CASE REPORT

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Stab Wounds and Personal Identity Determined from Skeletal Remains: A Case from Kansas

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ABSTRACT: Evidence for cause of death in skeletonized remains is uncommonly found and cases that involve stabbings are particularly rare. In the following report, evidence is presented for a fatal stabbing, determined from analysis of a recent homicide. Because multiple stab wounds were present and several different bones were involved, estimates of the dimensions of the murder weapon were also possible. We also review some distinct vertebral anomalies used for personal identification.

KEYWORDS: physical anthropology, human identification, stab wounds, skeletal remains, personal identification

In the late summer of 1983, a human skeleton was accidentally discovered by a bird watcher in dense brush off a county road in Leavenworth County, Kansas. Retrieval of the material by local authorities revealed that the individual had been wrapped in a blanket and long window drape and then placed in an army-type duffle bag. When discovered, most of the skeleton was contained in the duffle bag, although some bones were scattered over a 5-m radius. A survey of this area produced a nearly complete skeleton except for both feet, which were never recovered. We suspect that the feet were not enclosed in the duffle bag and were carried away by animal predators, although no gnaw marks on the distal tibia and fibula were found. Besides the material in which the skeleton was wrapped, no articles, such as clothing or jewelry, were present. Preliminary examination of the remains showed only a few amorphous remnants of soft tissue, primarily decomposed portions of the right palmar surface and a gelatinous muscle mass in the region of the right shoulder. Most of the vertebra were disarticulated and bones below the waist were relatively free of soft tissue. The skull was nearly completely skeletonized, but was associated with an intact scalp containing closely cropped, reddish-brown hair. Analysis of the hair indicated that it was spiral-type, typical of American black people. A Tubegauz® bandage consistent with professional application was found covering the decomposed remains of the right index finger. Preliminary identification suggested that the individual was a relatively young black female. No indication of cause of death was noted in the field.

Queries at area police agencies led to the discovery of a missing black female who fit the gen-

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eral description of the remains. Particularly important in the preliminary matching was the existence of the Tubegauz bandage, since the missing female had received medical treatment for lacerations of the right hand approximately two days before her disappearance, about ten weeks previous to the discovery of the body. According to the medical report, she was involved in an early morning bottle fight and treated for superficial lacerations to the right hand. The following day she was reported missing by relatives. For more corroborative identification, we examined the dentition, which revealed several previous extractions and two teeth with amalgam restorations. However, irregularities in the dental records (lack of definitive X-rays and indications that two separate individuals were included as the same person in the dentist's records) precluded positive identification. For further work, skeletal materials were sent to the University of Kansas, where they were cleaned and subjected to further analysis.

An inventory and preliminary examination of the bones before maceration revealed that two ribs (right and left rib 5) were severed about 20 mm from their anterior medial ends. These specimens were separated from the rest of the skeletal remains and cleaned individually. The remainder of the skeleton was macerated in a hot water/ammonia bath at the Museum of Natural History, University of Kansas. No cleaning of the remains occurred before the material was placed in the macerating tank. After this process, the skeleton was aged and sexed according standard anthropological techniques [*1–3*]. The pelvis was clearly female, and, based on epiphyseal closure in the long bones and the morphology of the face of the pubic symphysis, the individual was aged about 19 years. Calculated stature closely matched medical records of the suspected victim. Further skeletal analysis produced more evidence for personally identifying the remains. Because the suspect suffered rheumatic heart disease, serial X-rays were obtained from a local hospital that covered about a ten-year period. Comparing the most recent radiographs to the relevant skeletal elements, two sets of vertebral anomalies were noted. Chest X-rays showed that the individual had unbifurcated dorsal spines on cervical vertebrae 3 to 6. This uncommon condition [*4–5*] matched the skeletal remains. Also, thoracic vertebrae 9 to 11 exhibited marked asymmetry in size and morphology between the left and right transverse processes. Both these skeletal variations and the presence of the Tubegauz bandage exactly matched the medical records of the missing person and led to the identification of the skeletal remains.

