Research Article

Advances in Neurology and Neuroscience

Predictors and Management Strategies of Pseudomeningoceles in Neurosurgical Procedures: Breaking the Ice

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Submitted: 20 Jan 2020; **Accepted**: 28 Jan 2020; **Published**: 03 Feb 2020

Abstract

Background: *Pseudomeningoceles are extradural collections of CSF that result following a breach in the dural–arachnoid layer. Pseudomeningoceles are recognized complications after cranial and spinal surgery with some centers reporting an incidence exceeding 40%.*

Aims and Objectives: *To evaluate the predictors of post-operative pseudomeningoceles in neurosurgical practice. To formulate a standardised management protocol for treatment of pseudomeningocele.*

Materials and Methods: *This is a prospective study where all cases of cranial and spinal pseudomeningoceles were taken into consideration from October 2016 to October 2018 (2 years).There were 45 consecutive cases of pseudomeningocele were included in the study.*

Results: *Among the total cranial and spinal cases operated in one year period at our institute incidence of pseudomeningocele was noted to be 1.1% (45/3892). 38 (84.4%) were cranial cases, among them 21 (46.7%) were supratentorial and 17 (37.8%) were infratentorial, 5 (15.6%) cases had primary water tight dural closure, 33 (73.3%) duraplasty done using pericranial fascia, Dura was not kept opened in any cases and artificial sealants were not used in any case.7 (15.6%) were spinal cases and 4 cases dura was not opened and didn't recognize any leak,3 cases dura was opened and primary dural closure done in 2 cases and 1 case closure was done using a muscle graft, no artificial sealants were used. Pseudomeningocele was managed with multiple treatment modalities and best treatment options noted were bed rest with tight bandage application (44.4%), Continuous lumbar drain for 5 days (17.8%), Intermittent lumbar drainage for 5 days (13.3%), these three constituted 75.5% of successful treatment modality used. Post pseudomeningocele development hydrocephalus was noted in 7 (15.6%) among them 3 (6.7%) cases required ventriculo-peritoneal shunt. Only 2(4.4%) patients developed complications like csf leak and meningitis and 3 (6.7%) cases had mortality.*

Conclusion: *We conclude that in our study pseudomeningocele was found to be more common in the supratentorial compartment in contrast to other studies in literature, majority of the cases subsided with conservative management, type of closure of the dura did not impact the outcome, meningitis was not a significant etiology and standardized management protocol has been proposed for effective management of pseudomeningocele.*

Introduction

Pseudomeningoceles are extradural collections of CSF that result following a breach in the dural–arachnoid layer. Pseudomeningoceles are recognized complications after cranial and spinal surgery with some centers reporting an incidence exceeding 40%. Hydrocephalus, poor surgical closure of the dura, and subarachnoid scarring have all been implicated as potential contributing factors. Once a pseudomeningocele is identified, its management is complicated by the fact that most resolve spontaneously while some progress until wound breakdown occurs.

The factors that contribute to a persistent communication between the subarachnoid and the extradural spaces have been debated. Teplick, et al. have suggested that when intact arachnoid herniates into the cyst, the communication is more likely to remain open and form a pseudomeningocele, whereas when an arachnoid tear occurs, the likelihood of closure of the communication is greater.

Definitive causes and pathology of development of psuedomeningocele and exact predictors and best suitable treatment option for pseudomeningocele have not been clearly mentioned

anywhere, so this study has been taken up to evaluate the exact predictors of pseudomeningocele at our institute.

Aims and Objectives

1. To evaluate the predictors of post-operative pseudomeningoceles in neurosurgical practice.
2. To delineate indications and timing of treatment for pseudomeningocele.

Materials and Methods

This is a prospective study where all cases of cranial and spinal pseudomeningoceles were taken into consideration.

Study Period: October 2016 to October 2018 (2 years).

Sample Size: All cases of cranial and spinal pseudomeningoceles were taken for this study over a period of 2 years with a sample size of 45 cases. All cases were operative in the Neurosurgical department of NIMS.

