

# Penetrating cardiac injury: the nail gun, a potentially dangerous tool

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Penetrating injuries caused by nail guns most frequently involve the extremities. Injuries to other organs such as the head, lungs and aorta have been occasionally reported.<sup>1,2</sup> Cardiac penetrating trauma from a nail gun is rare,<sup>3</sup> and we report such a case.

## Case report

A 25-year-old construction worker was installing a window from the inside but bent his upper body to the outside through the window. As he used a nail gun to secure parts to the window sill, the nail gun ricocheted and misfired a nail into his left chest. After evaluation at a peripheral hospital, he was quickly

transferred to our tertiary care centre.

On initial evaluation he was awake and alert. He had a paper cup carefully taped to the left anterior chest wall. His blood pressure was 100/70 mm Hg, and he had a heart rate of 102 beats/min. Auscultation of the lungs revealed normal air entry bilaterally. His first and second heart sounds were clear, and there was no murmur. Findings on abdominal examination were unremarkable. There was a nail protruding 3 cm from the anterior chest wall in about the sixth left intercostal space 4 cm lateral to the midline. The nail was angled toward the midline and moved synchronously with respiration. Accompanying information indicated that the nail was 10 cm long.

Appropriate intravenous access was secured and the patient was transferred to the operating room.

The chest was opened through a sternotomy under general anesthesia. The nail could be seen entering the mediastinum abutting the intact left pleura and then penetrating the left anterolateral aspect of the pericardium. The pericardium was carefully opened to reveal a small amount of blood clot and the nail penetrating the anterior wall of the right ventricle. A 4-0 prolene pursestring suture was placed around the nail and tied as the nail was extracted. Two mediastinal drains were inserted, and the chest was closed in the usual fashion. He had an uncomplicated postoperative course



FIG. 1. The nail has entered the left chest from the sixth intercostal space 4 cm lateral to the midline. Patient's head is to the right.



FIG. 2. Intraoperative view shows that the nail has penetrated the right ventricle just above the acute margin. Patient's head is to the left.

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and was discharged home 4 days postoperatively. At the 3-month follow-up he was well and had normal electrocardiographic and chest film findings.

### Discussion

Nail guns are power tools that can be activated either pneumatically or by an explosive cartridge. They are categorized as being either high velocity, which shoot nails similar to a rifle shooting a bullet, or low velocity, which directly press the nail head. Nail guns can drive a nail into wood, plastic, brick and even concrete surfaces with ease and speed and are therefore one of the most commonly used tools in the construction business. Sophisticated and high-velocity nail guns are available with a permit through special dealerships and are mainly used by professional workers, whereas low-velocity nail guns are available to the general public through most hardware stores in North America. Whereas safety education may be compulsory for professional workers, this is generally not the case for nonprofessionals.

Nail gun-related injuries have been reported since their introduction in

1959. Although some were self-inflicted for suicide,<sup>4</sup> most reported injuries are work-related. The mechanism of the injury can be overpenetration, ricochet from a hard surface or inappropriate triggering, as in this case. The severity of the injury depends on the force applied to the nail, the length of the nail and the organ injured.

In most reported cases, patients survive nail gun injuries because the nail wedges into the tissue. Catastrophic hemorrhage is unlikely, even when the injury involves the heart, as in this case. Expeditious transfer to the operating room for formal exploration is the key to salvaging these patients. If a nail has penetrated the precordial area, a sternotomy is the most appropriate approach because the heart and great vessels are ideally exposed and surgeons have the flexibility to use cardiopulmonary bypass in the rare instance when this might be required.

Prevention is the key to avoiding nail gun-related injuries. The engineering design needs to be modified to produce a better triggering system so as to avoid ricochet and misfire. Professional workers and the public need better training as well as improved safety education to raise

awareness of the potential for injury. In our case, injury could have been prevented by more appropriate positioning of the person using the gun.

In summary, the frequency of nail gun-related injuries will likely increase with the increased use of this efficient but potentially dangerous tool. Design improvements, more formalized safety training and greater awareness of the potential for injury would decrease the number of injuries. Injury involving the heart requires early exploration and repair.

**Competing interests:** None declared.

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