Evidence for Cause of Death

Five separate bones gave evidence of being cut or pierced by a knife. Left rib 5 showed a diagonal cut, slanting from the upper to the lower margin and severing a medial segment of the rib that measured 19 mm along the superior surface and 11 mm at the inferior margin (Fig. 1). The diagonal length of the cut surface was 15 mm and exhibited a very flat, smooth appearance (Fig. 2). On the superior posterior border a small bone chip was spalled off, measuring 7.5 mm along its longest (superior) aspect. At the inferior margin there was another bone chip missing along the posterior border. Direction of the chipping in both areas indicated that the cut rib fragment was displaced internally from a blow delivered to the anterior surface. Since the cut surface was angled to the long axis of the rib, the weapon appeared to have been directed slightly laterally as it entered the chest cavity. On left rib 10, a small cut mark was also discovered (Fig. 3). The wound barely penetrated the cortical surface and occurred on the superior margin, posterior to the midpoint of the shaft. This small mark opened toward the vertebral border of the rib and appeared to represent the most inferior extent of the knife's course through the chest cavity on the left side. Thus these two wounds on left ribs 5 and 10 provide evidence of the beginning and end of one stabbing action. From reconstruction of the thoracic cage, it was apparent that the knife first severed the portion of left rib 5 and continued its course in a downward, lateral direction, ending with the small cut in the superior surface of left rib 10.

Right rib 5 presented evidence very similar to that seen in left rib 5, with a sharp, flat cut running diagonally from the superior to the inferior border (Fig. 1). This cut severed a small medial

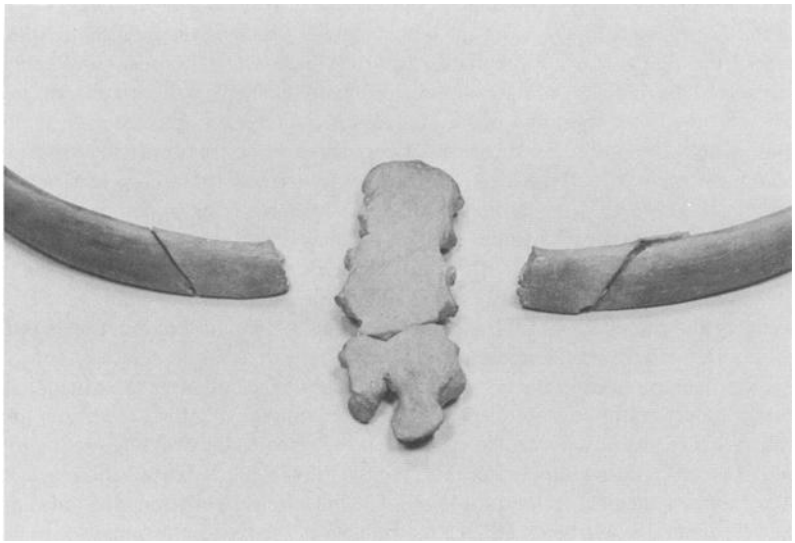

FIG. 1—*Left and right fifth ribs with mesosternum. Severed medial portions on both sides have been repositioned into anatomical order. The transverse gap in lower half of mesosternum and the notched area in inferior portion are not traumatic, but are a result of incomplete fusion of sternal segments.*

