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INFLAMMATORY CHANGES IN THE OSTEOLOGICAL REMAINS FROM THE KŘTINY OSSUARY (CZECH REPUBLIC)

ABSTRACT: Skeletal remains of nearly 1,000 individuals coming from the 13th–18th centuries were found in an ossuary in Křtiny (Czech Republic). From the total number of detected pathological cases in the Křtiny set ($N=306$), inflammatory lesions made 33.0%. The traces of inflammations occurred in 10.3% (15 cases) in all the detected palaeopathological lesions in skulls ($N=146=100\%$). Most of cranial lesions had typical signs of syphilis. Leprous disease could not be eliminated in one case. Postcranial skeleton bones most often showed non-specific inflammations of post-traumatic purulent osteomyelitis. The diagnosis of tuberculosis (two cases) was supported by DNA detection specific for *Mycobacterium tuberculosis* by means of PCR methods.

KEY WORDS: Bone remains – Inflammations – Osteomyelitis – Syphilis – Tuberculosis

INTRODUCTION

At the Department of Medical Anthropology of the Institute of Anatomy – Medical Faculty, Masaryk University, osteological material from the Křtiny ossuary (Moravia, 15 km north-east of Brno) has recently been researched.

Skeletons of almost a thousand individuals who lived in the period from the late 13th to the 18th centuries were examined macroscopically, radiographically, histologically, and two of the bone samples were submitted to detection of DNA for *M. tuberculosis* using PCR method. In the Křtiny skeletal series a number of interesting pathological lesions were found starting from traumata through inborn malformations to tumours. The subject of the present contribution is the evaluation of a comparatively rich group of palaeopathological findings – inflammatory lesions.

One of many commonly used definitions explains inflammation as a basic type of a defensive and reparative response of the organism to the disturbance of inner equilibrium caused by an intervention of a injurant. Inflammations can be classified according to a number of various perspectives, e.g. length of course, aetiology,

clinical manifestation, etc. From the palaeopathological point of view it is most effective to divide bone inflammations into specific and non-specific, according to the type of response of the organism on action of the pathogenous agent. Diagnosis and a precise classification of the pathological states was, in this case, limited by the character of the ossuary material studied. The basic diagnostic criterion for differentiation of both groups of inflammations was the presence or absence of large pyogenous cavities and fistulae.

PALAEOPATHOLOGICAL FINDINGS

As typical examples of non-specific bone inflammations, we can present inflammatory changes on two femora of adult individuals. In the first case K14 (Figure 1), there is an orifice into the interior of the bone (24 mm × 30 mm), on the medial side of the distal end of the left femur of an adult woman. A fragment of compact bone (sequester) of the medial side is wedged inside. Sides of the defect are slightly smoothed with marks of reparative process. The

