Rheumatoid and other diseases of the cervical interspinous bursae, and changes in the spinous processes

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SUMMARY Bursal spaces between the cervical interspinous processes were found at necropsy in 14 out of 27 'normal' adult necks, especially when the spines were close together. In this random series they were the seat of crystallopathic disease in 2 instances out of 14 cases. In spines from 9 cases of adult-onset rheumatoid arthritis, rheumatoid bursitis was seen in 2 and banal bursitis in 2. In juvenile-onset chronic arthritis inflammatory bursal changes of a rheumatoid nature were found in 2 out of 5 cases, and are compared with the 'normal'. A third case showed crystallopathic destruction. In one instance of adult RA very severe changes were seen, with destruction of the spinous processes, and this was associated with hypermobile segments dependent on discal destruction starting in the oncovertebral joints. An association is described between discal lesions, spinous erosion, enthesopathy, and interspinous bursitis.

In addition to 156 bursae already listed a variable number of bursae may occur between the spinous processes of the vertebrae. In the lumbar region these may give rise to symptoms known as Baastrup's syndrome2 and have recently been described pathologically.3 We have also seen patients, as described by Michotte,4 with pain in the neck ascribed to a similar process. The anatomy of such bursae has not heretofore been described (except in brief abstracts4−7), and the present study was undertaken to discover their appearance in 'normal' spines and in diseased spines.

Materials and methods

The cervical spine was removed as a whole from C1-T1 in 25 random necropsies and a less complete segment in 2 (Table 1). A midline sagittal section was taken (as well as other sections), inspected, photographed, and x-rayed. Blocks were cut for histological examination. Material was available from 9 cases of rheumatoid arthritis and 5 of juvenile rheumatoid arthritis, treated in a similar way.

Table 1 Cervical spines studied

<table>
<thead>
<tr>
<th>Category</th>
<th>Total spines studied</th>
<th>No. showing bursae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random necropsies</td>
<td>27</td>
<td>14</td>
</tr>
<tr>
<td>Juvenile chronic arthritis</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Adult-onset rheumatoid arthritis</td>
<td>9</td>
<td>4</td>
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NORMAL ANATOMY

In a random series of 27 spines from patients aged 24-77 years bursae were found in 14 cases. They occurred most frequently at C6–7 but could also be found at all other cervical interspaces except C1–2. Their presence seemed to be related to the nearness of the spinous processes to each other, as we have shown (statistically) occurring in the lumbar spine (Bywaters and Evans, in preparation).

It was more difficult to measure the ‘bursal index’ (a quantitative measure of spinous process spacing*) in the neck than in the lumbar spine because of the greater irregularity of the distance between 2 adjacent spines and the greater variation between the different spines. It was also less valid because of the greater mobility of the neck and uncertainty about the final post-mortem posture. Thus for instance the distances between the lower 5 spinous processes added together may vary (as a total) from 2.9 cm in flexion to 0.8 cm in extension, a variation from the intermediate erect position of +70% in flexion to −50% on extension, the biggest range being shown in the lower segments (Fig. 1).

The intermediate position (erect) gives a bursal index of 23% compared with 32% in flexion and 19% in extension. However, it is apparent on looking at lateral x-rays that in some people—usually with short necks—the spinous processes are crowded together and touch on extension, whereas in others they are far apart and may never come into contact. Thus the 2 spines illustrated in Fig. 2 show ‘bursal indices’ of 26% for the long neck and 11% for the short neck. It is the latter type of patient that forms bursae.

DESCRIPTION

These bursae in the neck consisted normally of narrow slits starting at the base of the spinous process and extending up from the dorsal surface of the

*The % ratio of the summated distance between the spinous processes of C2-C7 to the total distance between the bottom of spine C2 to the bottom of spine C7.*

Fig. 2 Tracing of lateral x-ray of 2 necks one with close spinous processes (bursal index 11 %) and one with widely separated spinous processes (bursal index 26 %—both random necropsy mid-sagittal section.)

Fig. 3 Left: Mid-sagittal section showing spinous processes of C5, 6, 7, and T1, with intervening bursal spaces in a female aet 77. (Azan, ×2.5). Right: Same (×23) C5-6 bursae showing fibrin encrusted, sparsely cellular lining and, on the left, covering the lower surface of C5 spinous process, a layer of fibrocartilage, calcified at its junction with lamellar bone.
Fig. 4  Mid-sagittal section, gross and x-ray, in female aet. 77 years, showing discal degeneration at C5-6 and C6-7. There is calcific deposit suggestive of CaPPD in C4-5, C5-6, C6-7 and C7-T1, and also in the interspinous bursae at ligamentum flavum of C3-4 and C4-5.