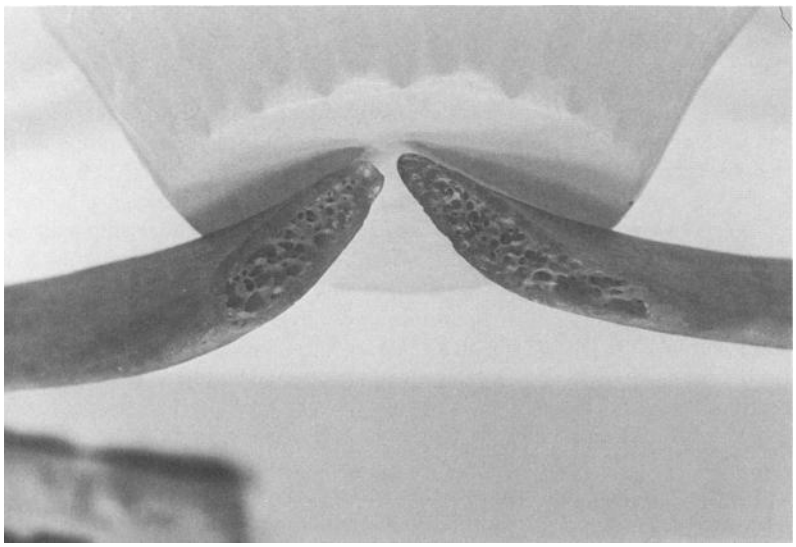

FIG. 2—*Cut surfaces on the main parts of the left and right fifth ribs. Note the smooth shear plane of both the cortical and cancellous bone. View is internal.*

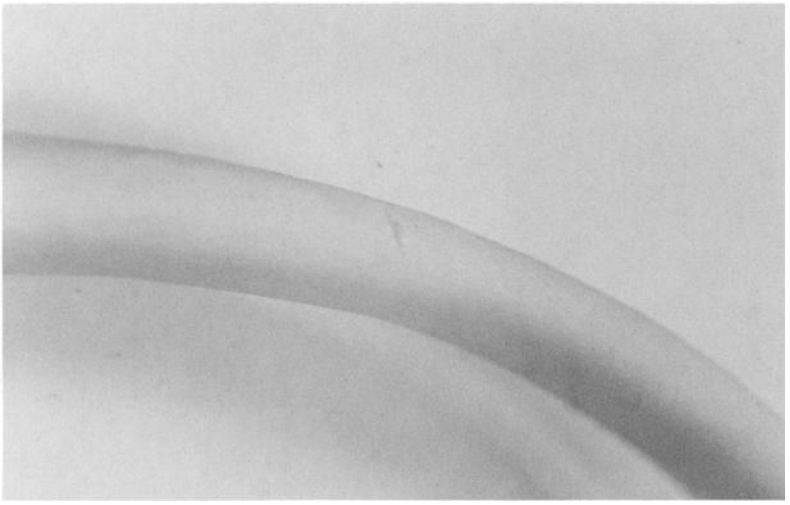

FIG. 3—*Small cut on superior surface of left rib 10. The wound barely penetrates the cortical surface.*

portion of the rib, measuring 22 mm along the superior and 17 mm along the inferior surface. Although the angle of the cut was approximately the same in both left and right ribs (60° to the inferior border), the severed segment on the right rib was a little larger, which suggested a slightly more lateral entry of the weapon. As in the left rib, the face of the cut surface on right rib 5 was angled laterally from the external to internal border, indicating that the blow was directed obliquely into the chest. Compared to the left rib, the cut on the right rib was smoother, lacking any marked spalling of the bone. Along the posterior inferior surface there was a very small chip, approximately in the same position as on left rib 5. On the posterior surface a few very small chips were dislodged from the lower half of the cut surface.

Although there was no involvement of any of the lower ribs on the right side, the rib directly above the severed right rib also showed signs of trauma. Located along the inferior margin of right rib 4, about 27 mm from the intact medial end, was a superficial nick in the bone surface. This nick was diagonally aligned with the cut surface on rib 5 and marked the continuation of the blow delivered mainly to right rib 5 (Fig. 4).

The right humerus also bore evidence of being pierced by a knife point. On the lateral surface at the inferior margin of the deltoid tuberosity, there was a puncture wound located 175 mm above the elbow. This wound pierced about half the total thickness of the cortical bone, leaving a V-shaped defect in the bone (Fig. 5). The wound (measuring 2 mm in the long axis) was oblique to the maximum length of the humerus, angling about 45° to the shaft. Along the superior surface a small bone chip was spalled off the margin, while the inferior margin of the cut was elevated and displaced laterally. In anatomical position, this wound is on about the same plane as those on the upper chest.

