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CASE REPORT

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Forensic Radiology with Cross-Section Modalities: Spiral CT Evaluation of a Knife Wound to the Aorta†

ABSTRACT: We describe the extraordinary case of a penetrating knife wound to the aorta. The localization of the tip of the knife was documented with a Computed Tomography examination and subsequent two- and three-dimensional reconstruction. Based on this case report, the utilization of computed tomography in forensic science and its potential for vizualization are discussed.

KEYWORDS: forensic science forensic radiology, visualization, computed tomography

References in clinical literature concerning the use of Computed Tomography for evaluating stab wounds to blood vessels are scanty (1). The newer diagnostic imaging tools, Computed Tomography (CT) and Magnetic Resonance Imaging (MRI), are underutilized in forensic examinations of living and dead persons (2). CT and MRI provide invaluable, detailed anatomic information for use in both diagnosis and treatment.

We report a case in which Spiral-CT (including 2D and 3D reconstructions) was invaluable in the evaluation of a stabbing knife injury to the thoracic aorta. Developed in the early 1970s, CT is a technique that mathematically constructs a digital cross-sectional axial image by assimilating tissue absorption data obtained from multiple transaxial X-ray projections (3). Spiral-CT allows for continuous volume data collection without intersectional gaps nor interscan delay (4). The acquisition of volume data also makes postprocessing possible in order to obtain new 2D and 3D images (5).

Case Report and Examination Methods

A 36-year-old man, found with a knife imbedded in his back, was brought into the emergency room. The chest X-ray showed the knife tip in the left paravertebral area where the aorta descends (Figs. 1,2). Since the patient was in stable clinical condition (Fig. 3), contrast-enhanced CT (Siemens Somatom Plus 4, Erlangen, Germany) was performed, using the spiral technique to exactly localize the knife blade in order to direct the subsequent surgical approach (Fig. 4). Using a workstation (Advantage 3.1, General Electric Medical Systems, Milwaukee, WI), 2D and 3D reconstructions were made from the volume data.

Results

The cross-sectional images showed the tip of the knife inside the lumen, piercing the posterior wall of the descending aorta (Fig. 5). Subsequent 2D and 3D reconstructions showed the exact position and dimensions of the embedded knife blade in virtual space (Fig. 6), the surrounding bony structures, and the aorta (Figs. 7,8). Surgery was successful and the follow-up uneventful.

Discussion

Using the Spiral-CT acquisition technique, data from a complete volume can be recorded and studied. 2D and 3D reconstructions offer the possibility of precisely localizing a foreign body in its relation to anatomical structures. So, without any displacement, the exact location of a knife imbedded in a wound can be documented in very little time. Despite the appearance of metal artifacts in the CT scans, anatomical localization of the knife is accurate for treatment planning and, in this case, supported the decision to leave the knife in place until surgery, which decision was probably life-saving.

For vascular injuries, the Spiral CT technique presents a noninvasive alternative to the classic method of angiography. Three-dimensional presentation of CT data based on postprocessing is especially helpful in forensic cases in court. The 2D and 3D reconstructions offer a method ideally suited for demonstrating medical

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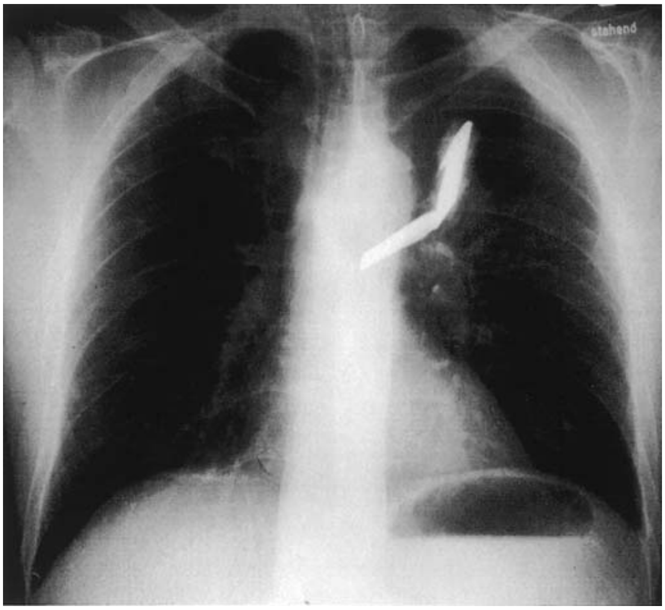

FIG. 1—*Posteroanterior radiograph of the chest showing the knife blade in the left paravertebral area where the aorta descends.*

FIG. 2—*Lateral localization view showing the position of the knife.*

FIG. 3—*Patient sitting in stable clinical condition on the CT table.*

FIG. 4—*CT examination: Patient lying on the right body side, with the knife still in the back.*

