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Diagnosis and Results of Different Treatment Regimes in Patients with Spinal Abscesses

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Summary

Bacterial abscesses involving the spinal canal are associated with a high morbidity and mortality. Most frequently, these lesions are found in the epidural, rarely in the subdural space. In this report, our clinical material consists of a series of 16 patients treated during the last seven years.

The clinical presentation included local neurological signs (back pain, para-/tetraparesis, bladder dysfunction), disturbances of consciousness (ranging from drowsiness to deep coma) and general inflammatory signs (meningism, fever). All patients presented with risk factors (septic foci, chronic diseases, and iatrogenic causes). Laboratory investigations revealed typically pathological blood sedimentation rate, leucocytosis and CSF-pleocytosis. Radiologically, the diagnosis was confirmed by myelography, CT and preferably MRI. The abscesses were located epidurally in 14 and subdurally in 2 cases. The surgical treatment included laminectomy, or multiple flavectomies in extensive lesions. Drainage systems (either simple silicon outflow drains or suction-/irrigation systems) were installed in all cases, as well as antibiotic treatment.

Results of treatment: Following an observation period of 0,5–6 years, we found complete recovery in six (38%) cases, six (38%) others were mildly disabled and four (25%) patients died.

Focussing on the results of the two different drainage systems, we found a statistically significant superiority of the inflow-/outflow system.

Complications included mandatory re-exploration, post-inflammatory hydrocephalus, syringomyelia, spinal instability, surgical treatment of peripheral septic foci and therapy resistant septicaemia.

In conclusion, we propose that spinal epi-or subdural abscesses require surgical evacuation, using a suction-/irrigation drainage system, as well as antibiotic and intensive care treatment.

Keywords: Spinal abscess; epidural; subdural; surgical treatment; antibiotics; risk factors; diagnostic procedures; MRI.

1. Introduction

Spinal abscesses can be found in the epidural[6, 12, 16, 20, 22, 25, 30, 40, 47, 49], subdural[7, 48] or intramedullary[5, 35, 36] space. In every location it is a very rare disease. Searching the literature, for the epidural lesion, the estimated incidence ranges from 0,02% to 0,05% of all spinal surgical procedures[20, 40]. The subdural spinal abscess is even more rare. Barthels[7] reports 45 cases in the available literature. Intramedullary abscesses have been reported in about 70 cases[5]. Our material includes 14 patients with epidural and two with subdural spinal abscesses.

Aetiologically, most intraspinal abscesses are a complication of other peripheral septic foci. Bacteria can be spread by haematogenic pathways (such as from untreated panaritium)[27, 49] or by direct contact with the intraspinal space (fistulae with Crohn's disease, osteomyelitis)[18]. Another pathogenic mechanism could be a local invasive manoeuvre. (such as intra-/paravertebral injections)[16, 27, 49]. Usually, these patients are suffering from risk factors with diminshed resistance to infection. Among them, chronic disease (diabetes mellitus, alcoholism, tumours, Crohn's disease etc.)[2, 18, 23, 25, 29, 44, 52] were found, as well as iatrogenic causes (postsurgical complications, local injections)[6, 18, 27, 33, 47]. Furthermore, minor trauma and lymphatic spread have been described[6, 28, 49]. The most common bacterial source is Staphylococcus aureus[6, 7, 12, 40, 47, 49].

In view of the complexity of this disease, spinal abscesses are therefore associated with high risk of morbidity and mortality. Focussing on these problems, we present here our experience over the last seven years including a comparison of two different surgical procedures (simple silicone tube outflow drainage versus inflow-/outflow, i.e. suction-/irrigation drainage system). We excluded patients referred prior to this period in view of the inconsistent diagnostic procedures as

