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Neurological complications of spinal tuberculosis in children

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Abstract Neurological complications of thoracic and lumbar spinal tuberculosis were studied in 32 patients under the age of 16 years. The majority had lesions involving three or more vertebral bodies. Paraplegia occurred in 8 patients and was always associated with bladder and bowel dysfunction. Lesions located at T4/5 were most commonly accompanied by paraplegia. Deterioration of the neurological status was related to the degree of spinal stenosis, whereas the degree of kyphosis was of less importance. Radiculopathy is rare in children with Pott's disease.

Résumé Sont étudiées les complications neurologiques de la tuberculose vertébrale observées chez 32 enfants âgés de 16 ans au maximum avec une lésion de la région thoracique et la région lombaire. Dans la plupart des cas l'atteinte a été de trois vertèbres et plus. 8 cas de paraplégie complète ont été notés toujours accompagnés par la dysfonction des organes du bassin. Les problèmes moteurs sont observés le plus souvent dans les cas de la lésion des vertèbres T4-T5. La gravité des troubles neurologiques dépend de la sténose du canal rachidien. On ne trouve pas de relation directe entre la caractère de la myélopathie et l'importance de la cyphose. La radiculopathie est observée très rarement chez les enfants souffrant du mal de Pott.

Introduction

It is known that spinal tuberculosis is more severe, dangerous and disabling in children than it is in adults. The purpose of this study was to examine the relationship between neurological complications and the level of the lesion, the degree of kyphosis and the extent of spinal canal encroachment in children with spinal tuberculosis.

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Patients and methods

From 1991 to 1997 76 children with spinal tuberculosis underwent surgical treatment. Thirty-two children under the age of 16 years with radiological involvement of the thoracic and lumbar spine and neurological dysfunction of more than 2 months' duration were included in the study.

The grading of motor function was estimated according to the Frankel scale [2]. Grade A, paraplegia with complete sensory loss; grade B, paraplegia with or without sensory loss; grade C, incomplete paraplegia (paraparesis) with or without sensory loss; grade D, paraparesis or abnormal pyramidal reflexes; grade E, normal neurological status.

Bladder and bowel dysfunction was documented. Myelography with non-ionic contrast media (iogexol) was performed pre-operatively and 2 months after the operation. Quantitative analysis was taken from the central of the lateral laminograms. Two parameters were measured: the kyphotic Cobb's angle and the relative spinal stenosis (RSS, as a percentage) (Fig. 1). The term "relative" was

Fig. 1 Methods for the quantitative estimation of spinal tuberculosis. A, kyphotic Cobb's angle; RSS, relative spinal stenosis: a, antero-posterior (AP) size of the subarachnoid space at the neutral zone (if the lesion is located at the level of physiological widening of the spinal cord Th11–Th12, a is estimated as an average between the AP size of the subarachnoid space on the neutral zones located above and below the level of compression). b, AP size of the subarachnoid space at the top of kyphosis

Table 1 Pediatric patients with neurological complications of spinal tuberculosis

Patient number	Age (years)	Level	Initial kyphosis	Relative spinal stenosis	Neurological status					
					Pre-operative			Post-operative		
					Frankel grade	Bladder/bowel dysfunction	Radiculopathy	Frankel grade	Bladder/bowel dysfunction	Radiculopathy
1	4	Th2–9	75	75	D			E		
2	11	C7–Th5	48	100	A	Yes		E	No	
3	2	Th2–4	30	56	D			E		
		Th10–11								
4	2	Th8–9	26	100	A	Yes		C	No	
5	3	Th3–5	47	67	D			E		
6	3	Th11–L1	41	56	E		Yes	E		No
7	14	Th5–7	55	100	C			C		
8	2	Th3–8	54	100	D			E		
9	2	Th2–5	52	36	C			E		
10	3	L1–2	59	50	D			E		
11	19 month	Th1–8	38	67	B	Yes		C	No	
12	5	Th1–5	87	53	C	Yes		E	No	
13	15	Th5–7	65	59	D			D		
14	15 month	Th3–8	70	100	A	Yes		A	Yes	
15	13	Th4–8	90	66	D			E		
16 ^a	7	Th8–9	65	66	D			D		
17	11	Th5–7	32	69	A	Yes		B	Yes	
		Th11–12								
		L1–2,4–5								
18	3	Th4–7	45	73	C			E		
19	2	Th5–10	50	53	D			E		
20	9	Th3–5	35	43	C	Yes		E	No	
21	17 months	Th7–9	43	73	D		Yes	E		No
22	3	Th5–L1	70	70	A	Yes		C/A ^b	Yes	
23	18 months	Th6–11	32	50	D			E		
24	15	Th12–L1	55	33	E		Yes	E		No
25	2	Th4–8	38	100	A	Yes		E	No	
26	3	Th4	13	100	B	Yes		E	No	
27	2	Th8–10	58	100	D			E		
28	2	Th11–L2	24	21	D			E		
29	3	Th8–10	63	46	D			E		
30	3	Th7–11	44	40	D			E		
31	18 months	Th4–6,9	38	20	E		Yes	E		
32	16	Th7–8	35	100	C/B	Yes		E	No	

Ages of the patients under 2 years are indicated in months

^aPatient with associated cerebral palsy

^bPatient with transplant dislocation (explanation in the text)

used as the narrowing of the subarachnoid space was measured; thus, the maximum RSS value of 100% was found in cases of complete block at the level of the lesion.

