Weakness might be mild and limited to a specific muscle group. Pain is the most prevalent manifestation in people who have no history of spina bifida, followed by weakness and urinary dysfunction. Trauma frequently causes symptomatology in patients who do not have orthopedic abnormalities or urinary dysfunction. The trauma might be minor (pregnancy, delivery, activity) or severe (direct damage to the spine).[10-12]

All MMC (Myelomeningocele) patients are born with a tethered cord, which is repaired and closed at birth or shortly thereafter. Tethered cord syndrome can arise in up to 2.8–32 percent of MMC patients due to retethering as the spinal column grows and lengthens. Scarring at the place of previous healing causes retethering, which attaches the chord and prevents it from climbing throughout development. At the time of retethering, the patient is between the ages of 5 and 9 years old and is frequently at a stage of fast growth.[13] Lipomyelomeningocele is the most prevalent kind of occult spinal dysraphism and comprises a subcutaneous lipoma connected to an intradural lipomatous mass in the lumbar or sacral region. Pain, motor or sensory impairments, and sphincter abnormalities are the most common symptoms of TCS in adults.[13-16]

MATERIALS AND METHODS

Study Design and Setting

A Descriptive study was conducted at the Neurosurgery Department, Allied Hospital, Faisalabad, from 10th August 2020 to 9th February 2021.

Inclusion Criteria

All patients of age more than 2 years of either gender admitted for surgery of tethered cord syndrome diagnosed clinically and by imaging were included in the study.

Exclusion Criteria

Primary repair of meningomyelocele, paraplegia, hydrocephaly, and patients undergoing concurrent surgery for various spinal disorders such as spinal Dural arteriovenous fistula, neurenteric cyst, and sacral canal cyst were all not included.

Data Collection

Following Ethical Review Committee clearance, participants satisfying the operational definitions and inclusion criteria were enrolled in the research after providing informed permission. Clinical, laboratory, and imaging examinations were used to assess all patients' general and neurological conditions. All patients had a preoperative MRI of the spine, and those above the age of 6 had urodynamic tests. Clinical evaluations were performed until hospital release, then again at 3, 6, and 12 months. Urodynamic tests and MRIs of the spine were performed one year following surgery. Under general anesthesia, all patients had microscopic untethering procedures to release tethering materials and heal the thecal sac.

Surgical Methods

Patients were given general anesthesia while lying prone. Longitudinal incisions were used to expose the whole operative field. The removal of excess fat, fibrous tissue, and scarring resulted in the spinal cord and nerve compression. The dural sac was opened along the midline using a microscope. To the greatest degree possible, any components that may strain or compress the spinal cord were eliminated. Finally, the filum terminale was cut to relieve tension in the lower spine and cauda equina. Tight filum terminale: the border between the spinal cord and the filum terminale was identified, and the lower end of the filum terminale was severed. Lipomyelomeningocele: the normal dura limit was identified by separately stretching the top and bottom lamina of the bulging region to liberate the bulging sac and safeguard the spinal cord. To ensure that the bulging cord and nerve roots descended into the dural sac, the extradural sac was removed after the adhesion nerves were liberated. Finally, 5-0 absorbable suture was used to rebuild the lumbosacral epidural form.

The scar and adhesion(s) were surgically removed under a microscope while electrophysiological monitoring was performed in the event of cicatricial adhesion. Lipomas are characterized as dorsal, transitional, terminal, or chaotic depending on their proximity to the conus medullaris. For the terminal type, the border between the spinal cord and the filum terminale lipoma was discovered intraoperatively, and the lipoma was removed. The neural placode for dorsal and transitional types must be recognized. The dissection began at the rostral end of the lipoma and went into the neural placode using a Cavitron Ultrasonic Surgical Aspirator and neurophysiological monitoring. In most cases, complete or near-complete resection was achieved. Because identifying the full neural placode is difficult, and the nerve root always goes through the lipoma, only near-total excision will be possible for some chaotic types. Following lipoma removal and complete nerve adhesion release, the pia from both sides was sutured together using 6-0 absorbable thread to reconstruct the neural placode and decrease the possibility of local adhesions. Finally, a synthetic dura mater was used to repair the dural sac.

Data Analysis

Data was assessed in SPSS version 24. Means were calculated for age. Frequency and percentage were calculated for gender, type of TSC, and CSF leakage. Effect modifiers include age, gender, type of TSC, stratification of data was done and post-stratification chi-square was applied.