Table 1. *Individual Data of the Patients*

Patient no.	Age/ Sex	History	Pre-operative symptomatology	Risk factors	Radiological examinations	Localisation: level ED/SD	Surgery: lami-flav.; UD/SID	Organism	Antibiotics	Outcome		Complications
										early (4 weeks)	late ($^1/_2$–6 years)	
1	52/m	chronic back pain	meningism, bladder dysfunction	local injections	myelo	Th 12-L 1 ED	lami Th 12/L 1 SID	staph. aur.	FFM, GTM, CFM	no deficits	full recovery able to work (I)	psoas abscess (OP)
2	47/m	weakness of limbs	paraparesis, fever, meningism	chronic alcoholism	myelo, CT	Th 9–11 ED	lami Th 9/11 UD	staph. aur.	DCX, GTM	decreasing paraparesis	slight paraparesis able to work (II)	
3	67/m	prostatic hypertrophy urosepsis	paraparesis, mental confusion, fever, gener. sepsis	chron. alcohol. diabetes, card. insuffic., bladder catheter	myelo	L 4–5 ED	lami L 4/5 UD	E. coli	CFT, GTM RFA	gener. sepsis, dead	(IV)	recurrent pus, re-operation
4	46/f	complicated previous abdom. surgery	meningism gener. sepsis	diabetes previous surgery	myelo, MRI	Th 6 SD	lami Th 6 UD	staph. aur. streptococc.	FFM, GTM, CFT, PG, RFA	mental confusion	dead (IV)	hydrocephalus subd. haemorrhage gener. sepsis
5	70/m	back pain weakness of limbs	meningism fever, paraparesis	untreated panaritium	CT	Th 3–5 ED	lami Th 3/5 UD	staph. aur.	DCX, CFM	decreasing paraparesis	slight paraparesis, able to walk, self-supporting (II)	finger amputat. (OP)
6	62/m	chronic back pain	mental confusion meningism, back pain, bladder dysfunction	diabetes	myelo, CT	L 4–5 ED	lami L 4/5 UD	staph. aur.	DCX, MTZ, PIP	moderate paraparesis	slight paraparesis (II)	recurrent pus, re-op.
7	68/m	previous sept. herniotomy	back pain, fever meningism	previous septic. complicated surg.	myelo CT, MRI	L 1–3 ED	lami L 1/3 UD	staph. aur.	FFM, GTM, CFT, IMP	moderate paraparesis	no deficits able to work (II)	retropharyngeal abscess (OP)
8	62/m	cardiomyopath., phlegmonia, back pain	septic shock unconscious, paraparesis	untreated phlegmonia, cardiomypath.	myelo CT, MRI	Th 2–3 ED	lami Th 2/3 UD	streptococc. agalacticae	GTM, IMP, AMC	septic shock coagulopathy	dead (IV)	therapy resistant septicaemia

Table 1. *(continued)*

Patient no.	Age/ Sex	History	Pre-operative symptomatology	Risk factors	Radiological examinations	Localisation: level ED/SD	Surgery: lami-flav.; UD/SID	Organism	Antibiotics	Outcome		Complications
										early (4 weeks)	late ($^1/_2$–6 years)	
9	72/m	previous amputation of the lower leg under spinal anaesthesia	somnolence, meningism, paraparesis	diabetes, previous spinal anaesthesia	myelo MRI	C4-Th3 ED	lami C4 + lami Th2 SID	staph. aur.	CFM, CLM	artificial respiration	slight paraparesis (II)	
10	32/f	Crohn's disease back pain, fever	unconscious gener. sepsis tetraparesis	Crohn's disease presacral abscess fistulae	myelo CT MRI	C3-sacrum SD	flav C7/Th1 flav Th12/L1 SID	streptococc. viridans	PG, MTZ, OFT	ataxia, mental disorder	able to walk (II)	hydrocephalus syringomyelia presacral abscess (OP)
11	49/m	chronic back pain	meningism rever, back pain	alcoholism	myelo, MRI	C3 ED	lami C3 UD	staph. aur.	DCX, MTZ, CFT, VCM	decreasing tetraparesis	residual arm paresis, able to work (II)	spinal instability
12	73/m	urethral stenosis bladder catheter	tetraparesis meningism	diabetes urethral stenosis	MRI	C3-L5 ED	lami C6 + lami Th5 + lami L3 SID	staph. aur. staph. epid.	CFT, DCX, MTZ, VCM, IMP	decreasing tetraparesis	recurrent sepsis, dead (IV)	deep vein thrombosis gener. sepsis
13	67/m	septic complication of pleural drainage	tetraparesis unconscious artif. respiration	plasmocytoma	myelo	C3-L5 ED	flav C7 Th1 + flav Th5/6 + flav L5/S1 + craniotomy fossa posterior SID	staph. aur.	CFT, GTM, RFA, VCM, MTZ, IMP, DCX	decreasing tetraparesis mental disorder	able to walk, no deficits (I)	hydrocephalus, psoas abscess
14	49/m	chronic back pain	back pain, fever meningism	local injection alcoholism	myelo CT, MRI	L2–5 ED	flav L2–5 SID	staph. aur.	CFT, FFM, DCX, GTM, MTZ	no deficits	full recovery able to work (I)	
15	52/f	chronic back pain	paraparesis, fever, meningism	diabetes, card. insuff. adipositas	MRI	Th6–9 ED	lami Th6/9 SID	staph. aur.	GTM, DCX, CFX	decreasing paraparesis	able to walk, no deficits (I)	
16	58/m	increasing sciatics	fever, back pain sciatics	pyelonephritis minor trauma	CT, MRI	L2-sacrum	flav L2/3 + flav L5/S1	staph. aur.	CFT, FCX, GTM, MTZ, PIP	no deficits, free of pain	full recovery (I)	

