


# Uneventful survival of a rural child after penetrating cardiac injury by a thorn: a case report

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## Background

Paediatric penetrating cardiac injury is extremely rare, precluding published management guidelines, therefore warranting a case-by-case approach with learning points gleaned from each case.

## Case summary

A 7-year-old boy presented to a rural hospital with a stab wound to the chest by a Withaak (*Vachellia tortilis*) thorn. The patient was haemodynamically stable on presentation, but a 2 cm subcutaneous, pulsatile mass was present at the cardiac apex. Echocardiography revealed a foreign body penetrating from the apex into the heart, with evidence for a fistula between a cardiac chamber and the pulsatile mass. Angiography confirmed the existence of the fistula between the right ventricle (RV) and the pulsatile mass. A controlled extraction under general anaesthesia via median sternotomy was performed in-theatre, with blood products and cardiac bypass on standby. The patient recovered without complications and was discharged after 4 days.

## Discussion

Our case illustrates the limitations of echocardiography in identifying the precise anatomical definition of penetrating cardiac injuries. Angiography is therefore indicated in such cases. The injury to the RV and the haemostatic effects of the *in situ* thorn were favourable prognostic factors. We believe that the mortality risk reduction of extraction under full control warrants the minor morbidity of a median sternotomy.

## Keywords

Penetrating cardiac injury • Paediatrics • Echocardiography • Angiography • Median sternotomy • Case report

## Learning points

- Experience of penetrating cardiac injuries in children is very limited. Each case must be carefully managed on its own merits.
- The haemodynamic stability of a child with a retained foreign object may conceal a critical lesion if the foreign body is removed without prior investigation and due care.

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## Introduction

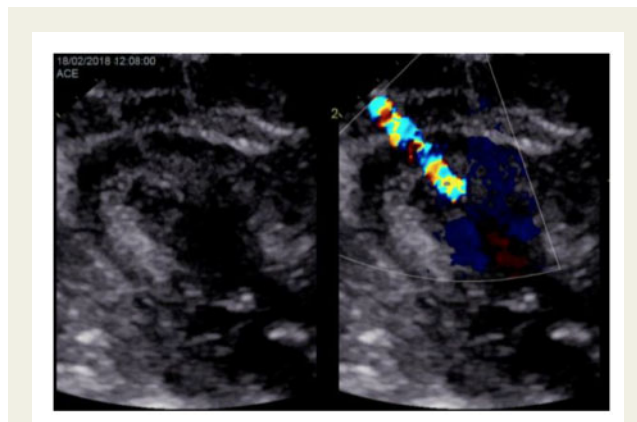
Penetrating cardiac injury in adults is a common occurrence in South Africa, of which stabbing was responsible for most of the cases.<sup>1,2</sup> In paediatric practice, however, this type of injury is extremely rare.<sup>3</sup> Iatrogenic myocardial punctures during medical procedures such as pericardiocenteses or cardiac catheterizations are rarely encountered, and even though occasionally they cause cardiac tamponade, are usually well-managed.<sup>4</sup> However, the rare occurrence and idiosyncrasy of traumatic injuries preclude published guidelines on management, and instead warrant a case-by-case approach.

## Timeline

Day	Event
0	Patient incurs penetrating thorn injury.
1	Presents to rural clinic, pulsatile apical mass noted, wound dressed only, referred to local tertiary hospital in Eastern Cape, South Africa. No management offered there.
2	Transferred via air ambulance to Cape Town.
3	Echocardiography and angiography followed by controlled extraction of thorn.
6	Discharged without complications.

## Case presentation

A 7-year-old orphan boy presented to a small rural hospital in the Eastern Cape province of South Africa following a penetrating injury to the chest by a Withaak (*Vachellia tortilis*) thorn. The injury occurred after falling from a Withaak tree, and he sustained no other injuries. On presentation, two small lacerations and a subcutaneous pulsatile mass of 2 cm diameter at his cardiac apex were noted. A foreign object was apparent in one of the lacerations. The boy had no medical history of note, was not taking any medication. He was haemodynamically stable, not in pain, but reluctant to allow any close palpation. The wound was dressed, and he was referred to a paediatric surgeon at a tertiary hospital in East London (South Africa), then transferred by air ambulance to the Red Cross War Memorial Children's Hospital (RCCH) in Cape Town. On admission, his vital signs were all normal, and besides the puncture wound, no abnormal clinical signs were detectable. A chest radiograph showed nothing of note, and an urgent echocardiogram excluded a pericardial effusion. All blood tests were within normal limits. However, formal echocardiography revealed a foreign body penetrating from the apex into the cardiac mass. A fistula with a continuous Doppler blood flow pattern between the cardiac chambers and the pulsatile mass at the apex was noted. Unusually, the Doppler blood flow pattern of the fistula crossed anatomical planes: it arose from immediately below the skin



