

Spinal Dural Arteriovenous Fistulas: Surgical Outcome Analysis of Twenty Cases

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ABSTRACT

Background: Spinal dural arteriovenous fistulas (SDAVFs) are rare complex spinal vascular shunts, which can inevitably lead to severe disability if remain untreated. **Methods:** Retrospective analysis of SDAVF patients in a period of three years (2019 to 2021) who presented with progressive paraparesis, bladder symptoms, and/or sensory disturbances. They were evaluated by MRI and localization of the fistula was done by spinal catheter angiogram. Spinal AV fistulas were simply classified as extradural and intradural. They all underwent microsurgical shunt interruption. Neurological function was evaluated by Aminoff-Logue Scale (ALS). Individual ALS scores of each patient (pretreatment and post-treatment) were recorded to find out the p-value of the surgical intervention. **Results:** A total of 20 patients (mean age 35 ± 10 years, 16 (80.0%) are male. The mean interval from onset to diagnosis was 6 ± 3 months. Among the anatomical location of fistulas, 1 (05.0%) was cervical, 16 (80.0%) were in thoracic, and 3 (15.0%) were lumbar. Among the angiographic types of fistulas, 18 (90.0%) were intradural and, 2 (10.0%) were extradural. Compared with pre-operative ALS scores, 15 (75.00%) patients received improvement, and 05 (25.00%) patients felt worse or more stable. Among 20 surgical procedures, there were complications in three cases (15%): epidural hematoma in 1 case, cerebrospinal fluid leakage in 1 case, and postoperative wound infection in 1 case. **Conclusions:** In our study, microsurgical interruption of timely diagnosed SDAVF showed good and stable results over time.

Keywords: Spinal dural arteriovenous fistula, spinal catheter angiogram

INTRODUCTION

Spinal dural arteriovenous fistula (SDAVF) is a rare disease, whose etiology is not entirely clear. It is the most common vascular malformation of the spinal cord, comprising 60-80 % of the cases [1]. They are defined as direct arteriovenous shunts in the spinal dura mater between a segmental root

artery and a peri-medullary vein [2]. The etiology of SDAVFs is unknown but they are presumed to be an acquired pathology mainly affecting middle-aged men. High venous pressure leading to chronic hypoxia is presumed to be the cause of clinical symptoms [3-6]. SDAVFs are commonly located at the thoracic and lumbar levels and are responsible for progressive myelopathies with progressive sensory and motor deficits of the lower limbs associated with sphincter disturbances [7]. There is a male predominance with a sex ratio of almost 5:1 [8]. SDAVFs are considered a curable cause of myelopathy. SDAVF treatment consists of interrupting the shunt between the artery and the vein either surgically or endovascularly. The main surgical difficulty is locating the origin of the shunting vein [9].

The main objective of this study was to describe the clinical outcome of SDAF patients who were treated surgically. The secondary objectives were to find out the failure rate, late recurrence rate, and complication rate of surgery.

MATERIALS AND METHODS

We conducted a retrospective observational study. The medical records of 20 consecutive patients with SDAVFs treated in 2 academic neurosurgical departments (Combined Military Hospital Dhaka and Dhaka Medical College Hospital) between 2019 and 2021. Inclusion criteria were patients treated for SDAVFs surgically. Exclusion criteria were SDAVFs that were treated endovascularly and those that were not treated.

Clinical data: Age at diagnosis, gender, and duration of symptoms were collected for each patient. The onset of symptoms was when neurological deficits (gait disturbances, bladder incontinence) were first noticed. The functional status of the patients was assessed using the Aminoff and Logue's Scale (ALS, which grades gait and urinary incontinence before and after the surgery).

Radiological data: The level of intramedullary hyperintensity and flow voids on T2-weighted MRI was measured using the corresponding number of vertebral bodies. Fistula level was identified by selective catheter spinal arteriography.

Treatment: All selected patients underwent surgical closure of the fistula. The initial success of treatment, recurrence, and complications was reviewed. The surgical procedure consisted of a laminectomy centered on the arteriovenous shunt under the guidance of an image intensifier, the opening of the dura, and the exclusion of the fistula at the origin of the draining vein. Recurrence was defined as a symptomatic re-opening of the fistula after an initial successful exclusion.