f female, *m* male; *ED* epidural, *SD* subdural, *UD* usual drainage, *SID* suction-irrigation-drainage, *lami* laminectomy, *flav* flavectomy, (*OP*) additional general surgical treatment necessary. Antibiotics: *AMC* Amicacine, *CFM* Cefamandol, *CFT* Cefotaxim, *CFX* Cefatriaxon, *CLM* Clindamycine, *DCX* Dicloxacilline, *FCX* Flucloxacilline, *FFM* Fosfomycine, *GTM* Gentamycine, *IMP* Imipenem, *MTZ* Metronidazol, *PG* Penicilline G, *PIP* Piperacilline, *RFA* Rifampicine, *VCM* Vancomycine. Results: (*I*) recovery, (*II*) mildly disabled, (*III*) severely disabled, (*IV*) dead.

well as the varying medical, antibiotic and intensive care treatment modalities.

2. Patients and Methods

From 1985–1992, 16 patients (13 male, 3 female) were operated on for a spinal abscess in our hospital. The age distribution ranged from 32–73 years, the mean was 58 years.

2.1. Clinical Symptoms and Signs

An overview of the clinical condition of our patients is presented in Table 1. Typically, most patients presented with a short history of less than 2 weeks, the others became symptomatic within one month.

The patients showed three kinds of main symptoms, namely spinal symptoms (nine cases with para-/tetraparesis, five patients with back pain and two others with bladder dysfunction), disturbances of consciousness (six patients, ranging from drowsiness to deep coma) and general inflammatory signs (meningism in 14 cases and fever of more than 39 °C in 11 patients).

Risk factors could be evaluated in all patients: The most frequent was diabetes mellitus (n = 6), followed by chronic alcoholism (n = 4), peripheral septic foci (panaritium, untreated skin infections (n = 2), urosepsis (n = 3), tumour with pleura empyema (n = 1), Crohn's disease (n = 1) and minor trauma (n = 1). Iatrogenic causes were local injections/spinal anaesthesia (n = 3) and post-surgical complications (wound infections after herniotomy or gastro-splenoduodenectomy, n = 2). In nine cases we found more than one risk factor. Haematogenous dispersion was responsible in ten cases, local direct spread occurred in three patients (Crohn's disease with fistula findings, pleura empyema/tumour and one case with osteomyelitis in the vertebra), local injections were responsible in three cases (intra-/paravertebral injections and spinal anaesthesia with lumbar puncture).

Usually, the standard laboratory examinations revealed a high blood sedimentation rate. Furthermore, in all cases, a leucocytosis was observed, ranging from 10000–30000 cells/µl. Typically, septic findings were present in the CSF as well, namely pleocytosis ranging from 200–40000 cells/ml and an elevated protein content from 125–6300 mg/dl.

