

Self-inflicted nail-gun injury with intracranial and intracardiac nails

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Nail-gun injury is commonly encountered in the emergency department. The severity of the injury depends on the specific injuries to organs and vascular structures. Computed tomography (CT) is the ideal imaging test of choice, as it can identify the more critical injuries that require immediate intervention. We present a case of self-inflicted nail-gun injury with intracranial and intracardiac nails that was optimally evaluated with CT. CT significantly changed the patient's management, giving priority to potentially life-threatening penetrating cardiac injuries.

Case report

A 55-year-old male with a history of depression was transferred to Vancouver General Hospital from the Royal Inland Hospital after sustaining multiple self-inflicted nail-gun wounds to the head and heart with 18-gauge, 5cm nails after an attempted suicide. His initial attempt was not fatal, and a few hours later, he aimed the nail gun at his heart and triggered it several times again.

He initially presented to the local hospital several hours after injury, having removed a single nail from his submental region. The patient developed severe epigastric pain but was otherwise hemodynamically stable upon arrival—awake, alert, and responding to commands. Although his airway was protected, he was quickly intubated for investigation and management.

A plain radiograph (Fig. 1) revealed three nails projected over the skull. The subsequently performed noncontrast-enhanced CT images (Fig. 2) also displayed the three nails. One entered via the left temporal region, extending supe-



Figure 1. AP radiograph of the skull showing the presence of three metallic nails.

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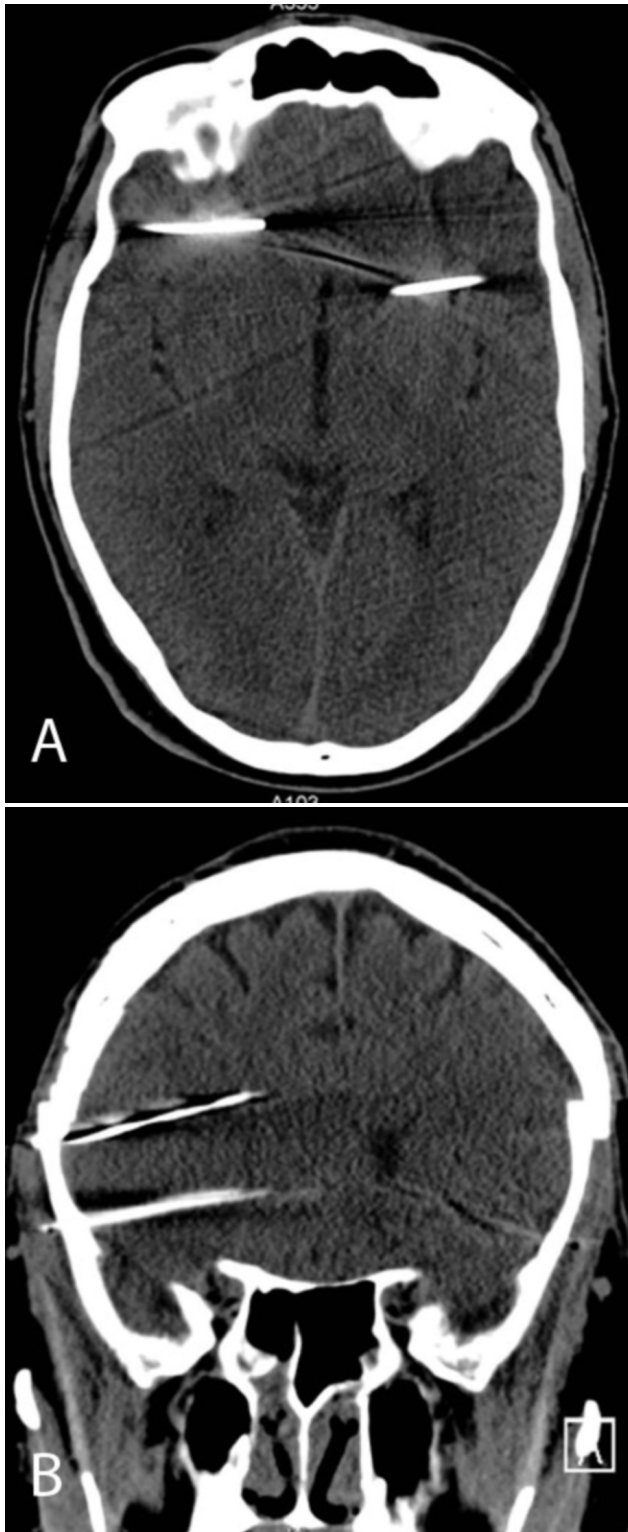


Figure 2. Nonenhanced head CT with axial image (A) and coronally reformatted image (B), showing three intracranial nails within both temporal lobes associated with a very small subarachnoid bleed. No evidence of parenchymal hematoma or mass effect is noted.

