Primary sternal tuberculosis: a case report and review of the literature

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Introduction: Primary sternal osteomyelitis caused by Mycobacterium tuberculosis is a rare manifestation of extrapulmonary tuberculosis.

Case presentation: We present a case of isolated sternal tuberculosis and review the demographic, clinical, diagnostic and therapeutic features of 32 published cases found in a systematic review of the literature. Patients with primary sternal osteomyelitis due to M. tuberculosis are often young and have no co-morbidity. Diagnosis is frequently delayed. Common symptoms and signs are local swelling and a discharging sinus tract. Patients frequently have at least one systemic symptom, including fever, weight loss and night sweats. Our case and half of those found in the literature review were successfully treated with antituberculous drugs alone.

Conclusion: Treatment concepts for primary sternal tuberculosis are not established and are often derived from those of osteoarticular tuberculosis. These data point towards an interdisciplinary concept without surgery.

Keywords: sternal osteomyelitis; TB medication; tuberculosis.

Background
Tuberculosis (TB) can disseminate to almost every organ after a primary infection or reactivation of latent foci. Osteoarticular TB accounts for approximately 10% of extrapulmonary TB and up to 2% of all TB cases in the USA (Peto et al., 2009; CDC, 2013). While the spine is the most common site of osteoarticular TB, osteomyelitis of the sternum is rare. In clinical series, the reported incidence is approximately 1% of all bone and joint TB cases (Enarson et al., 1979; Davies et al., 1984; Ali et al., 2008). The majority of reported sternal TB cases occur secondary to sternotomy. Because TB of the sternum is uncommon, the diagnosis is often delayed, and treatment concepts are not standardized. We present a case of primary sternal TB and review the demographic, clinical, diagnostic and therapeutic features of 32 cases found in a systematic review of the literature.

Case report
A 35-year-old man from Ethiopia presented with a fluctuant mass over the upper sternum. It gradually developed over 2 months prior to referral. The lesion was excised, a swab sample taken and a course of oral antibiotics given. No bacterial growth was detected, and the antimicrobial treatment had no beneficial effect.

Because the lesion continued to grow, he was referred to our centre. His previous medical history was unremarkable. On clinical examination, two pre-sternal fistulous lesions were detected (Fig. 1a, b). White blood cell counts, C-reactive protein levels and chest X-rays were unremarkable. The result of a human immunodeficiency virus antibody test was negative. A computed tomography (CT) scan of the thorax revealed a heterogeneous soft-tissue mass from the posterior of the manubrium sterni up to the skin surface (Fig. 1c). In the CT scan, no pathological findings in the pulmonary parenchyma, pleura and lymph nodes were detected. Deep biopsy samples from the lesions were obtained. The histopathological result was consistent with caseous necrosis. The results of an auramine stain for acid-fast bacilli were negative, but PCR was positive for Mycobacterium tuberculosis complex DNA. Thus, a diagnosis of sternal TB was made. Because of this diagnosis, the previous CT scan was reviewed again. Even in retrospect, only a single non-specifically enlarged para-aortic lymph node was found (diameter 18 mm). Antituberculous therapy with isoniazid, rifampicin, ethambutol and pyrazinamide was initiated. M. tuberculosis grew in cultures 5 weeks later and was susceptible to all tested antituberculous drugs. After 2 months of treatment, the lesions had healed completely. The antituberculous therapy was reduced to two compounds (rifampin and isoniazid) and continued for 7 months. At the 15-month follow-up visit, the patient was in good health.

Abbreviations: CT, computed tomography; TB, tuberculosis.
Methods

The PubMed database was searched for primary sternal TB cases by using the keywords ‘sternum’ AND ‘tuberculosis’ and ‘tubercular osteomyelitis’ AND ‘sternum’. The literature search included cases that were published from 1 January 1966 to 1 March 2013. Patients younger than 18 years of age and cases reported in a language other than English were excluded. A total of 70 articles were retrieved by the search. References cited in each of these articles were also reviewed for any additional eligible articles. Nine further cases were thereby identified. In total, 36 of the 79 articles were excluded after reviewing only the title or the abstract. Sixteen articles were excluded after reviewing the full text or because of insufficient data. Finally, a total of 27 articles reporting 32 cases were included in our review (Table 1).