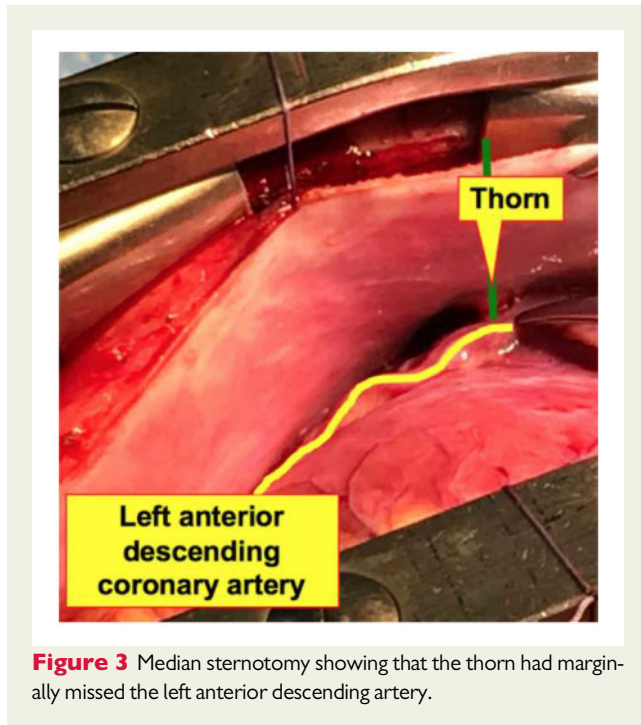
**Figure 1** Echocardiography revealed the thorn inside the fistula: it is unclear which ventricle it had penetrated.



**Figure 2** Angiography of the whole heart (left) showing the fistula arising from the right ventricle and (right) with scalpel blade at the apical wound.

at the apex, crossed the pericardium, and seemed to cross through the anterior right ventricle (RV) and the interventricular septum and enter the left ventricle (LV). The foreign body created an obvious filling defect within the fistula (*Figure 1*).

Discomfort on echocardiography precluded certainty of the position of the tip of the thorn within the heart. Diagnostic cardiac angiography was therefore planned under general anaesthesia (GA). Echocardiography under GA suggested that the tip of the thorn was in the LV, but it remained difficult to ascertain its exact position. Transoesophageal echocardiography was unhelpful. Angiography of the LV and coronary arteries was entirely normal. On angiography of the RV, however, a fistula was seen to arise anteriorly from the RV, run anterolaterally towards the apex and end subcutaneously at the pulsatile mass (*Figure 2*). This was confirmed on angiography by placing the tip of a scalpel handle at the pulsatile mass (*Figure 2*). With this imaging, it was considered unnecessary to perform computed tomography angiography or cardiac magnetic resonance imaging.



**Figure 3** Median sternotomy showing that the thorn had marginally missed the left anterior descending artery.

The attending cardiothoracic surgeon (A.M.) decided that the safest approach to removing the thorn would be by controlled extraction in cardiothoracic theatre. Blood was available in theatre in anticipation of potential major haemorrhage and cardiac bypass on standby in the event of coronary artery injury. The thorn was exposed and stabilized by forceps before median sternotomy was performed, and the pericardium hitched to expose the heart. No blood was noted in the pericardial space. A large adhesion from the apex of the heart traversed the pericardial space containing the thorn, which had penetrated the myocardium immediately adjacent to the left anterior descending coronary artery (Figure 3).

The thorn was extracted percutaneously under direct vision, and the injury at the right ventricular entry point closed spontaneously without haemorrhage. A single pericardial drain was inserted and the chest was closed routinely. The thorn was measured to be 4.5 cm long (see slide set).

Anaesthesia was maintained with isoflurane, cisatracurium and fentanyl, and analgesia included intravenous fentanyl, paracetamol, clonidine, with local bupivacaine wound infiltration. The patient was extubated in theatre and transferred to the paediatric intensive care unit. His post-operative course was unremarkable, and he was discharged without incident 4 days after admission. Echocardiography on the day of discharge showed a completely normal heart with no evidence of the penetrating injury.

## Discussion

Penetrating cardiac injury in childhood is exceedingly rare. Isolated case reports describe injuries by projectiles (air rifles),<sup>5-7</sup> a crotchet hook,<sup>8</sup> a pencil,<sup>9</sup> and a sewing needle.<sup>10</sup> An unusual case at RCCH

described a stab injury with pericardial and myocardial laceration without penetration.<sup>11</sup> An 11-year retrospective study<sup>3</sup> showed 32 out of 4569 (0.7%) children admitted for trauma had penetrating cardiac injuries, of which 81% were stab wounds. Review of the RCCH trauma database since 1991 failed to find any stabbed heart cases, and none of our senior cardiology consultants has managed a stabbed heart.