RESULTS

Age Distribution

The mean age of the patients was 15 years. The majority of the 45 patients (60.0 percent) were between the ages of 2 and 15 years old (Table 1).

Table 1: Ages (n = 75).

Age	No. of Patients	%age
2 – 15 years	45	60.0
> 15 years	30	40.0
Mean ± SD = 15.39 ± 8.32 years		

Gender Distribution

Out of the 75 patients, 51 (68.0%) were males and 24 (32.0%) were females.

Clinical Results

52% of patients fall under TCS type 'simple', whereas, 48% of patients found with complex TCS (Table 2). The frequency of CSF leakage in post-operative patients with a tethered spinal cord was found in 13 (17.33%) (Table 3).

Table 2: Distribution Concerning the type of TCS.

		Frequency	%age
Type	Simple	39	52.0
	Complex	36	48.0

Table 3: Frequency of CSF leakage in post-operative patients with the tethered spinal cord (n = 75).

	Yes	No
Frequency of CSF leakage	13 (17.33%)	62 (82.67%)

Distribution of TCS w.r.t Age, Gender, and Type of TCS

No CSF leak was reported in the majority of patients (49%) patients in the age group 2 – 30 years. 8 cases of CSF leaks were observed in patients in the age group 2 – 30 years and 5 cases were observed in the age group 31 – 60 years out of 75.58% of male patients reported no CSF leaks. 9 male and 4 female patients reported CSF leaks out of 75. There existed an insignificant association between age groups and gender for CSF leak (p values: 0.9). See Tables 4 and 5.

Table 4: Stratification of CSF leakage concerning age groups.

Age	CSF Leakage		p-value
	Yes	No	
2 – 30 years	08	37	**0.901** (insignificant result)
31 – 60 years	05	25	

Table 5: Stratification of CSF leakage Concerning Gender.

Gender	CSF Leakage		p-value
	Yes	No	
Male	09	42	**0.917** (insignificant result)
Female	04	20	

Table 6: Stratification of CSF leakage Concerning Type of TCS.

Type	CSF Leakage		p-value
	Yes	No	
Simple	00	39	**0.0001** (Significant result)
Complex	13	30	

52% of patients with simple TCS reported no CSF leak, whereas, only 13 (18%) patients with complex TCS reported CSF leaks. 40% of patients reported no CSF leak who was diagnosed with complex TCS. There existed a significant relationship between the type of TCS (simple/ complex) for CSF leak distribution. See Table 6.

DISCUSSION

Surgical detethering with one-level lumbar laminectomy has typically been used to treat tethered cords.[17] Depending on the underlying disease, the filum is often located, coagulated, and sliced, with good results and a low overall complication rate. Infection, CSF leak, and nerve root or spinal cord damage are also possible consequences.[18] Occult Spinal Dysraphisms (OSDs) are said to have a female predominance, but there is no evidence documenting if there are gender variations in surgical outcomes.[19] In the present study, CSF leakage was identified in 13 (17.33 percent) tethered spinal cord post-operative patients. Controllable consequences following de-tethering, according to Elmesallamy et al. include cerebrospinal fluid (CSF) leak in 18.6 percent and wound infection in 4.7 percent. Urodynamic tests improved in 73% of adults following surgery, and children improved significantly in all cases.[20] Each etiology of TCS necessitates a unique set of surgical treatments, ranging from simple filum release to sophisticated lipomyelomeningocele excision and release. Surgical site infection (SSI) and cerebrospinal fluid (CSF) leaking are the most prevalent consequences following TCS surgery, regardless of the underlying condition. Complication rates range from 3.2 percent to 5.6 percent (infection) and up to 16.7 percent (other) (CSF leak).[21] A correct clinical categorization for tethered cord syndrome will help predict prognosis and guide treatment.[22]