Review and Discussion

Although primary sternal TB is rare, the clinical presentation in this case is even more uncommon. No body site was indicative for TB, neither the proximate lymph nodes nor the lung. The persistent ulcers and the patient’s origin were the key to the diagnosis. The demographic characteristics in our case (i.e. an otherwise healthy young man) were similar to those found in the literature. Primary sternal TB was more common in men (76 %) and occurred at a relatively young age (mean 40.3 years, median 37.0, range 18–74). All patients except one were either residents of or had immigrated from countries endemic for TB. There were only seven reports that described possible predisposing conditions for TB reactivation, including diabetes mellitus in four patients. This finding is different than in cases with sternal TB after sternotomy (Wang et al., 2007). The erythrocyte sedimentation rate was reported in 27 of 32 patients and was always elevated (mean 70 mm h⁻¹, median 60, range 25–140). However, in our view, this laboratory parameter is not helpful in clinical practice. In our patient, the sternum was the only site of TB manifestation. Among the 32 reviewed patients, 13 (40.6 %) had evidence of TB at additional body sites, with lymph node involvement (seven cases) being most frequently reported. Five patients had musculoskeletal involvement at multiple sites. Three patients had pulmonary TB; formally, these three sternum TB cases are not considered as extrapulmonary TB (WHO, 2009). These data indicated that the pathogenesis was seeding via the haematogenous or lymphogenous route in most cases. The pathogenesis in our case is unclear. Because no other site of infection was found, we postulate a haematogenous seeding. Another possibility could be an infection of retrosternal lymph nodes that erode into the sternum over time. However, even in retrospect, we cannot draw any conclusion from the CT scan.

There are no specific radiological features that are pathognomonic for osteoarticular TB (Watts and Lifeso, 1996). In our review, most of the patients had, in addition to the chest X-ray, further imaging studies [CT scan (23 of 32 patients), magnetic resonance imaging (six of 32 patients) or bone scan (seven of 32 patients)]. Common findings included bone erosion or destruction, signs of sequestra and abscesses. The magnetic resonance imaging was helpful for determination of the delineation of the adjacent soft tissue.