All the cases were grouped into following categories:

1. Cranial pseudomeningocele with hydrocephalus
2. Cranial pseudomeningocele without hydrocephalus
3. Spinal pseudomeningocele

Age group ranging from 2 years to 80 years were taken into the study who developed post-operative psuedomeningoceles.

Exclusion Criteria

1. Cases operated outside NIMS.
2. Cases where intra-operative details were not available

Various predictors of pseudomeningocele were noted with a pretested proforma for each patient and all the details were noted down and the etiological factors were considered and various treatment options and associated complications were taken into the study and were evaluated.

All the results of the patients collected data accumulated and the predictors of psuedomeningocele were determined and treatment options best possible for the patient in different scenarios were evaluated.

Statistical Analysis

Data Analysis was done by using SPSS version 21.Categorical data was represented as frequencies and percentages. Chi square test is used as test of significance for categorical data. P value less than 0.05 was considered as statistically significant.

Results

In this study 40% (18) of cases were females and 60% (27) were males. Cranial cases constituted 84.4% (38), 15.6% (7) were spinal cases. Of cranial cases 21 were supratentorial and (46.70%), 17 infratentorial (37.80%).Post op shunt was done in 3 cases (67%).

a) Cranial cases with hydrocephalus ,supratentorial were 1 and infratentorial were 2,
b) Cranial cases without hydrocephalus, supratentorial were 20, infratentorial were 15.

Operative factors looked in the development of pseudomeningocele were:
Of 38 cranial cases, 5 (15.6%) cases had primary water tight dural closure, 33 (73.3%) duroplasty done using pericranial fascia, dura was not kept opened in any cases and artificial sealants were not used in any case.7 (15.6%) were spinal cases and 4 cases dura was not opened and didn't recognize any leak, 3 cases dura was opened and primary dural closure done in 2 cases and 1 case closure was done using a muscle graft, no artificial sealants were used.

Configured bone flap used in 40 cases (88.9%). 25-50% configured bone in 2.2% cases, 50-75% configured bone in 22.2%, >75% configured in 44.4% cases.

All cases multiple layer closure done using vicryl and nylon. Hydrocephalus noted in 7 patients (15.6%).Flap was tense in 7 cases (15.6%). Best treatment option used was bed rest, tight bandage done in 20 patients (44.4%), Lumbar drain used as treatment option in 8 cases (13.3%), Lumbar picture initially and lumbar drain later together used as treatment option in 6 cases (13.3%), VP shunt used in 3 cases (6.7%).

Swelling improved in 38 cases (84.4%). Mean day of pseudomeningocele development was 5.82 days. First choice of treatment used for 6.24 days, pseudoeminingocele completely reduced in 10 days.

Bed rest, tight bandage, lumbar puncture and lumbar drain was used as best treatment modality and constituted 75.5 % of all treatment options.

Multiple options used in 62.2% of patients, one case redo-surgery was done and patient developed meningitis and died, totally 3 cases expired and 2 cases developed complications like csf leak, wound infection and meningitis.

	AGE	PSEUD POST OP DAY	FIRST CHOICE DAYS	COMPLETELY REDUCED DAYS
MEAN	35.94	5.82	6.24	9.91
MEDIAN	38.00	5.00	7.00	7.00
STD. DEVIATION	17.992	2.871	4.328	8.911
RANGE	67	14	30	60
MINIMUM	1	1	0	0
MAXIMUM	67	15	30	60