Fig. 5  Left: Same section (H and E ×2) showing bursal slits between C3-4 and C4-5. Right: Base of bursa C3-4 (decalcified, H and E, x27) showing areas occupied by CaPPD crystals, (ovoid) and areas occupied by hydroxyapatite-(granulomatous).
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ligamentum flavum for a variable distance, usually near the under surface of the upper spinous process, and sometimes difficult to see in the gross (Fig. 3). The lining consisted microscopically of sparse synovial cells on a bed of adipose tissue or on a thin layer of collagen fibres, sometimes with flakes of fibrin on the surface. Occasionally the cavity appeared to show such tissue centrally (Fig. 4), but this was probably due to tangential sectioning of an irregular cavity. Subsynovial blood vessels were few and small. The spinous processes usually showed no cartilage covering and consisted of normal lamellar bone covered by connective tissue. Occasionally, however, with close contact of the spines, the bone showed fibrocartilage with chondrocyte-like cells, underlain by a calcified layer of fibrocartilage.

In 2 cases of the random series calcium pyrophosphate dihydrate (CaPPD) could also be seen in the bursae (Fig. 4), occurring, as in the discs and elsewhere, as rounded, pale, ovoid collections of crystals, positively birefringent and showing typical x-ray diffraction spacing, occupying the subsynovial areas. These collections could be recognised even on decalcified specimens because they showed the ghosts of the characteristic rhomboid crystals. One of them showed in addition hydroxyapatite deposits (Figs. 5a, b). Both these cases were elderly females, and one of them gave in addition a history consistent with hyperparathyroidism, but no pathological confirmatory evidence was available.

In 5 cases of juvenile chronic arthritis with death due to renal failure from amyloid disease rheumatoid tissue was found lining the bursae in 2 instances (Fig. 6). The bursal space was enlarged, indicating an effusion; there was plentiful fibrin within the synovial cavity and abundant blood vessels in the neighbourhood, together with synovial cell hyperplasia. Comparatively few lymphocytes and plasma cells were seen in the granulation tissue compared with rheumatoid lesions in peripheral joints. In these cases

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**Fig. 6** Mid-line sagittal section C4-C7 in a boy with juvenile onset chronic arthritis, dying of amyloidosis aet. 34 years. Note bursal spaces between spinous processes of C4-5, C5-6, and C6-7 near ligamentum flavum.

**Fig. 7** Same C5-6 showing osteoclastic destruction of spine (H and E, × 350).
Fig. 8  Same case. Bursal cavity C3-4 at the posterior end of the interspinous space associated with distended cavity anteriorly. (H and E, ×33).

Fig. 9  Left: Mid-sagittal slice (×1·2) and, right, x-ray (×0·8) of patient A female aet. 44 with RA (see text). Note destruction of C5-6 and C6-7 discs and spinous processes. Some erosion is also seen of the neighbouring spines; bursal cavities are distended and injected.
Fig. 10  Patient A. Spinous processes in and tracing of bony spinous processes C3-T1 in midsagittal section. Note bursal spaces and gross erosion of spinous corresponding to discal destruction. Even the ligamentum flavum is disrupted. (Marrow pattern is an ice artefact).
there was erosion of underlying bone (osteoclastic resorption) (Fig. 7). In one case the bursal tissue had spread a great deal further dorsally than is usual (Fig. 8). We did not feel that this was spread from the affected apophyseal joint, which lay over 10 mm distant laterally and anterior. In another case, of a patient who died in uraemia, hydroxyapatite was present contiguous with CaPPD deposits in the walls of the bursae.

RHEUMATOID ARTHRITIS IN ADULTS
Most of the RA cases studied showed no specific rheumatoid lesion. Two out of 9 did indeed show bursae between the interspinous processes, but without any specific features of rheumatoid involvement. One case showed minor rheumatoid changes. One case, however, showed major lesions, and is reported in detail below.

