



Pneumatic Nail Gun Injury Complicated with Bladder Penetration and Occult Jejunum Perforation

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Injuries due to the improper or careless use of pneumatic nail guns have been reported since the introduction of the tool in the 1950s. The sites of injury include the hands, lower limbs and other areas that can produce life-threatening injuries. An example of the latter, which occurs infrequently, is perforation of the abdomen. We present an abdominal injury from a self-inflicted wound while using a pneumatic nail gun. The injury involved the lower abdomen and was complicated with penetration of the bladder and occult perforation of the jejunum. This rare bowel injury could have been catastrophic had it escaped diagnosis. We recommend that a prompt exploratory laparotomy with a thorough survey should be performed in such patients.

Key words: bladder penetration, jejunum perforation, pneumatic nail gun

INTRODUCTION

Pneumatic nail guns are a relatively new type of tool and can drive anything from a small finishing nail to a large fixing nail into wood and concrete blocks with the squeeze of a trigger. Because of such functions, they are a powerful and useful tool for construction. Nevertheless, nail guns impart a large amount of energy to a small projectile. If workers do not use them carefully and the nail is not properly aimed, the nail may strike the worker and cause an injury. Case reports of nail gun injuries were documented by Montoli as early as 1966, and reported injuries range from damage to the extremities to more serious injuries to the brain, heart, neck and eyes¹. However, our survey of the literature showed that no abdominal injury, especially one resulting in perforation of intra-abdominal organs has been reported. Here we report such an unusual case and emphasize the importance of both careful surgical exploration and proper safety precautions in using such a powerful machine.

CASE REPORT

A 27-year-old male construction worker presented to our emergency department with “a nail trapped in his abdomen”. The patient reported that he lost hold of a pneumatic nail gun when it encountered a knotted area on the ceiling. Unfortunately, the gun fired into his lower abdomen. On physical examination, the patient presented a soft abdomen without rebound pain. His white blood cell count was 15,600/ μ l and other laboratory studies were normal. Plain films of the abdomen revealed a metallic nail about 5 cm in length and 2 mm in diameter that had penetrated upwards and to the posterior into the lower abdomen (Fig. 1). Contrast-enhanced computed tomography (CT) of the abdomen revealed that the nail was penetrating through the supra-pubic region into the urinary bladder. Minimal fluid had accumulated in the rectovesical pouch. The small intestine and colon displayed a normal gross appearance, with no evidence of perforation (Fig. 2).

Under the presumption of penetration of the urinary bladder, a laparotomy was performed with repair of the urinary bladder. Abdominal exploration was also performed. During surgery, a round, long, silvery steel nail with a pinpoint penetration on the anterior aspect of the urinary bladder was identified. The nail was easily removed and a primary suture of the urinary bladder was made. During the routine abdominal check, we thoroughly surveyed the whole abdomen and discovered two tiny, non-necrotic perforations over the jejunum. The perfora-

Received: February 12, 2007; Revised: March 30, 2007;
Accepted: April 30, 2007

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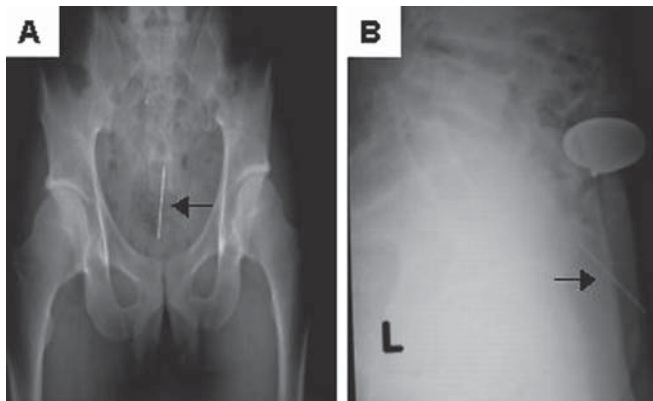


Fig. 1 (A) Anteroposterior view of the abdomen shows the position of the nail (arrow). (B) Lateral view of the abdomen confirming that the nail (arrow) directly penetrated the abdomen at a 50 degree angle and was trapped.

tions were immediately closed by primary suture with enterorrhaphy.