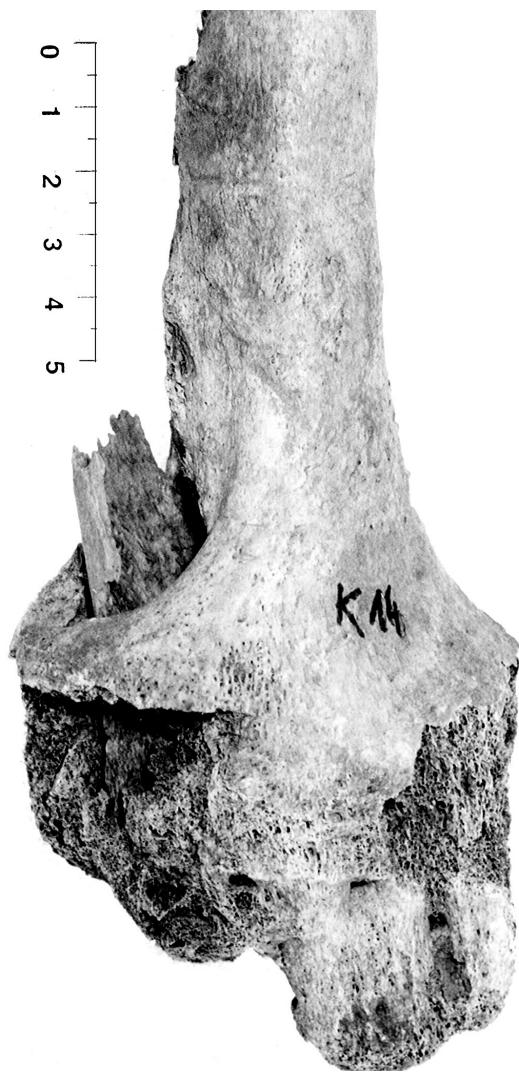


FIGURE 1. An osteomyelitic process (with sequester), arthritis and ankylosis of the left knee joint (ventromedial view).

whole distal end of the femur is changed by purulent osteomyelitic process, arthritis and resulting ankylosis in the area of the knee joint. *Basis patellae* fused with both condyles of the femur. On the whole uneven surface of the lesion there is a number of big fistulae. The greatest density of fistulae can be found in the intercondylar fossa and along the circumference of the coalescence of patella with the distal end of femur. The surface of the joint area of both condyles, as well as intercondylar fossa and patellar surface are considerably deformed. In addition, the whole distal epiphysis is rotated in medial direction. As a result of a certain change in walking mechanics (steady extension with varuse orientation of the tibiae) there was damage in the hip joint of this lower limb. There is some evidence not only in marks of rich vascularisation along the circumference of the head and the neck of the femur, but also in the angle of inclination which is 140 degrees.

In the second case K1 (Figure 2) a healed subtrochanteric fracture of the right femur of an adult man was found. It was complicated by large purulent



FIGURE 2. A healed, subtrochanteric fracture of the right femur complicated by pyogenous osteomyelitic process.

osteomyelitic process. The fracture line is almost transversal and is aimed towards the *trochanter minor* close underneath the basis of *trochanter major*. On the medial side of the lesion there is a large pyogenous cavity with a totally destroyed front side posthumously (the length of the lesion is 91 mm, the width and depth 43 mm). Its wall, 0.5 mm thick, is formed by a plate of sclerotised compact bone with supports of bone trabeculae located transversally. Only sporadically, remains of typical spongy bone can be found on the wall. At the distal end of the defect there is a number of tiny fistulae.

These inflammations are characterized by the creation of specific structures. In this category above all tuberculosis, syphilis and leprosy can be included.

In the Křtiny bone material specific inflammatory changes were found that were caused by tuberculosis and syphilis, and in one case even leprosy cannot be excluded.

For example, four caudal thoracic vertebrae (Th_{8-11}) were affected by typical changes caused by tuberculosis of an adult individual. After the destruction of the anterior side,



FIGURE 3. The skull K303 with a destruction of the nasal cavity.

the bodies of the vertebrae gained a cuneiform shape merging in one kyphotic bent – gibbus. Clearly apparent are terminal superior surface of Th₈ vertebral body and terminal inferior surface of Th₁₁ vertebral body whose position is in right angle to each other. Bodies of the vertebrae Th_{9–10} are totally destroyed and bodies Th₈ and Th₁₁ have a cuneiform shape. Intervertebral joints are fully ossified, at Th₁₀ and Th₁₁ also *ligamenta flava* became ossified. Costal facets are totally destroyed by tuberculous arthritis. The diagnosis of the tuberculous process was confirmed by X-rays, histology and, above all, by PCR method. From a sample of the spongy bone tissue of the left articular superior process Th₈, by amplification of the short fragment 123 bp and negative amplification of fragments 338 bp and 440 bp DNA, *M. tuberculosis* was proved (Horváth *et al.* 1997).