Treatment Option * Diagnosis Cross Tabulation

			DIAGNOSIS			TOTAL
			INFRATENTORIAL	SPINAL	SUPRATENTORIAL	
TREATMENT OPTION	ASPIRATION	COUNT	0	0	1	1
		%	0.0%	0.0%	4.8%	2.2%
	BED REST +TIGHT BANDAGE	COUNT	6	4	10	20
		%	35.3%	57.1%	47.6%	44.4%
	BLOCKED VP SHUNT OPENED	COUNT	1	0	0	1
		%	5.9%	0.0%	0.0%	2.2%
	LUMBAR DRAIN	COUNT	3	0	5	8
		%	17.6%	0.0%	23.8%	17.8%
	LUMBAR PUNCTURE AND DRAIN	COUNT	4	0	2	6
		%	23.5%	0.0%	9.5%	13.3%
	TIGHT BANDAGE + LUMBAR DRAIN	COUNT	1	0	1	2
		%	5.9%	0.0%	4.8%	4.4%
	TIGHT BANDAGE +ASPIRATION+LUMBAR DRAIN	COUNT	1	3	0	4
		%	5.9%	42.9%	0.0%	8.9%
	VP SHUNT	COUNT	1	0	2	3
		%	5.9%	0.0%	9.5%	6.7%
TOTAL		COUNT	17	7	21	45
		%	100.0%	100.0%	100.0%	100.0%

Chi square test = 19.834, p value = 0.0135 (s).

Cranial

Table 1: Frequency table of cranial and spinal cases

CRANIAL	FREQUENCY	PERCENT
NO	7	15.6
YES	38	84.4
TOTAL	45	100.0

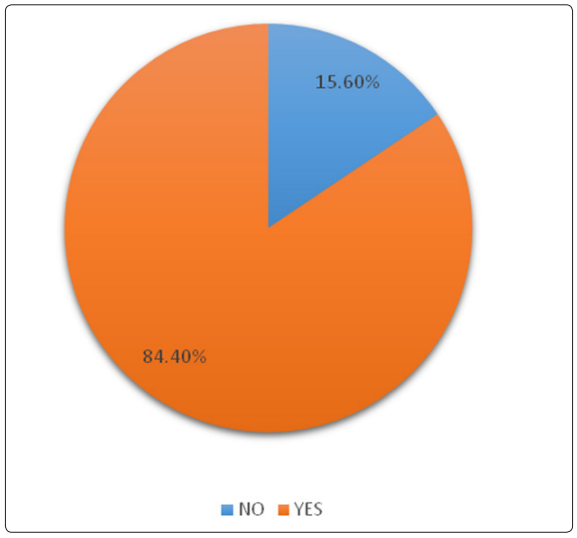

Figure 1: Pie chart of cranial and spinal cases

Table 2: Frequency table of infratentorial, supratentorial and spinal cases

DIAGNOSIS	FREQUENCY	PERCENT
INFRATENTORIAL	17	37.8
SPINAL	7	15.6
SUPRATENTORIAL	21	46.7
TOTAL	45	100.0

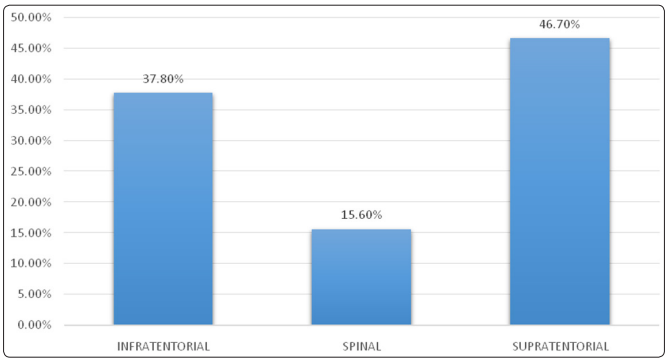

Figure 2: Bar diagram showing percentage of infratentorial, supratentorial and spinal cases

Table 3: Frequency chart showing diagnosis of spinal cases

DIAGNOSIS	FREQUENCY	PERCENT
C1-C2 IDEM	1	2.2
C2 NEUROFIBROMA	1	2.2
D9-D11 OYL	1	2.2
DORSAL IDEM	2	4.4
L4/L5 PIVD	1	2.2
TYPE I CHIARI & SYRINX	1	2.2
NIL	38	84.4
TOTAL	45	100.0