riomedially to the left temporal lobe, with the tip lying just inferolateral to the head of the caudate nucleus. The other two nails were located within the right temporal lobe. The inferior right nail was more anterior, and extended medially and superiorly through the inferior right frontal lobe, with its tip anteroinferior to the frontal horn of the right lateral ventricle. The second right nail entered more superiorly in the right frontotemporal region, extending superomedially towards the tip of the frontal horn of the right lateral ventricle. Each nail was associated with a small amount of beam-hardening artifact that partially obscured some of the immediately adjacent structures. A very small amount of subarachnoid blood was seen within the sulci of the frontotemporal region. However, there was no large parenchymal hematoma or significant mass effect. The ventricles appeared symmetric within normal limits, and the midline remained central. The left-sided nail was associated with very slight (1mm) inward displacement of the inner table of the skull.

Chest CT following administration of intravenous contrast showed two nails from the nail gun (Fig. 3). One of these nails entered 1.5cm to the left of the sternum. This nail was 5cm long and traversed the free wall of the right ventricle, and its tip appeared to be lodged in the interventricular septum. A small hemopericardium was noted, with evidence of high-density material suggestive of active extravasation into the pericardium. Mediastinal hematoma was also seen anterior to the pericardium with stranding. The anterior nail was very close to the internal mammary artery, and injury to this vessel could not be excluded.

A second nail entered the anterior chest, although the skin entry site was not visualized on physical examination. This nail traversed and remained within the fourth costochondral cartilage, with no associated rib fracture. It penetrated through the left ventricular apex—possibly involving a portion of the inferior septum. The tip appeared to exit via the free wall of the posteroinferior left ventricle. There was possible involvement of the papillary muscles on the left side and the moderator band on the right side. The more inferior/posterior portion of the nail was possibly traversing the diaphragm, with involvement of the adjacent gastric cardia, although there was no evidence of extraluminal air. Left-sided pleural fluid was noted, with a high attenuation suggestive of hemothorax.

Of this patient's injuries, the cardiac injury was the more critical. Therefore, the patient was initially taken to the operating room for sternotomy and cardiotomy. Cardiopulmonary bypass was not required. Two nails were found, one with an entry site in the right ventricle free wall, continuing into the interventricular septum. The other nail entered the anterolateral wall of the left ventricle and exited through the posterolateral wall into the posterior pericardium. The right ventricular nail was removed first, and bleeding from the entry site was repaired with pledgeted 4-0 prolene sutures. The left ventricular nail was then removed and found to be adjacent to a large obtuse marginal branch of the coronary artery, which was then repaired with pledgeted 4-0 prolene sutures. Intraoperative ultra-

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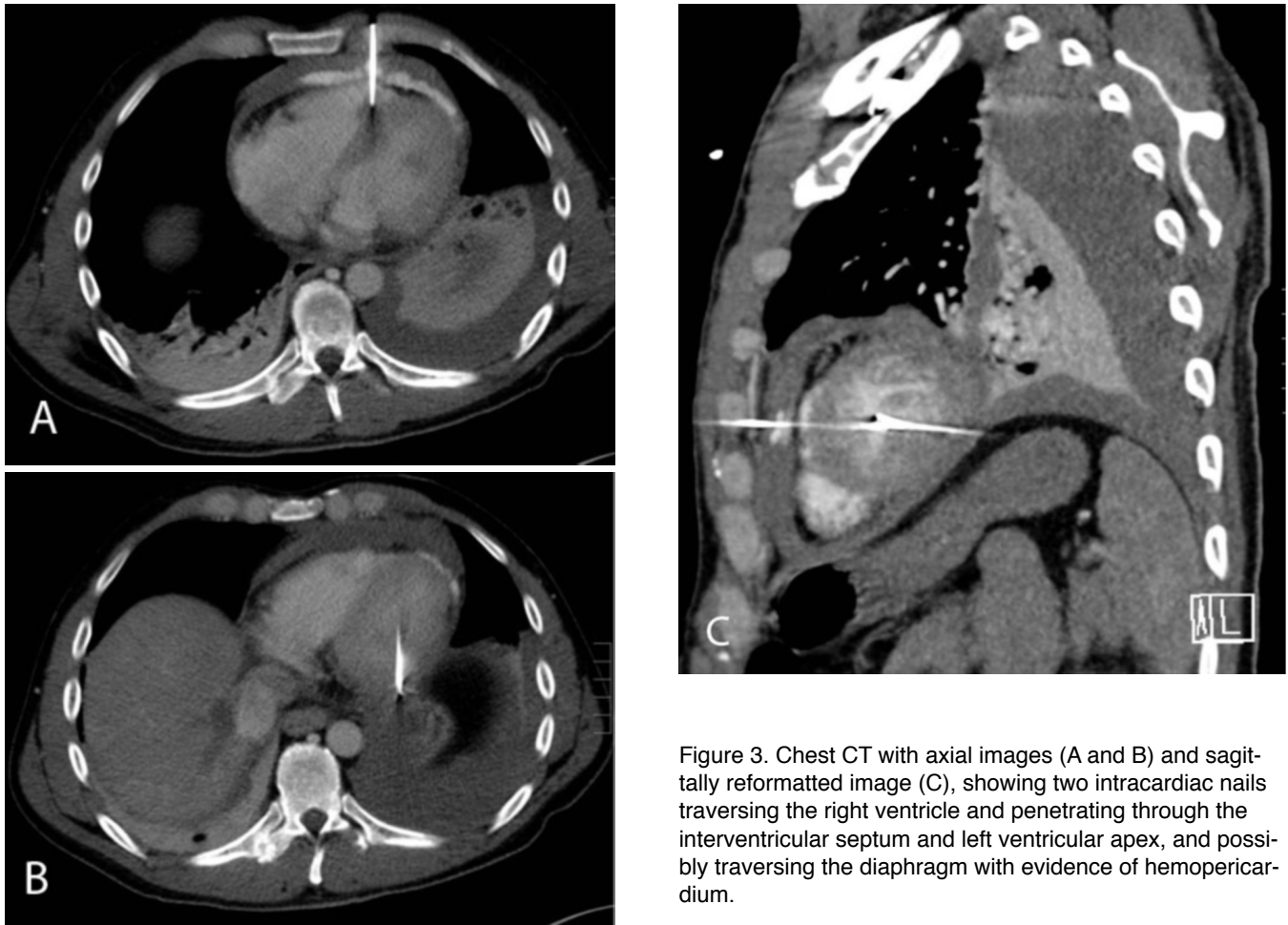