In the Křtiny osteological series, inflammatory changes caused by the tertiary stage of syphilis were also often found. For example, in the skull K303 (Figure 3) both nasal bones are deformed into a triangular plate (with a height of 19 mm, width of the basis 11 mm). It is apparent that, as a result of a deep depression in the internasal suture, the nasal part had a typical saddle shape. The piriform aperture has rounded edges and especially in the upper area (to the extent of approximately 4 mm) they are strengthened by a reparative process. The inflammatory changes affected almost the whole nasal cavity. From bone nasal septum, only the dorsal part of vomer was preserved. By a lytic process the whole lateral wall is destroyed together with all three *conchae nasales*, therefore entrances into maxillary and frontal sinuses, into ethmoidal cells are widely opened. The hard palate was almost as thin as paper,



FIGURE 4. The skull K12 with lytic lesions of the palatonasal region (leprosy? TBC?).

especially in the area of both horizontal laminae of the palate bones. The oral side of hard palate has a "scary" surface. On the flat bones of the skull no other pathological changes were found, neither macroscopically nor by X-rays.

Although lytic lesions are missing on the calvarium, all other symptoms described, especially palatonasal deformations with the saddle nose, are typical for syphilitic infection of the skull. Leprosy, that could differentially diagnostically also be considered, does not usually affect the nasal bones.

In some cases differentiation between the diagnoses of the two diseases is even more difficult. For example in the skull of a 20–30 year-old female K12 (Figure 4), large inflammatory changes in the nasal cavity were found. Caudal edges of both nasal bones were significantly thickened (up to 6 mm), both palatine bones, vomer and perpendicular plate of the ethmoid, were destroyed. Cribiform plate of the ethmoid was also afflicted by substantial inflammatory changes, therefore the function of the olfactory tract must have been substantially damaged. Anterior nasal spine is totally destroyed and the inflammation progressed towards the upper incisive teeth. Their alveolar processes were attacked even from the side of the hard palate which is covered by little star-shaped scars and, in the front third, these are perforated (size of the lesions 7 × 2 mm). The configuration of the alveolar processes indicates the fact that all incisive teeth were lost intravitaly.

When distinguishing the diagnoses, two kinds of pathology appear: leprosy and syphilis. Leprosy could be proved mainly by a symmetrical attack of the nasal cavity with the destruction of anterior nasal spine and a progress

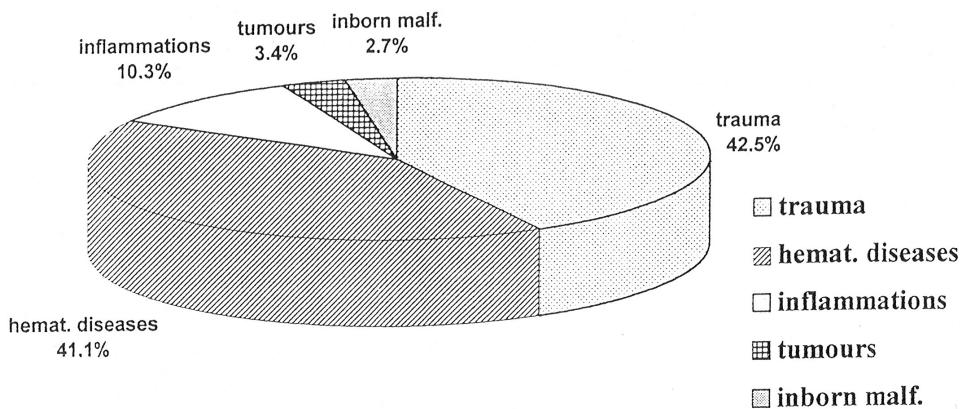


FIGURE 5. The share of detected pathological lesions in the total number of Křtiny skulls with pathological changes N=146 (100%).