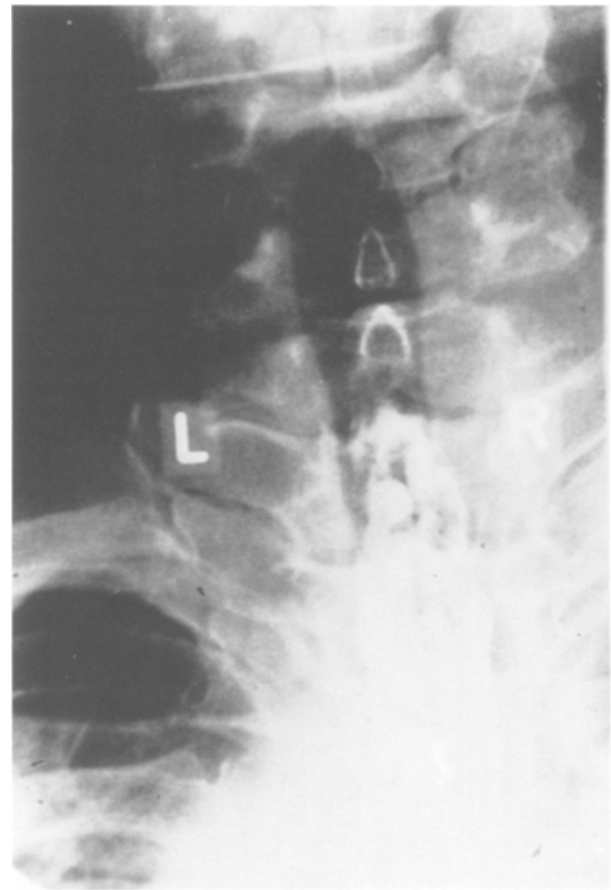

Fig. 1. Myelogram of a 49 years old male patient with fever, meningism and a history of chronic alcoholism showing an irregularly shaped contrast-medium filling with a block in the cervical spine, presenting the caudal margin of the lesion, whilst the cranial extension coult not be evaluated. Intra-operatively, epidural pus was evacuated

2.2. Radiological Examinations

In 12 patients, myelography was performed, in most cases before MRI examinations were available. In all patients, a block to the contrast medium was found at the caudal level of the lesion[35]. It was not possible to discriminate between epi- and subdural lesions and to determine the exact extension of the process. An example is given in Fig. 1.

CT scanning was carried out in eight cases, postmyelographic CT in five patients. Using this examination, the paravertebral extension could be visualized as well as the localization of the abscess in the spinal canal (Fig. 2)[18, 31, 32, 48].

MRI-examination (T 1-weighted, gadolinium-contrast enhanced, in sagittal and transverse imaging technique) was used in ten patients which enabled us to visualize the extension of the lesion in the best manner (Figs. 3–5)[4, 9, 14, 22, 25, 44] and revealed it to be the most reliable imaging technique.

The radiological investigations and findings are presented in Table 1. Most of the abscesses were located in the thoracic and lumbar area. Four patients were found with an extensive lesion of more than seven levels (in one case the posterior fossa was also affected).

2.3. Surgical Procedures

Laminectomy including one or more levels was necessary in 12 cases. In extensive lesions, laminectomy or flavectomy at several different levels had to be performed. Frank pus and/or granulomateous tissue was removed as far as possible. Drainage systems were used in all cases, in eight cases silicone tube outflow drains (usual drainage, UD) were used and in eight other patients an inflow-/outflow-drainage (suction- irrigation drainage system, SID) was installed for 4–17 days (mean 10 days). Pairs of tubes were installed following laminectomy or flavectomy, approaching the total extent of the lesion, in cases with different approaches up to four pairs of lines were required for adequate drainage. For irrigation, saline solution was used without strict volume limitation, but an exact inflow-/outflow balance was performed to detect possible congestion of the

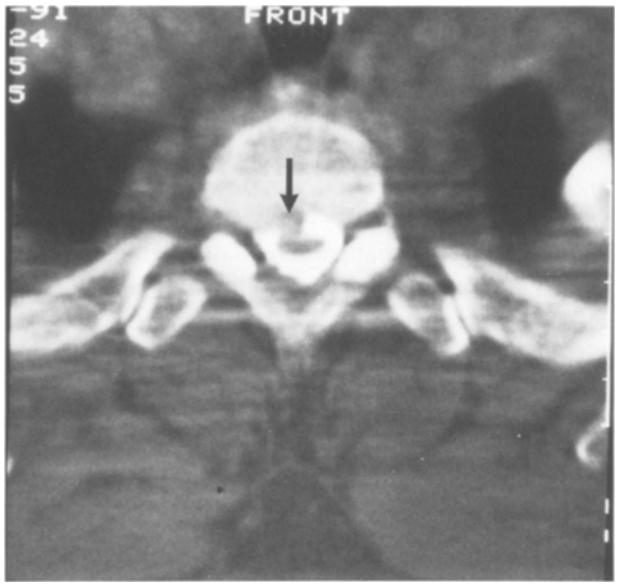

Fig. 2. Post-myelography-CT scan from the same patient as in Fig. 1, showing a break in the contrast material (arrow). An intraspinal ventral epidural space-occupying lesion can be visualized and was proven intra-operatively

Fig. 3. Sagittal T 1-weighted, contrast-enhanced MRI (from the same patient as in Fig. 1 and Fig. 2) presenting the total extension of the epidural abscess in the upper cervical spine (arrows). The abscess membrane shows high signal intensity because of contrast enhancement