Primary endpoint: The primary objective of the study was to observe the neurological outcome between the pre-treatment ALS and the last examination of ALS.

Secondary endpoints: Secondary endpoints were to determine the recurrence and complication rates.

Statistical analysis: Descriptive statistics were used for age, gender, anatomical location and angiographic typing, pre-treatment, and last examination of ALS. Linear mixed models were used for the primary objective. Comparisons between pre-treatment and last examination ALS for each subgroup were made using the Tukey Test. The significance threshold was set at $P \leq 0.05$.

Ethical approval: This study was reviewed and approved by the ethics committee of our institution.

RESULTS

Patient characteristics and treatment method: A total of 20 surgical procedures were performed: 18 as an initial treatment, 1 after an initial failed embolization attempt, and 1 after the failed initial surgery. (Figure 1)

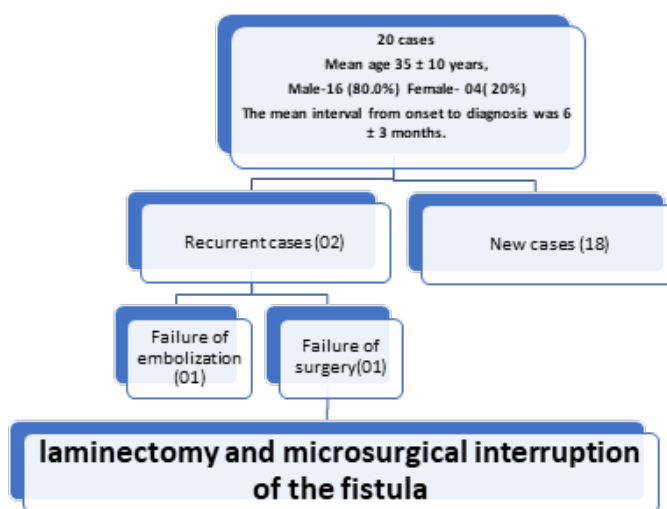


Figure 1: Flow chart of patient characteristics and treatment method.

Anatomical and angiographic findings: Among the anatomical location of fistulas, 1(05.0%) was in the cervical, 16 (80.0%) were in the thoracic, and 3 (15.0%) were in the lumbar

region. Among the angiographic types of fistulas, 18(90.0%) were intradural and, 2 (10.0%) were extradural. (Figure 2)

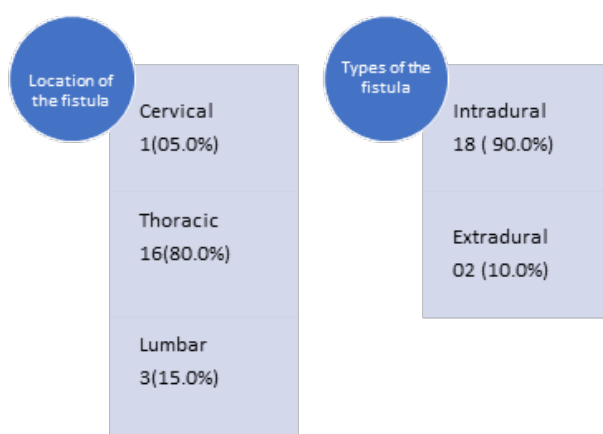


Figure 2: Anatomical and angiographic findings.

Clinical outcome: Mean pre-treatment ALS was 4.55 and the mean Post-treatment ALS was 2.85. There was a significant improvement in ALS between pretreatment and post treatment ALS (P = 0.0009). Further analyses were made for the G score and the M score. The mean pre-treatment and

post-treatment G scores were respectively 3.10 and 2.00. The G score improved significantly after surgery (P < 0.0001). Mean pre-treatment and post-treatment M scores were respectively 1.45 and 0.95 after surgery. M score did not improve significantly after the treatment. (Table 1)

Table 1: Clinical outcome after surgery.