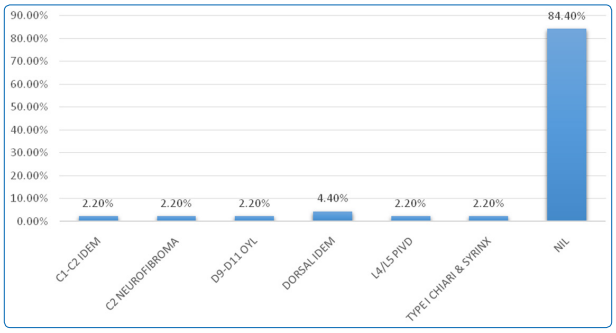

Figure 3: Bar diagram showing percentage of various spinal cases encountered

Table 4: Frequency table showing percentage of cases with dura closed or not

DURA CLOSED	FREQUENCY	PERCENT
NO	4	8.9
YES	41	91.1
TOTAL	45	100.0

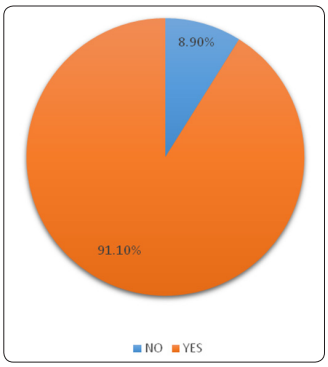

Figure 4: Pie chart showing the percentage of cases in which dura is closed and not closed

Table 5: Frequency table showing percentage of different methods of dural closure

PRIMARY /DUROPLASTY	FREQUENCY	PERCENT
DUROPLASTY	33	73.3
MUSCLE GRAFT	1	2.2
PRIMARY	7	15.6
Not opened	4	8.9
TOTAL	45	100.0

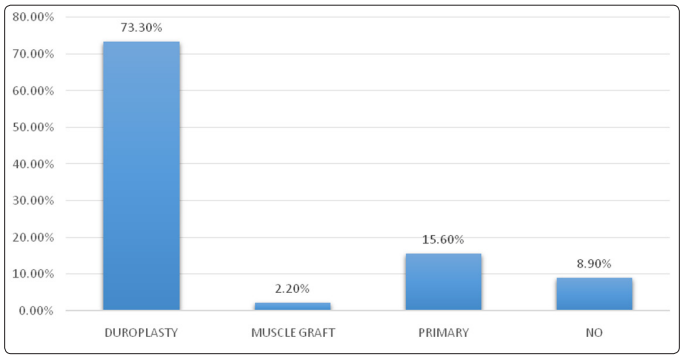

Figure 5: Bar diagram comparing percentage of different methods of dural closure

Table 6: Frequency table showing percentage of patients with type of tissue used for closure

GRAFT	FREQUENCY	PERCENT
AUTO/PERICRANIAL FASC	33	73.3
PRIMARY+NOT CLOSED	11	24.4
MUSCLE GRAFT	1	2.2
TOTAL	45	100.0

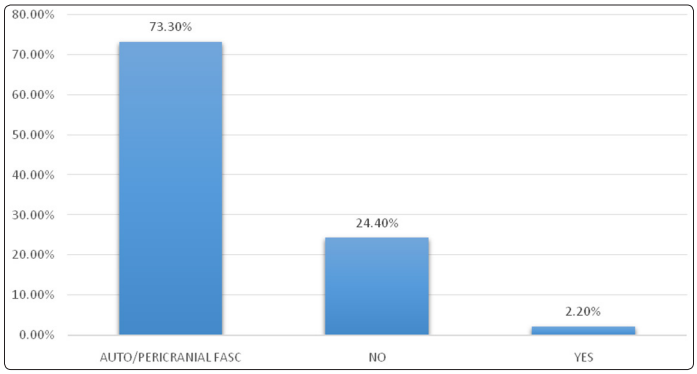

Figure 6: Bar chart showing percentage of patients with tissue used for closure

Table 7: Table showing various treatment options used

TREATMENT OPTION	FREQUENCY	PERCENT
ASPIRATION	1	2.2
BED REST +TIGHT BANDAGE	20	44.4
BLOCKED VP SHUNT OPENED	1	2.2
LUMBAR DRAIN	8	17.8
LUMBAR PUNCTURE AND DRAIN	6	13.3
TIGHT BANDAGE + LUMBAR DRAIN	2	4.4
TIGHT BANDAGE +ASPIRATION+LUMBAR DRAIN	4	8.9
VP SHUNT	3	6.7
TOTAL	45	100.0