Microscopic examination of these cut marks indicated that the weapon must have been very sharp. On the two severed ribs, the cortical and the cancellous bone were cut in a very smooth, even plane (Fig. 2). Postmortem breakage or a crushing blow by a blunt instrument would not have produced such a distinct clean cut [*6*]. Further, along the posterior or inner surfaces of both severed ribs, small microchips of bone were discovered, which presumably were broken off as the weapon entered the chest cavity. The nicked area on the inferior surface of right rib 4 had a straight walled cut on the lateral margin and a tapered face angling away from this surface. This wound lacked the clean shearing of the other two ribs and probably represented the first rib encountered in the weapon's penetration of the chest. Magnification of the humeral

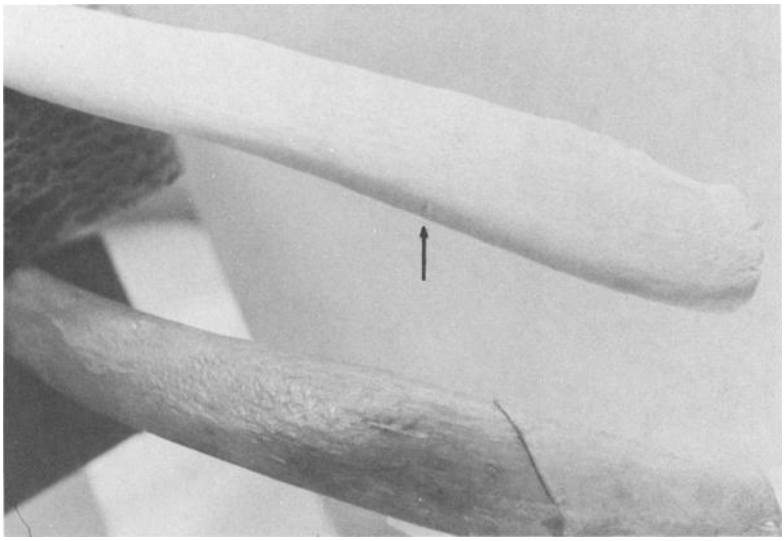

FIG. 4—*Reconstruction of right fourth and fifth ribs. The severed section has been attached to the main portion of the fifth rib. Note small nick on the inferior surface of the fourth rib. Differences in color of the two ribs relate to separate processing techniques.*

wound showed a sharp cleavage of the exterior bone surface, with no evidence of crushing in the surrounding bone. The weapon tip (or the humerus) seemed to have been slightly twisted during the assault, since the superior surface of the wound was clearly spalled off while the inferior surface showed upwelling and outward distortion.

Evidence about the Weapon

Based on these observations, we determined that the woman was stabbed at least three times, twice in the chest and once in the right humerus just below the shoulder. Judging from the evenness of the cuts on the left and right fifth ribs, marked by the clean shear face of the bone surfaces, the knife must have been very sharp. Since two ribs on both sides of the chest showed signs of being cut, we reconstructed the rib cage in order to determine the relationship of the multiple stab wounds to each other. First, the thoracic vertebra were reassembled by articulating and then gluing together the inferior and superior articular facets. The ribs were then attached to their vertebral facets on the lateral centrum and the transverse process. Through comparison with a standing skeleton, anatomical illustrations, and the chest radiographs of the suspect, we arrived at a reasonably accurate reconstruction of the thoracic cavity.

Once the reconstruction was completed, the relationship of the wounds to each other became more apparent. On the right side, the nicked surface on the fourth rib was directly above the severed portion of the fifth rib, and both appeared to have been produced by a single blow (Fig. 2). Reconstruction of the spaces between these two ribs suggested the knife blade was at least 25 mm in breadth. On a single stab, any narrower dimension would not have pierced right rib 5 and nicked the rib above it. Given individual variability in interrib spaces, the knife blade could have been as broad as 40 mm, yet lack of involvement of additional ribs directly below rib 5 on the right side and no similar wound on left rib 4 suggests that the smaller estimate is the more likely dimension. Also, the length of the knife could be reconstructed from the associated cuts on left ribs 5 and 10. Direct measurement of the distance between the severed left fifth rib to the small cut on the superior surface of the left tenth rib indicated that the knife was at least