After treatment and surveillance, the patient was discharged from the hospital four days after surgery. At that time, the patient was capable of tolerating food. The patient has remained free of any enteric or urinary impairment for six months in outpatient follow-up. The postoperative result was satisfactory.

DISCUSSION

Nail guns are used extensively in wood-frame building construction, with especially high use in residential construction. They are powered by a variety of sources, including compressed air (pneumatic), spring-loaded mechanisms and explosive cartridges^{2,3}. Injuries incurred in the misuse or careless use of these tools are of a penetrating type, and commonly occur in the nondominant hand of the user, although other less common injuries also occur⁴. Such penetrating wounds produce local tissue changes that are similar to gunshot wounds, and range from mild tissue damage to severe life-threatening injury.

Improper use of nail guns is a major cause of injury. Examples of improper use include continuous rather than periodic depression of the trigger and accidentally making contact with the body instead of the target. Pneumatic nail guns are typically fitted with a hand-operated trigger. Firing a nail is accomplished by applying approximately 6.81 kg (15 lb) of pressure to the tip or safety element of the nail gun while pulling the trigger to release a single nail⁵. Approximately 69 percent of puncture injuries may be due to an

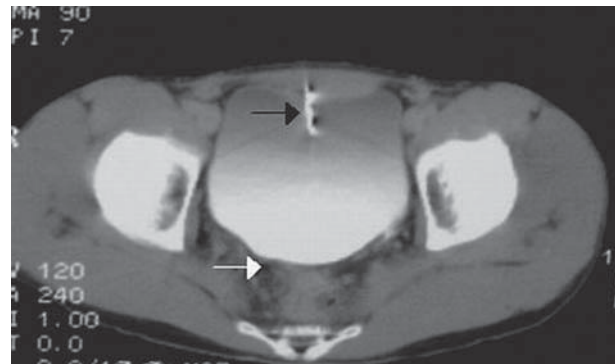


Fig. 2 Contrast-enhanced CT of the abdomen shows one metallic nail (black arrow) inserted through the suprapubic region into the urinary bladder with minimal fluid accumulation in the rectovesical pouch (white arrow).

inadvertent nail gun discharge or misfire, and are in large part preventable by the use of sequential triggers⁶. Thus, worker training and education are important components of the prevention of pneumatic nail gun injuries. The patient in this case stated that he had received inadequate training in the use of the tool and had carelessly dropped it, which resulted in the accidental and self-inflicted injury.

Indications for surgical exploration in penetrating trauma remain an unresolved issue. Nontherapeutic operations for penetrating trauma are associated with significant morbidity and mortality⁷. Laparoscopy is useful in detecting small lacerations of peritoneal organs, although the technique's usefulness in evaluating the entire bowel and the retroperitoneum is limited⁸. The present case is interesting in that penetration of the urinary bladder was recognized, while the tiny occult perforations of the jejunum remained undetected until exploratory surgery. The nail trapped in the abdomen involved both the urinary bladder and the jejunum and not just the urinary bladder as first thought.

Several cases of nail gun injuries have been documented, highlighting the need to be familiar with and observe the safety rules pertaining to the use of these tools. Such tools should never be used without the operator having first read the safety manual and having ensured that the tool is operating properly. Safety glasses should always be worn and a finger should contact the trigger only when the tool is being fired. In the case of pneumatic nail guns, only regulated compressed air should be used and the air supply should be disconnected before servicing the tool. Hands and feet should be kept clear of the area that is to be nailed. Finally, the tool should be operated on a stable work

surface. Although all pneumatic nail gun manufacturers provide labels with their tools that warn of the danger of bodily injury and that present explicit instructions in the owner's manual, special training courses should also be arranged for all users. Injuries such as that in the present case may have been prevented by mandating periodic training courses for all users, and implementing improved safety features such as two-handed operation to gain better control of the nail gun.

Unusual mechanisms of injury should be considered when designing management schemes for dealing with penetrating injuries of the abdomen. It is important to remember that missing or misdiagnosing a hollow-organ injury can lead to overwhelming infection and even death. It is critical to retain a high level of suspicion for this type of injury. Exploratory laparotomy combined with a thorough survey is needed in such unusual cases.

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