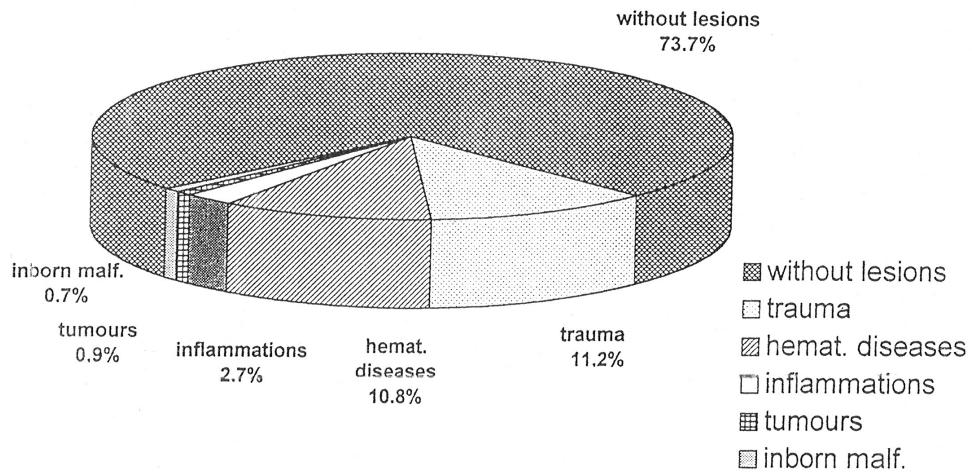


FIGURE 6. The share of pathological lesions in the total number of Křtiny skulls set N = 554 (100%).

of the infection towards incisive teeth. However, since there is no postcranial skeleton available with typical findings on the skeleton of hands and feet, this diagnosis is purely speculative. To be sure, neither affliction by syphilitic processes can be fully excluded. There is, however, something that contravenes this diagnosis which has been confirmed by X-rays – that nasal bones are not damaged in the way typical for syphilis and that lytic defects were not found on the flat bones of the skull either.

Pathological changes were found in 146 skulls out of 554 in Křtiny (Figures 5, 6). Of this figure, inflammatory processes represented 10.3% (15 cases) and with their recurring frequency they ranked after the group of traumata (42.5%) and hematogenous diseases (41.1%). The majority of the cranial lesions bore signs of tertiary form of bone syphilis.

DISCUSSION

The early information about syphilis in the Czech lands can be traced back to 1493 (Hűbschmann 1964). A good testimony about the expansion of the disease in this land is the rapidly increasing number of chronic and official

records about syphilis. The first reference in Moravia comes from 1495. As with any other infectious disease, the development of syphilis depended on a number of factors (e.g. on the receptivity of the population towards the infection, on social conditions and hygiene, etc.). The whole clinical image of the disease has changed over the centuries. Vlček (1975, 1989) made a summary of the entire period of its existence in the Czech lands dividing it into several epochs depending on the forms of the disease. The first two epochs started in 1493 and ended up in the second third of the 16th century. In that period the disease had a character of an acute infection, it spread explosively, seizing nearly the whole of Europe. Since there was no development of the tertiary stage of syphilis (the disease quickly led to death) we can find no marks of affliction on the skeletal remains. From the end of the 16th century to the last quarter of the 18th century the immunity of the organism for treponemic infection had been increasing gradually and its virulence was getting weaker. Syphilis transformed into chronic forms in which pathological changes on the skeleton can be met. The maximum degree of the development of pathological manifestations of syphilis on bones goes back to the period between the end of the 18th to the 19th centuries. On bones, signs of not

only acquired but also inherited forms of the disease can be found. The last period is that of the 20th century where, thanks to effective therapy by bismuth, arsenic and above all antibiotics, cases of organ afflictions by syphilitic infection are rare.

Although the description of the clinic course of the disease is known from historical literary sources, as described in cases of eminent historical personalities (Emperor Rudolph II, Albrecht of Wallenstein), only the characteristic findings on their bones can definitely confirm the diagnosis of syphilis.