The pathological symptoms (non-pyramidal) that corresponded to the affected vertebral segment were recorded as radiculopathy.

Results

The summarized data are seen in Table 1. The average age at the time of surgery was 5.3 years (1 year 6 months–16 years).

Following the complete removal of all pathological tissue, anterior and lateral spinal decompression with anterior fusion was performed. Pure radical anterior surgery (the Hong Kong operation) was used in 18 cases; the same surgery with added posterior instrumentation in 17 cases, including 2 cases using a 3-stage procedure [7,8]. Two patients underwent 2 or 3 procedures for

multi-level lesions. Surgery was always combined with long-term triple antibiotic therapy.

Myelopathy was present in 29 patients. Eight patients had paraplegia (grades A and B on the Frankel scale). In 1 further case (no. 32) paraplegia developed after admission to hospital. Bladder and bowel dysfunction were found in 11 patients, including all cases of paraplegia. Radiculopathy occurred in 4 patients, in only 1 of whom were there associated motor disorders (no. 21).

Widespread lesions were prevalent. Three or more vertebral bodies were destroyed in 27 patients. The average number of affected segments in this group was 5, with a maximum of 9 vertebrae in 2 patients (cases 17 and 22). Four patients had damage localized to 2 vertebrae, and only 1 patient (case 26) had 1 affected vertebra. Three patients had multi-level lesions that were separated by unaffected segments (cases 3, 17 and 31).

In patients with neurological complications, the mid-thoracic region (T4–T8) was the most commonly affected. In the group with severe motor dysfunction (grades A, B, C on the Frankel scale) the T4–T5 level was the most commonly affected. In the group with less severe dysfunction (grade D) the T8 level was most commonly affected.

The average Cobb's angle was 46°. However, unexpected results were revealed when the average kyphosis was measured within each group. The average kyphosis was significantly less in patients with paraplegia (grades A and B) than in Grade C and D (42°, 52° and 57° correspondingly).

Neurological dysfunction was present in the majority of cases where narrowing of the subarachnoid space exceeded 50%. The incidence and severity of this complication increased with the rise of RSS. This figure was highest in patients with paraplegia (94%).

Neurological improvement usually appeared during the first 2 or 3 post-operative weeks. The improvement in spinal stenosis was confirmed by postoperative myelography. No patient had spinal stenosis exceeding 50% after surgery. The post-operative neurological status is seen in Table 1. Complete neurological recovery was seen in 21 patients with myelopathy, and in 3 patients with only radicular symptoms. Incomplete neurological recovery after surgery occurred in 4 patients. In patient 22 significant improvement was seen immediately post-operatively; however, paraplegia returned due to subsequent cord compression. This patient, a 3-year-old boy, had maximal initial involvement with 9 affected vertebral bodies. Four patients (cases 7, 13, 14 and 16) had no change in neurological status, including 1 patient with associated cerebral palsy.

Discussion

Spinal tuberculosis most commonly affects the thoracolumbar region [5,6]. In this series of children with neurological complications, the mid-thoracic region was the most commonly involved. Disease at T4/5 was usually complicated by paraplegia or severe paraparesis. However, less severe myelopathy, (grade D on the Frankel scale), was usually associated with lesions at T7–9.

In contrast to congenital kyphosis [13] we found no relationship between the degree of kyphosis and the severity of motor dysfunction. Moreover, in our study paraplegia seemed to be associated with minor deformities; and kyphosis was more severe in patients with less severe myelopathy. Motor dysfunction was directly related to the degree of spinal stenosis. The risk of motor involvement sharply increased when compression on the subarachnoid space exceeded 50%.

This can probably be related to the nature of the local vascular anatomy; as the poorest vascular supply of the

spinal cord is at the T4/5 level [1,3]. In contrast, in patients with grade D myelopathy, the vascular component plays a less significant role when compared with the effects of direct compression of the spinal cord. The fact that myelopathy seldom occurred if the narrowing of the spinal canal was less than 50%, indicates the higher level of tolerance of the spinal cord in children to slowly progressive compression.

Radical anterior surgery led to complete neurological recovery in the majority of cases [6,7,9,12]. In one quarter of the cases incomplete recovery was seen due to irreversible changes within the spinal cord; changes that may be diagnosed pre-operatively on magnetic resonance imaging (MRI) scanning [10,11]. In a few of our cases the presence of epidural abscess interfered with the interpretation of cord involvement on MRI. Despite this, MRI must be recommended in all cases of paraplegia.

Radiculopathy was rare in children with spinal tuberculosis, and resolved post-operatively. Despite spinal instability the relatively larger size of the intervertebral foramina is of importance in explaining why radiculopathy occurs more rarely in children than in adults.

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