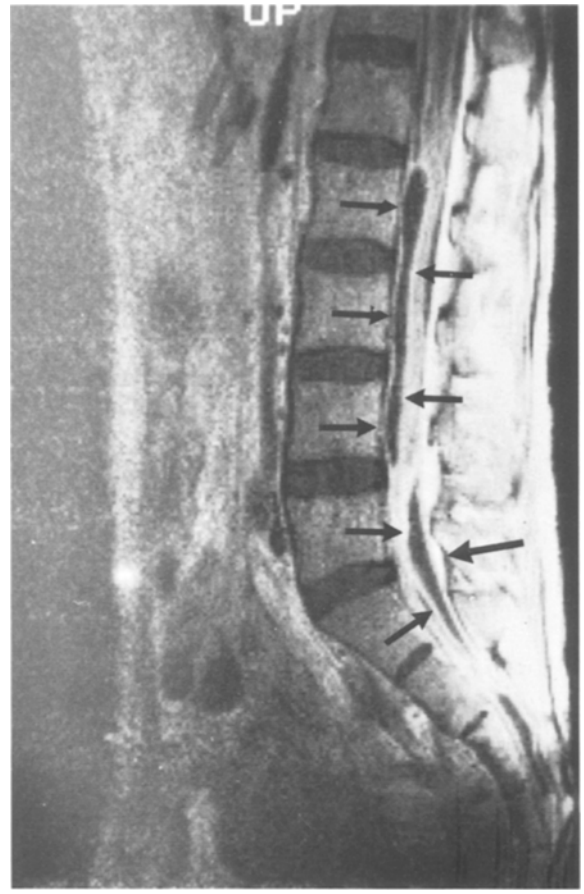

Fig. 4. Sagittal, T 1-weighted contrast-enhanced MR-image of a 30 years old woman suffering from Crohn's disease with fistula findings, showing multiple subdural abscesses (arrows). The membrane demonstrates characteristically high signal intensity because of contrast enhancement, the intramembraneous pus remains of low signal intensity. The longitudinal extension of the lesion can be visualized

outflow drain and effusion into the surrounding tissue. Furthermore, frequent serum electrolyte controls had to be done to avoid sodium intoxication. The saline inflow was driven by orthostatic forces only and occasional mild suction was performed to the outflow tube by syringe to maintain the line open. The system was kept until only clear, sterile fluid was obtained, the inflow lines were usually removed two to five days before the outflow tubes.

In 14 cases we found epidural and in two cases subdural abscesses. In the patient with abscess extension into the posterior fossa, an osteoclastic craniotomy was also performed. An overview of the surgical procedures is presented in Table 1.

2.4. Microbiological Findings and Antibiotic Treatment

The microbiological examinations revealed staphylococcus aureus in 13 cases, whilst in three other staphylococcus agalacticae, staphylococcus viridans and another staphylococcus were found. Escherichia coli and staphylococcus epidermidis were two other prevalent organisms. In three patients, two different organisms were

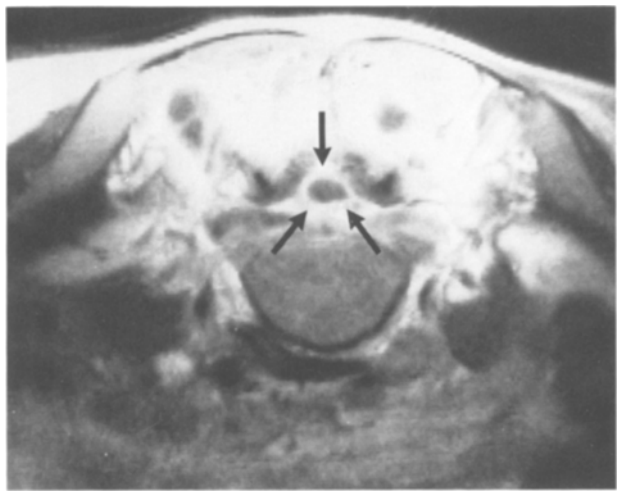

Fig. 5. MRI examination of the same patient as in Fig. 4, transverse view, (T 1-weighted, contrast-enhanced) presenting a high signal intensity around the membranes of the dura (arrows). The intradural space occupying pus remains of low signal intensity

found. In nine patients, the same organism could be found in the blood culture (n = 6), in the CSF-culture (n = 6) or in other peripheral foci (n = 4).