In our case, the results of an auramine stain of the specimen were negative. This result was reported in 20 of the reviewed cases and was positive in 13 (65 %) of them.
| Study                          | Age (years) | Gender | Possible predisposing condition | Symptoms and clinical findings at sternum | Systemic symptoms | Duration of symptoms (months) | ESR (mm h⁻¹) | Other foci | Surgery* | Anti-TB drugs† | Duration of therapy (months) | Outcome | Follow-up (months) |
|-------------------------------|-------------|--------|---------------------------------|------------------------------------------|-------------------|-------------------------------|--------------|------------|----------|----------------|-------------------------------|---------|------------------|
| Singh et al. (2011)           | 20          | F      | None                            | Pain, swelling                           | None              | 12                            | 40           |            | No       | R, I, P, E        | 6                             | Cured   | 36               |
| Singal et al. (2011)          | 65          | M      | None                            | Pain, swelling, discharge                | None              | 11                            | 75           |            | No       | R, I, P, E        | NR                            | Cured   | 3                |
| Barbetakis et al. (2011)      | 48          | M      | NR                              | Swelling                                 | Fever, anorexia   | 6                             | 60           | None       | Resected | R, I, P, E        | NR                            | Cured   | 6                |
| Boorugu et al. (2009)         | 28          | M      | NR                              | Swelling                                 | Fever, weight loss | 3                             | 140          | Lymph nodes | No       | R, I, P, E        | 12 (10 R, I)                  | NR      | Lost to follow-up |
| Khaira et al. (2009)          | 37          | M      | NR                              | Swelling                                 | Fever, weight loss | 3                             | 60           | None       | No       | 4 drugs, NS      | NR                            | Cured   | NR               |
|                              | 55          | M      | NR                              | Swelling, discharge                      | Weight loss       | 1                             | 50           | None       | No       | 4 drugs, NS      | NR                            | Cured   | NR               |
| Gupta et al. (2009)           | 20          | M      | NR                              | Swelling, discharge                      | Fever, weight loss | 6                             | 46           | Lymph nodes | No       | 4 drugs, NS      | NR                            | Cured   | NR               |
| Bhatia et al. (2009)          | 21          | F      | None                            | Swelling                                 | NR                | 3                             | NR           | None       | Resected | NS              | NR                            | Cured   | NR               |
|                              | 70          | M      | None                            | Swelling, erythema                       | NR                | 4                             | NR           | None       | Resected | NS              | NR                            | Cured   | NR               |
| Saifudheen et al. (2010)      | 42          | M      | Diabetes                        | Pain, swelling                           | Weight loss, night sweats | 2                             | 80           | None       | No       | R, I, P, E        | 6 (2 R, I)                    | Cured   | 6                |
| Sendi et al. (2008)           | 19          | M      | Trauma                          | Swelling                                 | Weight loss, night sweats | 5                             | NR           | Lung; calcaneus | No       | NS              | 12                            | Cured   | 24               |
| Mohammadi & Howell (2009)     | 32          | M      | NR                              | Swelling, erythema, discharge            | Fever, night sweats | 3                             | NR           | Lymph nodes | No       | R, I, P, E        | NR                            | Cured   | NR               |
| Bandyopadhyay et al. (2005)   | 55          | F      | None                            | Swelling                                 | Fever, weight loss | 3                             | 110          | Thoracic vertebra (D4/5,8/9), including prevertebral and epidural tissue | No       | NS              | NR                            | Cured   | NR               |
| Authors            | No. | Sex | Disease              | Symptoms                          | Duration | Treatment            | Follow-up | Complications |
|--------------------|-----|-----|----------------------|-----------------------------------|----------|----------------------|-----------|---------------|
| Ford et al. (2005) | 27  | F   | Swelling             | NR                                | 4 NR     | None                 | R, I, P, E| 9 (3 R, I)    |
| McLellan et al. (2000) | 35  | M   | Pain, swelling, erythema | Fever                            | 3 67     | None                 | R, I, P, E| 12 (9 R, I)  |
| Mulloy (1995)      | 59  | F   | Swelling             | None                              | 12 (cough); 3 (mass) | 50       | Thoracic vertebra (D6), rib | Debrided | R, I, P, E | 9 Cured |
| Mineo & Biancari (1995) | 28  | M   | Pain, swelling       | Fever                             | 3 78     | Lymph node           | Explored | NR NR NR NR |
| Watts et al. (1987) | 40  | M   | Pain, swelling       | Weight loss, fever, weight loss, night sweats | 3 87     | None                 | Explored | R, I, P, E NR Cured |
| de Carli et al. (2009) | 74  | M   | Alcoholism, chronic heart, renal failure | Pain, swelling, erythema, discharge Night sweats | 12 48    | None                 | Explored | R, I P NR Cured |
| Vasa et al. (2009) | 53  | M   | Pain, swelling, erythema, discharge | Fever, weight loss, night sweats | 30 (pain); 3 (mass) | 64       | Rib, paraspinal abscess at the thoraco-lumbar junction | No | 4 drugs, NS |
| Bajracharya et al. (2006) | 35  | M   | Erythema, discharge | Fever, anorexia                   | 3 48     | None                 | No | R, I, P, E | 12 (9 R, I) Cured |
| Jain et al. (2007)  | 57  | M   | Erythema, discharge | Fever, anorexia                   | 5.5 60   | None                 | No | R, I, P, E | 12 (9 R, I) Cured |
| DHINGRA et al. (2005) | 18  | M   | None                 | Fever, weight loss, night sweats | 2 50     | None                 | No | R, I, P, E | 17 (3 R, 1, 10 R, 1) Cured |
| Prakash & Hira (2000) | 31  | M   | None                 | Pain, swelling                    | 2 31     | Lymph nodes          | No | R, I, P, E | 7 (4 R, I, E) Cured |
| Subba Rao et al. (1982) | 40  | F   | Diabetes             | Swelling                          | 1.5 120  | Lung                 | Debrided | R, I, P, E | 9 (7 R, I) Cured |
| Subba Rao et al. (1982) | 50  | M   | Pain, discharge      | Fever, weight loss                | NR NR 60 | None                 | Resected | NS NR | Cured 6 |