CASE HISTORY
This was a female aged 44 years at death, patient A. She had had seropositive RA for 20 years with typical deformities of the hands, but no nodules. The neck had been painful and she had had to use a collar at home. Three close female relatives (mother, paternal aunt, and grandmother) had RA. Examination

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Fig. 11 Patient A. Upper surface of spinous process C5 showing pannus spreading beneath the fibrocartilage of the bursal space (H and E, ×95).

Fig. 12 Patient A. Erosion of C7 spine by rheumatoid bursal pannus (polarised light) (H and E, ×95).
showed widespread joint changes with dorsal kyphosis, right pleural effusion, and healed fractures of ribs. ESR (Westergren) 153 mm/h. Haemoglobin 6.2 g/dl. Analgesic nephropathy was diagnosed, with a blood urea of 119 mg/100 ml (19.8 mmol/l). No x-rays of the neck, thoracic spine, or peripheral joints were available. Septicaemia followed peritoneal dialysis, and the patient died. Post-mortem confirmed the clinical diagnosis and the presence of thoracic discal lesions. Midline section of the cervical spine (Fig. 9) showed posterior cavities associated with considerable erosion of the spinous processes as shown on x-ray of the slices. This was associated with erosive destructive lesions of the discs of the segments involved (C5–6 and C6–7) and presumptive hypermobility of these segments. Erosion was confirmed on histological section, which showed large bursal spaces lined by granulation tissue (Fig. 10). In this particular case there was far more bone destruction than bone formation, and we surmised that anatomically close spinous processes plus abnormal mobility due to disco-vertebral rheumatoid lesions, led to the extensive erosions in the spinous processes, both beneath the lining fibrocartilage (Fig. 11) and directly involving bone (Fig. 12). Some remodelling was visible, but even new woven bone was attacked.

Fig. 13 Patient A. Upper surface of spinous process C4 showing new woven bone being destroyed and fibrosis of the bursal lining. (H and E, ×85).

Fig. 14 Patient A. Totally necrotic fragment of C6 lying between 2 bursal spaces. (H and E, ×85).
The most exposed spicules of bone had undergone complete necrosis (Fig. 14).

The progression of spinous process erosion in rheumatoid arthritis can often be followed in vivo, but because radiological exposure is calculated for the vertebral bodies the spines are seldom clearly enough seen for publication. Fig. 15 shows a tracing of this process over years. While such erosions may be associated with rheumatoid bursitis, the lesions at the most dorsal end of the spinous process (Fig. 16) are probably the result of an enthesopathy of the posterior interspinous ligaments, equally due to undue mobility of the particular segment (Fig. 17) and characterised by osteoclastic bone resorption, new woven bone, and endochondral bone formation (Fig. 18). At the base of the spinous process erosion of lamellar bone is also seen at the attachment of the ligamentum flavum (Fig. 19), perhaps also associated with abnormal stresses due to fixation elsewhere in the neck (Fig. 20).
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studies confirming the syndrome describe effective treatment either by radiotherapy,9 procaine injection, or by bone resection."10 ‘Painful cervical enthesopathy’ (without anatomical confirmation11) could equally be attributed to bursitis or associated with it.

Congenital anomalies, as in myositis ossificans, may also trigger the syndrome.12 The essential components are close proximity of the spines and neck extension. The latter may also be very pronounced in patients with dorsal kyphosis from whatever cause.

In rheumatoid arthritis a third factor enters—abnormal mobility of the segment due to discal destruction and subluxation. In such cases the bursal synovial cavity may be the seat of rheumatoid disease, with resultant destruction of the spinous processes, visible radiologically.

Discussion

The existence of cervical interspinous bursae dependent on close contact and propinquity of the spinous processes and sometimes on abnormal mobility of the segment may explain posterior cervical pain in ‘normal people’ as Michotte originally surmised. Clinical
Fig. 19  *Same as Figs. 17 and 18.* Erosion at base of spine at attachment of ligamentum flavum, probably the result of stress. (H and E, ×96).

This work extending over many years done at Taplow, Hammersmith, and the London Hospital and sponsored by the Medical Research Council, owes much to my colleagues and especially to Chris Pirie, who provided me with some of the 'normal' neck specimens, and to Dr Eric Dykes, of the Dental Anatomy Department, the London Hospital, for x-ray diffraction studies.

References


Fig. 20  *Same as Figs. 17–19.* Coronal slice x-ray. Abnormal stress affecting the lower spinous processes from C1-2 surgical fixation and C3-4 ankylosis have resulted in lesions of the mobile discs C5-6 and C6-7.

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