Vlček (1989) found possible changes caused by syphilis on osteological material from the ossuary in Mělník, Hrádek u Znojma, and on skeleton remains in the early Modern Period burial-place in Prague (where the "Kotva" supermarket is located today).

A similar variability in syphilitic bone lesions as was the case in the osteological series in Křtiny, could be found in literary sources about ossuaries in Klostenburg and Eggenburg (Schultz, Nikola–Teschler 1987, Heinrich 1991), in our recent studies of bone remains from SS. Peter and Paul Cathedral in Brno and from the burial-place in Masaryk Square in Břeclav (Moravia). Both of these finds come from the 16th–18th centuries (Horáčková, Benešová 1993–95). There is an interesting assessment by the English author Roberts (1994), who describes symptoms of treponematosis on a skeleton of a young woman. It was found in Gloucester and it comes from the mid–15th century.

For us, the diagnostics of syphilis was very difficult, especially in cases of bones of lower limbs, because whole skeletons were not available in the ossuaries, therefore it was not possible to evaluate one of the most important indications for the diagnosis – the symmetry of the occurrence of syphilitic lesions. In fact, every large periostitis, especially that in the tibia, has to be considered as a possible syphilitic infection.

Not even the diagnosis of leprosy on the skeleton material is without its problems. The case of a suspected leprosy that was described above is only one of several possible diagnoses. However, from the differential diagnostics point of view it must be taken into consideration. In the Middle Ages this was a fairly common disease that proliferated widely during the crusades in the 11th–12th centuries. Its development climaxed towards the end of the 13th and at the beginning of the 14th centuries. The evidence that this serious disease appeared in the Czech lands is well known from literature. Those infected by leprosy were isolated in leprosaria (where many people suffering from various kinds of dermatitis were housed, since diagnoses were usually pronounced by lay people or priests without medical knowledge – Zapletal 1952). This certainly had an impact on spreading the disease through the population. Despite the fact that in the Middle Ages it was one of the most frequent diseases, we have not encountered findings of leprosy on skeletal material in this country so far. In Europe most cases of leprosy described

on the skeletal remains from past centuries come from Denmark (Møller–Christensen 1952, 1953).

As the wave of leprosy was coming to its end, a new epidemic of a serious, highly infectious disease was spreading through Europe – tuberculosis. In spite of the discoveries of many effective treatments, this disease has afflicted populations throughout the ages from the Neolithic period up to today. In Czech anthropological literature, a number of tuberculous bone lesions has been described. For example, an article (Vyháněk 1969) describing one case of tuberculous trochanteritis and spondylitis on skeleton material from the early Middle Ages comes from Libice, a description of tuberculous coxitis and spondylitis in Mikulčice osteological material (Stloukal, Vyháněk 1976), tuberculous spondylitis on skeleton remains from Josefov (Hanáková, Vyháněk 1981), tuberculous coxitis on bones from Lahovice (Chochol 1973), etc.

It was comparatively easy to arrive at a diagnosis of tuberculous spondylitis in the Křtiny case, because of the creation of a characteristic gibbus. Possibilities of differential diagnostics narrowed substantially. A much more difficult situation came when evaluating coxities or gonarthritides since they can originate in either tuberculosis or in syphilis. However, tuberculosis typically has a smaller range of afflictions. They can be called unifocal bone lesions instead. In two disputable cases, the diagnosis was made with help of DNA detection specific for *M. tuberculosis*.

CONCLUSION

Out of all the 306 pathological cases in the Křtiny osteological series, inflammatory lesions were found in 33% of them. Of the 554 skulls studied, they represented 2.7%. The percentage of lesions on the postcranial skeleton only gives an approximate orientation since with respect to the character of the bone material we did not go into a more detailed statistic evaluation. We assume that in spite of all difficulties with the palaeopathological diagnostics, the obtained results may contribute to history of medicine as well as epidemiology of infectious diseases in the Czech lands as well as elsewhere.

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