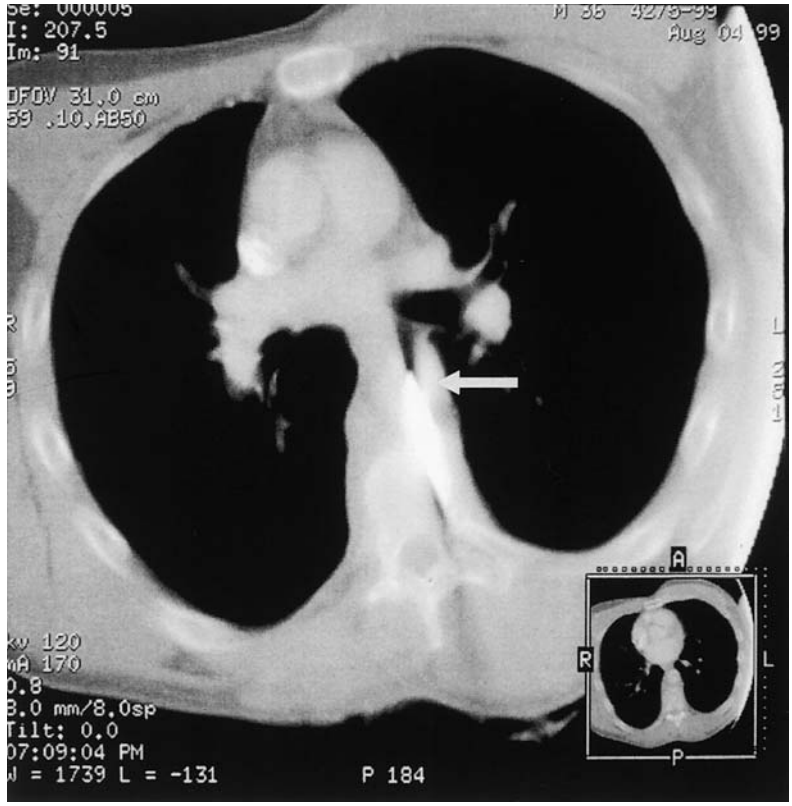

FIG. 5—*Representative CT section showing the knife piercing the aorta (arrow).*

FIG. 6—*Sagittal multiplanar reformation of the CT data showing the tip of the knife in the lumen of the aorta (arrow).*

FIG. 7—*3D reconstruction of the bony structures and the knife, view from the back.*

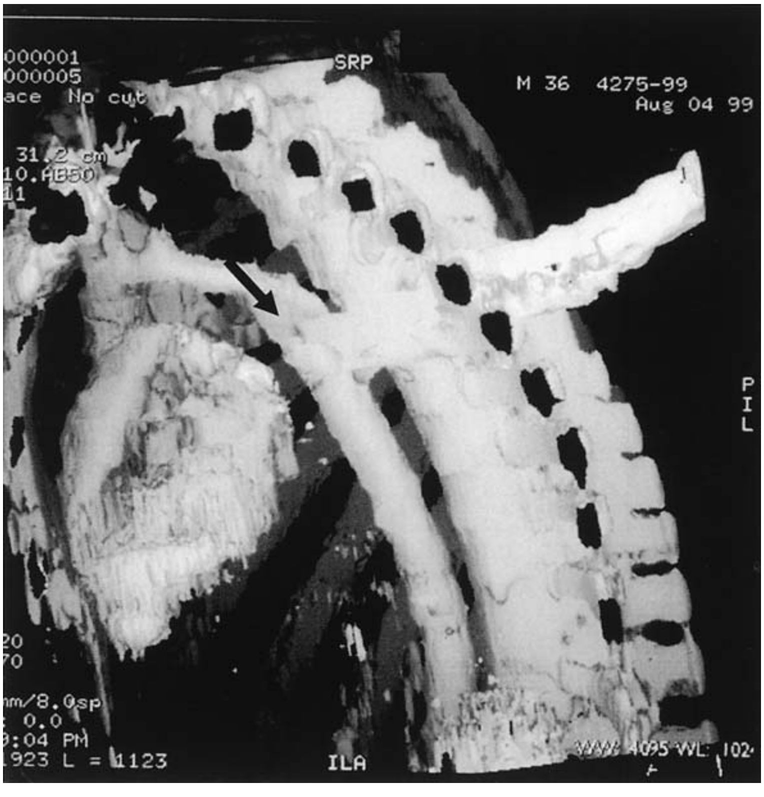

FIG. 8—*3D reconstruction showing the knife piercing the aorta (arrow).*

findings because they greatly reduce the difficulty of clearly and understandably communicating the findings, arguments and conclusions of medical forensic experts to a lay audience.

Conclusion

We agree with Harris' (6) statement that radiological visualizations "are presenting the viewer nearly sterile, scientific evidence—free of the taint of those gruesome, inflammatory and prejudicial elements which in the past have not permitted photographic material depicting blood, lacerated tissue, etc. as evidence in court." In addition, the newer radiological cross-sectional modalities have a great potential for documenting and depicting relevant forensic findings of living and dead persons. Utilizing the modalities of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) will open new radiologic horizons in forensic pathology, medicine and science.

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