**Table 1.** Continued.
In 32 patients, 21 culture results were reported, of which 19 were positive for *M. tuberculosis* (90.5%). Khan *et al.* (2007) reported a lower rate of positive culture results in their series (43%). PCR for *M. tuberculosis* complex is a rapid and sensitive test for the diagnosis of TB, especially in those with equivocal histopathological findings. The test has been reported as a useful diagnostic tool in bone TB, with a sensitivity of 85% and a specificity of 80% (Jambhekar *et al.*, 2006). In our review, PCR was reported in 12 of 32 patients (37.5%) and confirmed the diagnosis in all of them.

There is no consensus regarding the optimal treatment modality of sternal TB. The role of surgery in the management of sternal TB after sternotomy is more established. In a review by Wang *et al.* (2007), all but one patient underwent surgical debridement. Our case was managed without surgery, as were 50% of the patients found in the review. Some authors suggest that medical treatment alone is effective and that surgery should be limited to cases with large sequestra or to refractory cases (i.e. no signs of healing of the lesion after 3 months of therapy) (Hsu *et al.*, 1995; McLellan *et al.*, 2000). Other experts postulate that extensive debridement is essential to prevent recurrence (Kim *et al.*, 2008). In primary sternal TB, Khan *et al.* (2007) reported excellent results with conservative management alone in 12 of 14 patients. Similarly, Ali *et al.* (2008) showed in their case series that all 19 patients with isolated sternal TB responded well to a 12-month course of antituberculous treatment. Based on our experience of this and other extrapulmonary cases, and the results from the literature review, we are in favour of a conservative approach, unless there are signs of a large abscess or sequestra.

Treatment duration in our patient was 9 months. Treatment among our reviewed cases ranged from 6 to 17 months. This wide range reflects the controversial aspects in the treatment duration of osteoarticular manifestations. The World Health Organization (WHO, 2009) and the British Thoracic Society (1998) recommend the same treatment duration for both extrapulmonary and pulmonary TB. Other institutions recommend 9 months for osteoarticular TB because of the difficulties in assessing the treatment response (Blumberg *et al.*, 2003). In our patient, the treatment response could be observed by rapid wound healing. Thus, in retrospect, a 6-month treatment duration would probably have been sufficient. Two studies of the Medical Research Council Working Party on Tuberculosis of the Spine demonstrated the validity of the 6-month regimen (1986, 1999). Data regarding treatment length for sternum osteomyelitis are lacking.

**Conclusion**

In conclusion, isolated primary sternal osteomyelitis due to *M. tuberculosis* is rare. Patients are often relatively young and have no co-morbidity. The diagnosis is frequently delayed. Common symptoms and signs are local swelling, pain and a discharging sinus tract. Many patients described
in the literature have systemic symptoms, including fever, weight loss and night sweats. While surgery is often performed in patients with secondary sternal TB, this is not the case for patients with primary sternal TB. Our patient and half of the cases found in the literature review were successfully treated with antituberculous drugs alone.

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