Introduction

Trauma is a significant public health problem, representing the third leading cause of death in the United States. Trauma is also the leading cause of mortality in Americans under the age of 40. With the widespread availability of multidetector-row computed tomography (MDCT) in trauma centers, the traditional workup of trauma patients has changed. Blunt chest injuries are now frequently studied with MDCT to evaluate the aorta, and workup of the blunt trauma victim with abdominal injury is evolving with MDCT. MDCT now allows not only the detection of injuries but provides new information on the severity of injuries with improved detection of vascular injury manifested by “active extravasation.” Until recently, patients with a history of penetrating trauma went directly to the operating room for surgical therapy without preoperative imaging. Today, MDCT is often performed in patients with penetrating trauma in order to best identify vascular injuries prior to surgical intervention.

This chapter reviews the technique of MDCT and discusses major findings in abdominal MDCT in the trauma patient. The varied manifestations of bleeding are emphasized. Common mistakes and pitfalls in interpretation are described along with a step-by-step technique for interpretation.

MDCT Utilization in the Trauma Patient

Workup of the blunt trauma patient has evolved with the advent of MDCT. In the past, a large number of patients with deceleration injuries had abdominal CT in the search for solid-organ or hollow viscus injury, but few had a chest CT. With the installation of MDCT scanners in major trauma centers, the frequency of chest CT in the trauma patient has increased dramatically. MDCT provides the capability to perform high-definition multiplanar reconstruction (MPR) based upon thin sections reconstructed from MDCT raw data. Chest MDCT with MPR effectively produces CT angiograms, probably equal in quality to angiography (Fig. 1). A trauma surgeon can be provided definitive information concerning aortic injuries almost immediately with MDCT without the additional contrast load and invasiveness of traditional angiography. At many institutions, MDCT of the chest has almost completely replaced angiography in the initial workup of patients with possible aortic injuries. Angiography is often relegated to the role of a problem-solving tool. An MDCT of the chest not only provides diagnostic information concerning potential aortic injuries but also evaluates lungs, pleura, and bones. MPRs of the thorax

Fig. 1. Computed tomography angiogram (CTA) of motor vehicle accident victim demonstrating two pseudoaneurysms of the aorta (arrows), the smaller located on the anterior surface at the bottom of the aortic arch and the second located on the posterior proximal descending thoracic aorta.
facilitate detection of rib and spine fractures (Fig. 2a)

**Alternative Strategies in MDCT Acquisitions**

While the introduction of MDCT has dramatically changed the way many thoracic injuries are evaluated, it has had a lesser impact on evaluation of the abdomen and pelvis. Optimal use of MDCT below the diaphragm has not yet been established. Evaluation of the abdomen and pelvis with MDCT is currently performed differently in different institutions. Some centers, such as Massachusetts General Hospital, advocate the use of a “whole-body” CT in the trauma patient [1]. They utilize a continuous scanning technique through the areas to be scanned, such as cervical spine, chest, abdomen, and pelvis. Other centers, such as ours, continue to perform separate MDCT data acquisitions for each type of CT. For instance, a patient who has multiple types of CT studies in our Emergency Department will have them performed sequentially but not continuously, facilitating the optimization of contrast enhancement timing and radiation dose. Sequential rather than continuous scanning makes possible the use of different types of reconstruction algorithms for different anatomical segments.

**Alternative Means of MDCT Interpretation**

Another variable is the availability of freestanding image processing workstations. Workstations linked to CT scanners allow the interpreting radiologist to take raw data at the workstation and make customized MPRs. Off-line reconstruction has the added benefit of allowing the technologist to move on to the next patient without waiting for the CT computers to perform the MPRs. Alternatively, technologists can produce routine MPRs using standard imaging planes, such as sagittal or coronal planes. Our technologists obtain routine coronal and sagittal MPRs in chest trauma patients and also reconstruct an oblique sagittal MPR along the plane of the aortic arch (Fig. 1). When

Fig. 2a-c. Computed tomography (CT) of high-speed motor vehicle accident victim. **a** Coronal CT with bone windows readily identifies rib fracture *arrow). **b** Soft tissue coronal view demonstrates large amount of subcutaneous emphysema *white arrow) and active extravasation in upper abdomen medial to spleen *black arrow). **c** Lung window in coronal projection demonstrates medial and small apical pneumothorax *black arrows*