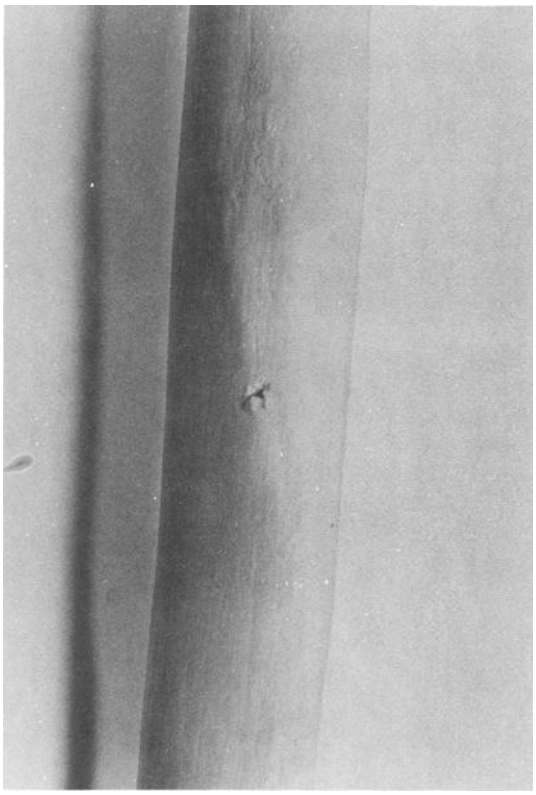

FIG. 5—*Puncture point wound in right humerus located on the deltoid tuberosity.*

200 mm long. This estimate took into account some constriction of the rib cage on impact and the thickness of soft tissue on the chest.

On the humerus, the minimum diameter of the cut mark suggested that the knife was less than 1 mm in cross section, although given the plasticity of fresh bone this estimate is conjectural. A latex mold was made of this wound; from this, as well as microscopic and radiographic examination of the puncture mark, it was clear that the end of the knife was pointed, rather than blunted or rounded.

Based on this evidence, we believe the weapon was a large, extremely sharp, pointed knife and that the victim received at least two stabbing blows to the chest and one to the right humerus. The humeral wound may have been the result of a defensive action on the part of the victim, since it occurred in approximately the same horizontal plane as the two severed fifth ribs. If so, it seems likely that the woman was attacked from the front, while she was standing and that her hands were not bound. Given the depth of penetration on the left side of her chest and the complete severing of the two fifth rib sections, the fatal blows were quite forceful. Unfortunately, the murder weapon has not been found, nor has has a suspect been identified. Confirmation of our weapon reconstruction awaits more police work and further developments in the case.

The wounds to the chest must have been fatal, although we could not determine if these were the actual cause of death. Even so, the knife penetrated the chest and would have injured the heart, mediastinum, or pulmonary hila. We strongly suspect that these stab wounds represent the cause of death, since there was no evidence of other trauma or violence. The cranium

showed no signs of severe blows to the head either in gross examination or X-ray. The hyoid was intact and gave no evidence that would indicate the suspect was strangled. Although some parts of the postcranial skeleton were damaged, these appeared to have occurred postmortem, presumably during collection of the remains and during transport.

Conclusions

Numerous studies provide techniques for identifying the sex, race, age, and stature of skeletal remains [*1-3, 7-9*]; a few also present variations of skeletal abnormalities and residual fractures as a means of personal identification [*10, 11*]. Here, the presence of uncommon vertebral variations along with other known identifying items firmly established the identity of the victim.

In our review of the literature, we found the cause of death in skeletal material to be limited largely to gunshot wounds, massive blunt trauma, and cranial injuries. In this case, presumably fatal, antemortem injuries as well as indications of the dimensions of the instrument of death were determined by detailed examination of carefully cleaned skeletal material. This emphasizes the importance of a close working relationship among investigating officers, pathologists, radiologists, and forensic anthropologists. Careful examination of any bony parts following removal of the decomposed tissues may reveal the appearance of unappreciated injuries that can lead to the delineation of the cause of death and definition of the weapon used in inflicting the wounds.

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