Initially, we started to treat all patients with combination of three antibiotics (cephalosporine of third generation, cefotaxime, 3 × 2 g/day; aminoglycosid, tobramycine 3 × 80–120 mg/day (1–2 mg/kg body-weight, serum level controls necessary) and penicillinase-resistant penicilline/dicloxacilline; 6 × 2 g/day). The detailed microbiological findings and antibiotic treatment schedule of each patient are described in Table 1. After the result of the microbiological tests, the treatment was adjusted accordingly. In eight cases the antibiotic combination had to be changed once again due to the development of resistant organisms.

The duration of antibiotic treatment was dependend on the clinical course of the patients; sometimes oral treatment was continued for several weeks in the post-acute phase[9], always with the well-known side effects in mind.

3. Results

3.1. Follow-up and Hospitalisation

All patients were followed-up at four weeks and then again, after an observation period of between six months to six years.

The hospitalisation in the intensive care unit ranged from 0–77 days (mean 28 days) and the duration of ward treatment ranged from 17 days to about six months in four cases. The mean total duration of hospitalisation was 108 days.

3.2. Clinical Results

The results of the surgical-, antibiotic- and intensive care treatment are presented in Table 1. Regarding the two different surgical regimes, we found in the group with conventional drainage treatment (n = 8) one case with total recovery, four were mildly disabled and three died. On the other hand, from the eight patients who were treated with the inflow-/outflow systems, five were classified as totally recovered, two were mildly disabled and only one died.

Comparing these data differentiated into percentage ranges, we found a superiority of the suction-irrigation-method, which could be proved statistically (χ^2-test, $p < 0.05$). The datailed data are given in Table 2.

Surviving patients, reviewed after a long observation period, showed a satisfactory recovery. Of these 12 surviving patients, six could be classified as fully recovered, six were only mildly disabled and are able to support themselves, and four of these are working again. It becomes obvious that in this disease a long time of around six months must be allowed to watch carefully for possible complications, but afterwards the chance of recovery is good.

3.3. Complications

Due to a recurrent intraspinal space-occupying lesion or wound infection, re-exploration became necessary in three patients. Post-inflammatory hydrocephalus occurred in three patients requiring a shunting procedure. Syringomyelia and a spinal instability problem developed in two patients, respectively. Because of other peripheral septic foci (such as psoas abscess, finger amputation following panaritium, retropharyngeal abscess) four patients had to be operated on in the general surgical- or ENT-department. One patient suffered from deep vein thrombosis. Four died, three of

Table 2. *Comparison of the Results of the Different Surgical Procedures: Usual Drainage versus Suction-Irrigation-Systems*

	Usual drainage	Suction-irrigation-system
Recovery (I)	1 (13%)	5 (63%)
Mildly disabled (II)	4 (50%)	2 (25%)
Severly disabled (III)	0 (0%)	0 (0%)
Dead (IV)	3 (37%)	1 (12%)
Total (n = 16)	8 (100%)	8 (100%)

The advantage of the suction-irrigation method could be established by finding a recovery rate of 63% with the suction-irrigation system, whereas usual drainage yielded only 13%. On the other hand, 37% of the patients died following the usual drainage, whilst only 12% died after treatment with suction-irrigation method. Statistical proof (χ^2-test, $p < 0.05$)[43] demonstrated the superiority of the suction-irrigation system.

them as a consequence of therapy-resistant septicaemia and another following a shunting procedure for hydrocephalus, complicated by subdural haemorrhage and septicaemia. These patients were aged (46, 62, 67, 72 years) and had severe risk factors (2 with urosepsis following prostatic adenoma, one patient with skin sepsis (phlegmone), one case with previous extensive abdominal surgery) and severe general diseases (2 with diabetes mellitus, one alcoholic, 2 with renal and cardial insufficiency). In one case, after initial improvement, the patient was transferrred to another hospital, but developed recurrent general septicaemia and died within four weeks. Time delay between surgery and death was ten days to five months.

4. Discussion

The first description of an epidural abscess was given by Morgagni, 1796[38], followed by Bergamashi, 1820[8]. The term "perimeningitis spinalis" was introduced by Albers, 1833[3]. The first surgical treatment was performed by Delorme, 1892[13]. Unfortunately, the results were poor at the end of the last and the beginning of this century. The first reviews of the literature, mostly of single case reports, were presented by Kaminski (1917)[28], Schmalz (1925)[45], Dandy (1926)[11] and Watts (1931)[50]. The reviews of Schmalz, 1925[45], Dandy 1926[11] and of Weber 1955[51], are summarized in Table 3 as well as the results from ten other groups, collected from 1930–1987.