Variables	Pretreatment score	Post-treatment score	P value
ALS	4.55	2.85	P=0.0009
G score	3.10	2.00	P<0.0001
M score	1.45	0.95	Not significant

Complications: Among 20 surgical procedures there were complications in three cases (15%): epidural hematoma in 1 case which needed re-exploration, cerebrospinal fluid leakage

in 1 case that s closed spontaneously, and postoperative wound infection in 1 case. (Figure 3).



Figure 3: Complications following surgery.

DISCUSSION

SDAVFs are rare and still underdiagnosed entities. They are the most frequent vascular malformation of the spine and account

for approximately 70% of all vascular spinal malformations. They need proper treatment to prevent morbidity with progressive spinal cord symptoms [10].

Table 2: Aminoff and Logue scale [11].

Gait (G)	Micturition (M)
G0 Normal	M0 Normal
G1 Leg weakness, abnormal gait or stance, but no restriction of activity	M1 Hesitancy, frequency, urgency
G2 Restricted activity	M2 Occasional urinary incontinence or retention
G3 Requiring one stick for walking	M3 Total incontinence or persistent retention
G4 Requires two sticks, crutches, or walker G5 Confined to a wheelchair G Score = G+M score=	M score =

Aminoff-Logue Scale (ALS) is used as a tool for neurological outcomes (Table 2).

Table 3: Baseline demographics with ALS.

Serial no	Age	Sex (M-16; F-04)	ALS		Remarks
			Pretreatment (G+M)	Post-treatment (G+M)	
1	45	M	5 (3+2)	3(2+1)	
2	36	M	5(4+1)	3(2+1)	
3	52	M	4 (3+1)	2(2+0)	
4	40	F	3(2+1)	3(2+1)	Stable
5	28	F	5(3+2)	2(2+0)	
6	35	M	5(3+2)	3(2+1)	
7	43	M	2(2+0)	2(2+0)	Stable
8	39	M	6(4+2)	4(3+1)	
9	54	M	7(4+3)	5(3+2)	

10	19	F	4(3+1)	2(1+1)	
11	38	M	4(3+1)	2(1+1)	
12	45	M	5(3+2)	3(2+1)	
13	49	M	4(3+1)	2(1+1)	
14	33	M	3(2+1)	3(2+1)	Stable
15	40	F	5(3+2)	6(4+2)	worsen
16	32	M	6(4+2)	4(3+1)	
17	44	M	4(3+1)	4(3+1)	Stable
18	42	M	3(3+0)	1(1+0)	
19	39	M	5(3+2)	2(1+1)	
20	48	M	6(4+2)	3(2+1)	

In the literature, there is a male predominance with a sex ratio of almost 5:1 [12]. In our study it was 4:1. There was a significant improvement in the ALS between pretreatment and post-treatment ALS (Table-3). These results suggest that microsurgical interruption of SDAVFs is an efficient treatment option for achieving permanent occlusion using a single procedure. Lee, H.S. et al. [13] proposed surgical treatment is still the first option when endovascular therapy (EVT) is not feasible after diagnostic spinal angiography. In our setup dedicated endovascular intervention is yet to develop. In this study, the overall complication rate was 15% which was higher than that of other studies [14]. All the complication cases were managed successfully after surgery. Therefore, the complication rate should not present an obstacle to the choice of surgery. Surgical technique has improved in recent years, which has raised the occlusion rate and decreased the risk of complications. Operating microscopes have been perfected with fluorescence modules. The use of indocyanine green or fluorescein has been proven to be useful in vascular neurosurgery [15-17]. They can be used in the same way for confirmation of the angioarchitecture of the SDAVFs and to verify its occlusion at the end of the procedure [18]. Furthermore, some authors have reported that pre-operative identification of the level of the SDAVF can be carried out by placing a coil in the feeding artery during the pre-operative spinal arteriography. This technique appears to decrease the risk of error at the vertebral level [19]. Finally, a mini-invasive technique with limited surgical exposure could reduce the risk of infection and decrease the length of hospital stay [20]. Our study has some limitations. The patient sample was small due to the rarity of this pathology. Our clinical endpoint (ALS) was calculated retrospectively which was a potential bias.

CONCLUSION

Surgery may be considered as a first-line treatment in SDAVFs considering the straight forward technical

aspects and favorable clinicopathological outcome.

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