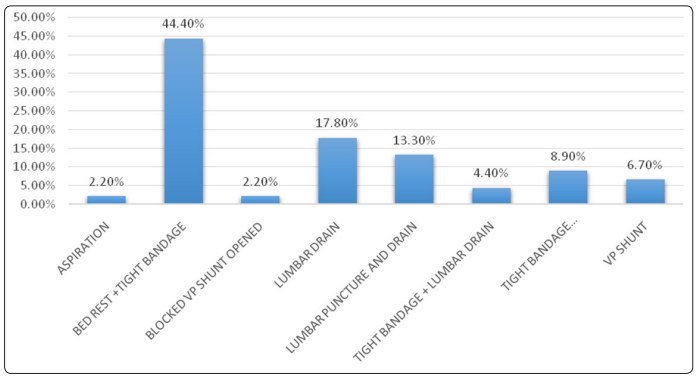

Figure 7: Bar diagram showing various treatment options used

Table 8: Table showing percentage of improvement of swelling in patients

IMPROVEMENT IN SWELLING	FREQUENCY	PERCENT
NO	7	15.6
YES	38	84.4
TOTAL	45	100.0

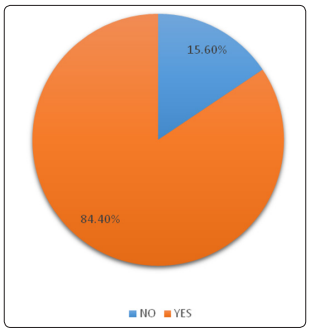

Figure 8: Pie chart showing percentage of improvement of swelling in patients

Table 9: Table showing second choice options for treatment of psuedomeningocele used

SECOND CHOICE	FREQUENCY	PERCENT
LUMBAR DRAIN	5	11.1
NO	39	86.7
Redo surgery	1	2.2
TOTAL	45	100.0

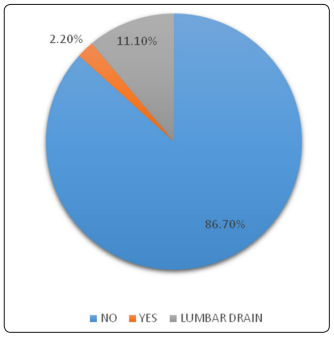

Figure 9: Pie chart showing second choice options for treatment of psuedomeningocele used