Table 3

Author	Period of observation	Number of patients	Reviews of the literature				
			Outcome				Follow-up period
Schmalz[45]	1796/1820–1925 (review)	43	I: III:	3/43 0/43	II: IV:	2/43 38/43	1–2 months
Dandy[11]	1833–1926 (review)	25	I: III:	0/25 2/25	II: IV:	0/25 23/25	1 month–years
Heusner[24]	1930–1948	20	I: III:	11/20 3/20	II: IV:	2/20 4/20	not reported
Hulme[26]	1933–1952	10	I: III:	4/10 2/10	II: IV:	1/10 3/10	1 month–10 years
Weber[51]	1932–1955 (review)	228	I: IV:	68/228 96/228	II + III: V:	24/228 40/228	3–8 months, sometimes not reported
Hancock[21]	1945–1968	49	I: III:	5/49 24/49	II: IV:	20/49 0/49	not reported
Baker[6]	1947–1974	39	I: III:	23/39 4/39	II: IV:	5/39 7/39	not reported
Dus[15]	1948–1957	8	I: III:	3/8 2/8	II: IV:	2/8 1/8	$^1/_2$–6 years
Dei Anang[12]	1956–1986	15	I: III:	9/15 3/15	II: IV:	2/15 1/15	"discharge"
Ravicovitch[40]	1957–1980	42	I: III:	19/42 8/42	II: IV:	14/42 1/42	$^1/_2$–22 years
Hakin[20]	1959–1979	12	I: III:	3/12 6/12	II: IV:	3/12 0/12	not reported
Strohecker[47]	1978–1984	15	I: III:	7/15 5/15	II: IV:	2/15 1/15	not reported
Hlavin[25]	1980–1989	39	I: III:	18/39 2/39	II: IV:	10/39 9/39	5 weeks/"discharge"
Klinger[30]	–1987	8	I: IV:	3/8 1/8	II + III:	4/8	not reported

I recovery, *II* improved, *III* unchanged, *IV* dead, *V* not reported.

Obviously, initially most of the patients did not survive this disease. Later, after introducing more skillful surgical regimes, and especially after the availability of antibiotics, the results clearly improved. Nevertheless, "modern authors" (1975–1990) report a mortality of 9–20% (Baker[6], Hlavin[25], Klinger[30], Leys[32], Stroeker[47]).

Especially regarding the subdural lesions, Bartels[7] describes a mortality of 25% and a mortality of 47% in his recent review of all reported cases (n = 44). This points out that, although the incidence of spinal abscesses is low, they are a severe and lifethreatening disease with a high morbidity and mortality rate. In our own material, we found a comparable mortality rate (epidural 3/14, 21%; subdural 1/2, 50%; or total 4/16, 25%).

In terms of diagnostic procedures, a number of differential diagnoses must be excluded: spinal tumours, degenerative disorders such as disc herniations or spinal stenosis, rheumatic diseases, spondylodiscitis, osteomyelitis, intracranial space-occupying lesions, meningitis, infectious diseases etc.[1, 6, 20, 25, 30, 40, 41, 49]. Clinically, the patients often present with non-specific signs of back pain, inflammatory signs or symptoms of intracranial lesions[47, 49], so that these differential diagnoses, as enumerated above, have to be considered especially in view of the rare incidence of spinal abscesses. The typical laboratory findings mentioned above[6, 7, 12, 23, 47] are helpful to confirm the suspected diagnosis. However, among the imaging techniques, MRI has proven to be the most reliable radiological examination[4, 9, 14, 22, 25, 44]. This non-invasive technique enables visualization of the longitudinal extension, epi- or subdural appearance, as well as dorsal, lateral or ventral localization and the paraspinal appearance.