In 22 patients, Duz et al.[23] observed a 5% CSF leak and no illnesses. Sofuoglu et al.[24] documented CSF leak and wound infection in three individuals (13 percent). Rajpal et al.[25] observed that 3/61 patients had wound infection, one had a CSF leak, two had pseudomeningocele, and one had acute respiratory distress syndrome. In their investigation of 34 patients, Iskandar et al 88 identified one CSF leak and five pseudomeningocele.[26-28] Chern et al.[26] demonstrated that the length of time a patient was kept flat in the postoperative context did not connect with the chance of a CSF leak or pseudomeningocele across three institutions. Ogiwara et al.[28] recently reported that there were no CSF leaks in a large sample of patients who were maintained flat for 72 hours. Previous studies reported that post-op infection and CSF leaks have been the most common complication for spinal dysraphism surgeries with the prevalence up to 30%. Hoffman et al.[29] have emphasized the need for early treatment of LMMC patients since the possibility of preventing or curing a neurological impairment by surgical therapy is highest early on and declines with age, implying that delayed treatment leads to permanent abnormalities. Early surgical surgery for LMMC has also been advised by McLone et al., Lamarca et al., and Herman et al. It is critical to note that the purpose of the procedures in this research was to untether the cord and resect as much of the lipoma as feasible while avoiding harm to the cord and nerve roots. Furthermore, restoring the dural sac is critical to preventing surgical retethering and maintaining a normal CSF circulation space.[30-32] According to Bulsara et al.,[33] early surgical surgery results in a positive prognosis, and younger patients benefit better than older ones.

Latex allergies should be avoided at all costs. The risk of latex allergy in children with spinal dysraphism is increased by the probability of latex antigen exposure through recurrent bladder catheterization. CSF leak prevention measures should be implemented. These precautions include paying close attention to a watertight dural closure, which may require grafting if necessary. A Valsalva maneuver performed under direct view can be used to assess the closure's integrity. To improve dura closure, adjuvant sealants such as fibrin glue or other commercially available materials may be employed. In addition to the dural closure, the superficial soft tissue closure is carefully monitored as an additional strategy for limiting CSF leaks.[34] Many tethered cord spinal abnormalities tend to retether postoperatively. To avoid retethering, hemostasis and closure must be performed with extreme care. Dural closure with 4 – 0 Nurolon is sufficient for many simple detethering surgeries. A flowing monofilament suture can be used successfully to treat more complicated spinal Dysraphisms.[35-36] Many untethering procedures are linked with significantly aberrant architecture as a result of both initial development and subsequent postoperative scarring. Starting the dissection from normal tissue (typically rostrally) is a good overall method. The discovery of a normal bony lamina may lead to the identification of the dura and, as a result, a better knowledge of aberrant tissue planes. This idea also applies intradurally, when rostral exposure to the normal spinal cord allows for safer dissection of more caudal anomalies.[34]

Because the dural architecture may be aberrant before to surgery and may be affected further by the operational technique, CSF leak is a concerning complication of procedures in children with tethered cords. To eliminate this possible issue, a thorough, watertight dural closure is required, with dural replacements and sealants employed as needed. If a CSF leak is identified, an additional examination may be necessary, and the involvement of plastic surgery professionals may be advantageous in arranging other ways of closure, such as transposition flaps, for patients who have undergone substantial surgery or several treatments. Urodynamics has been demonstrated to be a valuable technique in the assessment of patients suspected of symptomatic retethering. Preoperative and postoperative urodynamic scoring is a valid tool for identifying retethering.[37]

CONCLUSION AND RECOMMENDATION

According to the findings of this study, 17.33 percent of tethered spinal cord post-operative patients had CSF leaking. As a result, we propose that additional attention be made to patients to detect CSF leaking early and allocate resources accordingly. Tracking strategies for individuals with a tethered chord usually alter based on the underlying cause, therapy, and outcome. Patients who are neurologically sound and have had a fatty filum treated with a simple sectioning technique may not require significant long-term follow-up. Children with more physically complicated lesions, such as big lipomas or myelomeningocele, may require long-term, routine follow-up that includes medical services to watch for possible retethering.

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Additional Information

Disclosures: Authors report no conflict of interest.
Ethical Review Board Approval: The study was conformed to the ethical review board requirements.
Human Subjects: Consent was obtained by all patients/participants in this study.
Conflicts of Interest:
In compliance with the ICMJE uniform disclosure form, all authors declare the following:
Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

AUTHOR CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Muhammad Abdur Rehman	1. Study design and methodology.
2.	Junaid Aziz	2. Paper writing.
3.	Inamullah Asghar	3. Data collection and calculations.
4.	Taimoor Anwar	4. Analysis of data and interpretation of results.
5.	Anum Wahab	5. Literature review and referencing.
6.	Muhammad Akmal Hussain	6. Editing and quality insurer.