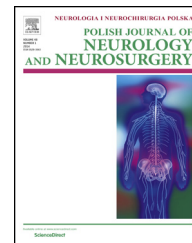




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Original research article

Surgical treatment for spinal dural arteriovenous fistulas: Outcome, complications and prognostic factors

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ABSTRACT

Background and purpose: Spinal dural arteriovenous fistulas (SDAVFs) are rare, acquired pathology and they inevitably lead to severe disability if untreated. The aim of this study is to present the outcome and complications, and to find factors that may affect the outcome after surgical treatment.

Methods: Seventeen consecutive patients (men – 14, women – 3, age: 41–79) were retrospectively analyzed. The patients presented with paraparesis (88%), bladder symptoms (71%) and/or sensory disturbances (65%). The fistula was found in the upper thoracic spine in 2 cases, in the lower thoracic (T7–Th12) in 11 cases, and in the lumbar spine in 4 cases. Microsurgical shunt interruption was performed in all, followed by epidural arteries coagulation in 12 cases.

Results: In the long term, improvement or achievement of a good stable condition was observed in 13 patients (76%), and no patient deteriorated. All 5 paraplegic patients improved by at least 1 grade in MCS. Satisfactory results (modified McCormick Scale grades I–II) were found in 10 patients (59%), and 15(88%) were independent. Postoperative complications occurred in 4 patients (24%), two of them (12%) required revision surgery for epidural hematoma. The success rate was 94%; one patient required revision surgery for recurrent SDAVF. Better neurological condition on admission ($p = 0.0098$) and age >60 years ($p = 0.0498$) were the factors associated with satisfactory outcome.

Conclusions: Microsurgical closing of a SDAVF brings good and stable results over time. Aggressive treatment should be attempted even in cases of total loss of spinal cord function. Neurological condition before surgery and age may influence the outcome.

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1. Introduction

Spinal dural arteriovenous fistulas (SDAVFs) classified by Spetzler as intradural dorsal arteriovenous fistulas [1] are the most common vascular malformation of the spinal cord. They are acquired and constitute approximately 80% of vascular malformations in the spinal canal [2]. SDAVFs are rare pathology with an incidence of 5–10 new cases per million per year. Most of them are located in the thoracolumbar region of the spine and they mostly occur in older and middle aged men. SDAVFs are rare in the sacral region (4%) and rarely may present as multi-level fistulas (2%) [1,2].

The essence of the disease is a direct connection between the meningeal arterial branch and the venous coronary plexus of the spinal cord. This causes a direct transmission of arterial blood pressure to the venous system which results in venous stasis in the spinal cord. This is the primary mechanism of spinal cord damage and may lead to irreversible symptoms [2–4]. SDAVFs are characterized by slow progressive symptoms which usually exacerbate with physical effort. Many SDAVFs remain underdiagnosed as the symptoms may be unspecific for along time [2,5].

Currently, microneurosurgical or endovascular methods may be employed for the treatment of SDAVFs [6,7]. Due to the rarity of these spinal vascular lesions, reports of their management and outcomes have been limited to case series and case reports. The purpose of this paper is to present the short-term and long-term outcome and postoperative complications, and to find factors that may affect the outcome on a series of 17 surgically treated SDAVFs.

2. Material and methods

2.1. Patients, signs and symptoms

A series of 17 consecutive patients surgically treated for SDAVFs was retrospectively analyzed. The study group consisted of 14 men (82%) and 3 women (18%) aged from 41 to 79 years (average – 61 y.o., median – 60 y.o.).

Progressive paraparesis was the most common initial symptom ($n = 10$; 59%). Other initial signs and symptoms were: pain in the lumbosacral region ($n = 3$; 18%), dysesthesia or paresthesia in the lower limbs ($n = 3$; 18%) and intermittent paraparesis related to physical effort ($n = 1$; 6%). On admission, the patients presented with paraparesis ($n = 15$; 88%), loss of sphincter control ($n = 12$; 71%) and sensory disturbances ($n = 11$; 65%). The symptoms intensified during effort in five cases (29%). According to the modified McCormick Scale (MCS) [8], 7 patients (41%) presented with good condition (MCS grades I–II) and 10 (59%) with significant deficit (MCS grades III–V, Table 2). The duration of symptomatic period ranged from 1 to 60 months (average – 18 months; median – 12 months; <6 months – 3 patients; 7–12 months – 7 patients; >12 months – 7 patients).

2.2. Work-up

All patients underwent preoperative magnetic resonance imaging (MRI) and digital subtraction angiography (DSA) with

selective segmental artery catheterization. All patients had segmental intramedullary hyperintensive signal on the MRI T2-weighted images: 3 levels in 2 (12%) cases, 4 levels in 1 (6%) case, 5 levels in 3 (18%) cases, 6 levels in 4 (24%) cases, 7 levels in 2 (12%) cases, 8 levels in 1 (6%) case, 9 levels in 3 (18%) cases and the 10 levels in 1 (6%) case (mean – 6 levels).

In DSA, 16 (94%) SDAVFs presented the arterial supply from a single radiculomeningeal arterial branch of the corresponding segmental artery. In 1 case (6%), the fistula was supplied from multiple branches of the segmental artery. The fistula was found in the upper thoracic spine (Th1–T6) in 2 cases, in the lower thoracic (T7–Th12) in 11 cases, and in the lumbar spine in 4 cases (Table 1).

In one patient, after the failed attempt of endovascular treatment in another center, a closed initial section of the right segmental artery at the Th12/Th11 level was demonstrated in DSA. The fistula was supplied by the collateral circulation from numerous small arteries from the Th11 segmental artery on the left side.

2.3. Method of outcome evaluation

The modified McCormick Scale was used to assess the neurological status [8], and grades I–II were considered as satisfactory, while grades III–V as unsatisfactory outcome. Relative evaluation of the outcome was performed compared to the preoperative condition, according to three possibilities: 1, “Improved” or “good stable neurological condition”; 2, “neurological deficit unchanged”; 3, “deterioration”. “Good stable neurological condition” was defined as the absence of neurological deficit before and after surgery (MCS Grade I).

The patients were invited for a check-up outpatient visit within 2–6 months after surgery. We used data from the last recorded outpatient visit or data obtained in a telephone interview to evaluate the long-term outcome. The follow-up period ranged from 6 to 200 months (average 7 years) and the data were available for all patients. All patients underwent follow-up MRI at least 6 months after surgery. The spinal cord and venous coronary plexus were evaluated on T2-weighted MRI images. Follow-up DSA was performed only in doubtful cases, i.e., in patients with neurological deterioration or with persistent features of SDAVF in an MRI study.

Statistical analysis was conducted to find the factors which may affect long-term outcome and the evolution of a neurological condition. The following factors were taken into account: age (<60 y.o. vs. >60 y.o.), sex, neurological status before surgery (MCS grades I–II vs. MCS grades III–V), symptom

Table 1 – The levels of SDAVFs occurrence.

Spinal level	Number	%
Th2/Th3	1	12
Th5/Th6	1	
Th7/Th8	1	65
Th8/Th9	1	
Th9/Th10	2	
Th11/Th12	3	
Th12/L1	4	
L1/L2	3	24
L4/L5	1	

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