Table 10: Table showing multiple options used for treatment or not

MULTIPLE OPTIONS	FREQUENCY	PERCENT
NO	17	37.8
YES	28	62.2
TOTAL	45	100.0

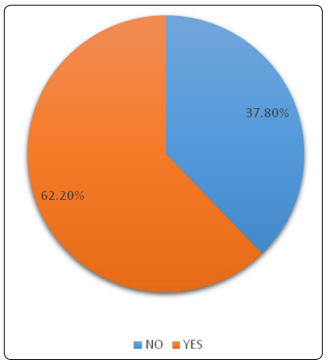

Figure 10: Pie chart showing multiple options used for treatment or not

Table 11: Table showing complications in the study group

COMPLICATION	FREQUENCY	PERCENT
CSF LEAK,MENINGITIS	1	2.2
NO	43	95.6
WOUND INFECTION AND MENINGITIS	1	2.2
TOTAL	45	100.0

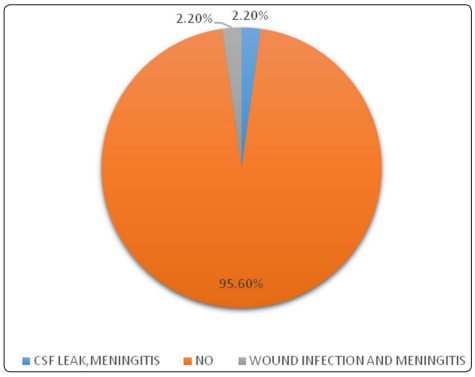

Figure 11: Pie chart showing complications noted

Table 12: Table showing follow up after 3 months

FOLLOW UP 3 MONTHS	FREQUENCY	PERCENT
EXPIRED	3	6.7
GOOD	42	93.3
TOTAL	45	100.0

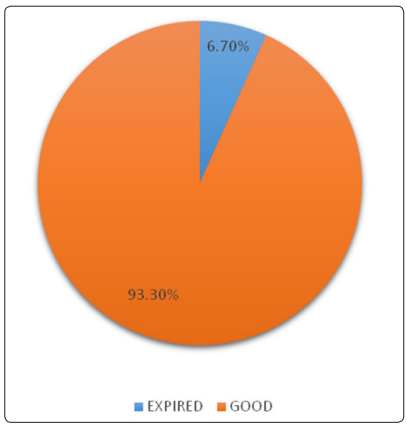

Figure 12: Pie chart showing follow up after 3 months

Discussion

Perative subcutaneous collection of CSF is Postoperative subcutaneous collection of CSF is usually resolved after repeated aspiration of CSF subcutaneously or by lumbar puncture combined with mechanical compression with a head bandage. In some individuals, however, particularly in patients after posterior fossa surgery, such nonsurgical methods of treatment may fail to eliminate the collection of CSF, and thereby wound healing is delayed with risk of intracranial infection. In previous publications, rarely has special attention been directed to the treatment of this condition. Some neurosurgeons may prefer direct surgical intervention, including repair of the dura mater, or excision of the sac combined with a layer-by-layer closure of the wound. These procedures, however, do not invariably resolve this pathology, presumably because persistent CSF collection is partly due to impaired CSF dynamics. Based on this possible mechanism, treatment by diverting the CSF is reasonable, and is also less invasive.

Continuous external drainage is the simplest mode of CSF diversion; however, this method has disadvantages including the risk of infection, and the restriction of the patient to bed for several days or weeks. In our experience, patients in whom bed rest and head bandage failed to eradicate the collection had a tendency to require relatively long lasting CSF drainage. We believe that when an initial external CSF drainage failed to resolve subcutaneous CSF collection within one week, subsequent installation of a LP shunt carries a high risk of infection. From these considerations, it appears that primary LP shunting is feasible as a reliable alternative to spinal drainage.

LP shunting is also available for the treatment of CSF leakage. In this situation, however, there is a risk of pneumocephalus, which precluded the acceptance of the LP shunt as a procedure of choice. However, the risk of pneumocephalus secondary to LP shunt is negligible in patients with persistent CSF collections.

Since the subcutaneous fluid not only contains ahigh concentration of protein but is also not necessarily sterile, it is recommended to aspirate it immediately prior to the LP shunt. In order to prevent postoperative subcutaneous CSF collection, the author has recently sealed the dura mater along the suture line using gel foam (gelatin sponge; Upjohn Co., Kalamazoo, Michigan) with aron-alpha (alkyl-alpha-cyanoacrylate; Sankyo Co., Tokyo). Since that time the incidence of persistent collection of subcutaneous CSF has significantly decreased in patients with posterior fossa surgery.

Conclusion

From this study, we believe that there are multiple options regarding the management of cranial and spinal pseudomeningoceles, but we have been able to identify an overlying theme. In general, most neurosurgeons act conservatively in treating cranial and spinal pseudomeningoceles in the absence of hydrocephalus. In the presence of ventriculomegaly, observation is still an option although consideration should be made for aggressive treatment of the hydrocephalus including upfront CSF diversion. The most important step to preventing a pseudomeningocele is primary dural closure, and adjuncts such as tissue glues and duroplasty should be used at the surgeon's discretion. The authors hope that this study serves as a guide to assist in decision making when faced with postoperative pseudomeningoceles in the future, as well as a consensus statement on what the current management of pseudomeningoceles is.

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