Figure 3. Chest CT with axial images (A and B) and sagittally reformatted image (C), showing two intracardiac nails traversing the right ventricle and penetrating through the interventricular septum and left ventricular apex, and possibly traversing the diaphragm with evidence of hemo-pericardium.

sound showed normal left and right ventricular function, with no intracardiac shunts and normally functioning valves. Postoperatively, the patient remained in the intensive care unit (ICU) for a few days, with three chest tubes in situ. These were sequentially removed, and the patient extubated uneventfully.

The patient remained hemodynamically stable, and on 9 March 2010 underwent craniotomy for removal of the intracranial nails. This procedure was also uncomplicated. The patient was extubated immediately postoperatively and transferred to the neurosurgical ICU. His only residual neurologic defect was right frontalis muscle palsy. The remainder of cranial nerve VII innervation was intact. A followup CT showed no pseudoaneurysm formation, bleeding, or brain parenchymal injury.

The patient then developed new-onset trismus. He was unable to open his mandible more than a finger's breadth, and had no obvious TMJ pathology. These symptoms were felt to be secondary to an infection due to the submental nail that he removed himself.

The patient was transferred back home on 12 March 2010, as soon as he was deemed medically stable from the perspective of his cardiac and brain injuries.

Discussion

Nail guns are commonly used in the construction industry to drive various sizes of nails into wood or concrete. They are powered by explosive cartridges or by compressed air supplied by an external compressor. These nail guns operate at pressures as high as 8.5 BAR, and are powerful enough to drive a steel nail into fully stressed concrete (1). Projectiles from these guns are considered low-velocity missiles (relative to conventional firearms). In about 40% of nail-gun injuries to the head, the outcome is fatal due to damage of critical structures, vascular injury, concussion blast injury, or meningitis (2). Our patient, however, managed to lodge three 5cm nails into his brain without causing much damage, other than a small subarachnoid bleed along the right frontotemporal region. The nails were removed without severe damage to his brain and without significant neurological impairment.

A bullet or projectile like the nail of a nail gun is not sterilized by firing and may carry viable bacteria into a wound (3). In addition, clothing may distribute bacteria along the wound track from both the entry and exit wounds. Bacteria may be drawn into the low pressure of the temporary cavity and distributed along the wound track (3). A short course of antibiotics is commonly advised (4, 5), but the

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need for this in low- to medium-energy-transfer wounds from handguns in civilian practice (or nail guns, as in our case) varies from practice to practice (6).

Nail-gun injuries to the heart are now considered mostly survivable, with a reported mortality rate of about 25% (7). The right ventricle is most frequently involved because of its anterior location (8), but the aorta and other mediastinal structures may be damaged too. The critical injury in this patient was the nail-gun wound to his heart. He was fortunate in that he developed only a small hemopericardium and minimal anterior mediastinal hematoma.

In nail-gun injuries, fast and decisive imaging is the key to adequate management of the patient. Computed tomography is ideal, as it is noninvasive and allows a rapid, thorough, and detailed look at the anatomy and critical structures such as the vessels, brain, and heart (9, 10, 11). Our case report demonstrates how rapid CT imaging can aid in the management of a patient with potentially life-threatening penetrating injuries, quickly identifying the more critical injuries that require immediate intervention.

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