It should be stressed that this diagnostic procedure has to be performed as early as possible to prevent progressive neurological deficits and complications. Patients with neurological symptoms and signs should be operated on immediately after establishment of the diagnosis. In cases without neurological deficit, conservative treatment also seems to be possible. Mampalam[34] describes a series of six patients, all of them without motor or sensory deficits, clinically presenting with septic symptoms and local spinal pain, which were treated only by antibiotics. Leys[32] points out that in his series of five patients he decided for conservative treatment because of high surgical risk in elderly cases already suffering from a multiplicity of other problems i.e. diabetes. But one of them was operated on later because of rapid neurological deterioration. Hanigan[22] mentioned three conservatively treated patients of either high risk or minor neurological deficits. All these patients improved or fully recovered. In some cases, a CT-guided puncture was performed to obtain pus for bacteriological examination. On the other hand, Baker[6] reported on five patients without surgery and lethal results. In conclusion, all authors describing a conservative treatment regime emphasize this procedure only for use in patients without neurological deficits or at high risk. In cases of neurological deterioration, a decompressive surgical procedure must be performed immediately[6, 7, 20, 22, 25, 27, 32, 37, 47].

Surgical procedures should include laminectomy in cases of limit extent. Not more than three levels must be removed in order to prevent problems of spinal instability[1]. In cases of wider spread, flavectomy or single laminectomy at several different levels could be done and the pus evacuated. In some cases it was intraoperatively difficult to differentiate between abscess membranes and the dura mater. Therefore, in subdural abscesses, the dura should be opened carefully using microsurgical techniques for evacuation of pus, but soft drainage systems should be installed as well. Membranes should be removed as far as possible to prevent abscess-remnants or regrowth. Membranes can often be visualized with the MRI or CT scan by contrast enhancement.

In six patients, we used a modified inflow-/outflow-drainage system as earlier described by Garrido and Rosenwasser[19], which was installed for five to 17 days[47]. As mentioned in 3.2, we obtained better results with patients treated by the suction-irrigation method. This demonstrates, that consequent removal of pus, which could not be achieved by surgical means only but needed the long-term wash-out procedure as well, is the requirement to improve the results.

With respect to the antibiotic treatment, we started, after taking an intraoperative smear, with a combination of three antibiotics (cephalosporines of third generation, cefotaxime; aminoglycosids, tobramycine and penicillinase-resistant penicilline, dicloxacilline), which are known to be able to treat the most frequently found staphylococcus aureus[12, 32, 49]. Following isolation of the organism by culture, the antibiotic therapy could be changed accordingly[34]. In 50% of our patients, a change of the antibiotic combination had to be made because of clinical resistance to treatment. Apart from the specifity of the antibiotics against the bacteria, the permeability of the blood-brain-barrier to these drugs

must be considered. It is well-known that some of these drugs can permeate at a higher rate in cases of inflammatory processes. In case of long-term treatment, the well-known side effects of antibiotic treatment must also be considered.

Some of these patients showed other peripheral abscesses, either as the origin of the disease (for example a panaritium) – or as sequelae of the spinal abscesses (for example psoas – or retropharyngeal abscesses). These complications made further surgical and antibiotic treatment necessary. Other rare complications mentioned are syringomyelia[10,46] or post-inflammatory hydrocephalus[17] – which required shunting procedures. The cervical spinal instability in one case led to a follow-up operation with stabilization procedure (ventral spondylodesis with bone graft)[1].

One of the striking problems of these patients are multimorbidity and risk factors. Chronic diseases such as diabetes mellitus, alcoholism, or immunsuppressive diseases like tumours or Crohn's disease[2, 18, 23, 29, 42, 52] are often the cause of an increased risk to infectious morbidity. Furthermore, the post-surgical intensive care treatment needs to be strict in this group of patients, and requires persistence in view of the long period, in which patients may succumb to vital complications.

5. Conclusions

Spinal abscesses (epi- or subdural) remain a rare disease with a high risk of morbidity and mortality, especially in patients with additional risk factors. The typical presentation includes spinal symptoms, inflammatory signs or disturbances of consciousness. The diagnostic procedure has to exclude a number of differential diagnoses and includes laboratory investigations (blood sedimentation rate, leucocytosis, CSF-findings with increased cells and protein content) and radiological examinations (myelography, CT and MRI). MRI (with gadolinium contrast-enhanced images, T1-weighted, in sagittal and transverse views) semms to be the most reliable diagnostic tool today. The surgical procedure requires laminectomy or, in cases with extensive lesions flavectomy at several different levels with consecutive drainage (inflow-outflow) systems. The antibiotic therapy should be started immediately and include a staphylococcus aureus fighting combination.

Septic complications requires mandatory intervention such as post-inflammatory hydrocephalus or metastatic abscesses.

Following their initial survival and a long high risk period with the necessity of surgical, intensive care and antibiotic treatment, the patients have a good chance of recovery.

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