Our case illustrates that echocardiogram after penetrating cardiac injury may exclude immediate life-threatening sequelae (e.g. tamponade) but fail to define the severity of the lesion. It is then impossible to predict the consequences of removing a penetrating foreign body (e.g. a pencil<sup>9</sup>), and as a result angiography may be indicated.

Our patient had an isolated right ventricular injury with fistula formation. Due to the anatomical locations of the cardiac chambers, the incidence of right ventricular injury is highest, followed by injury to the LV and right atrium (RA).<sup>1,3</sup> Right ventricular injury has the most favourable prognosis compared to injuries to other sites,<sup>1,3,12</sup> as a result of the relatively low pressures of the RV (compared to the LV) and its thicker walls (compared to the RA).<sup>3</sup>

Management of penetrating cardiac injuries depends upon the stability of the patient at presentation, and includes methods ranging from emergency-department thoracotomy, to in-theatre thoracotomy or median sternotomy.<sup>13</sup> Despite cases such as ours, where removal of the penetrating object did not cause any bleeding,<sup>10,11</sup> removal of the thorn without detailed investigation followed by median sternotomy could result in uncontrolled bleeding or cardiac tamponade.<sup>9</sup> We suggest that the mortality risk reduction of an extraction under full control warrants the minor morbidity of a median sternotomy.

Time from injury to surgery is critical for penetrating cardiac injuries, with significantly increased mortality if presenting after 30 min.<sup>1</sup> The timing may dictate whether cardiac tamponade becomes deleterious instead of protective,<sup>13</sup> but details surrounding this transition remain obscure. Despite a delay of 3 days between injury and thorn extraction, our patient had a (rare) favourable outcome, probably due to four important factors:

- (1) the thorn remained *in situ*, acting as a 'plug'
- (2) the injury was to the RV
- (3) no injury to the coronary arteries and other major arteries
- (4) the fistula from the RV was blind ending. Had the distal, superficial end of the fistula opened into the pericardial space, the mediastinum, or externally via the entrance wound, the injury may have been fatal.

## Conclusion

Despite the rarity of penetrating cardiac injuries in children, morbidity and mortality is significant.<sup>3</sup> Timing to medical intervention remains critical, and a high index of suspicion with an adequate arsenal of diagnostic tools must be adopted. Our patient's favourable outcome was intricately related to the anatomy of the injury. We recommend a controlled extraction of cardio-penetrating foreign objects with median sternotomy for all appropriate patients.

## Lead author biography



Rik De Decker is an Associate Professor in the Faculty of Health Sciences in the Department of Paediatrics and Child Health of the University of Cape Town, and as a consultant paediatric cardiologist, serves as the Director of the Cardiac Catheterization Laboratory and CATHCHAT at the Red Cross War Memorial Children's Hospital. As a

generalist cardiologist, he is involved in the management of children with heart disease, including the utilization of advanced echocardiographic, catheterization, and other tertiary investigations to assess and prepare children for interventions such as cardiac surgery and interventional catheterization. He is also a clinical geneticist with an interest in the genetic aetiology of congenital heart disease and a focus on the detection of the syndromic associations of children with heart disease. When not at work, he prefers to spend time in the wilder and steeper parts of the world.

## Supplementary material

[Supplementary material](#) is available at *European Heart Journal - Case Reports* online.

**Slide sets:** A fully edited slide set detailing this case and suitable for local presentation is available online as [Supplementary data](#).

**Consent:** The boy is an orphan and was accompanied by his aunt who is not his legal guardian. Consent for the procedure and

the publication of the case report was obtained from the Manager: Medical Service (Deputy CEO) of Red Cross Children's Hospital, as per statutory protocol.

**Conflict of interest:** none declared.

## References

- Campbell N, Thomson S, Muckart D, Meumann C, Van Middelkoop I, Botha J. Review of 1198 cases of penetrating cardiac trauma. *Br J Surg* 1997;**84**: 1737–1740.
- Degiannis E, Loogna P, Doll D, Bonanno F, Bowley DM, Smith MD. Penetrating cardiac injuries: recent experience in South Africa. *World J Surg* 2006;**30**: 1258–1264.
- Lustenberger T, Talving P, Lam L, Inaba K, Mohseni S, Smith JA, Demetriades D. Penetrating cardiac trauma in adolescents: A rare injury with excessive mortality. *J Pediatr Surg* 2013;**48**:745–749.
- Kumar R, Rana SS, Kumar S, Das D, Datta M. Management of accidental and iatrogenic foreign body injuries to heart-case series. *J Clin Diagn Res* 2017;**11**:PE01.
- Wascher RA, Gwinn BC. Air rifle pellet injury to the heart with retrograde caval migration. *J Trauma Acute Care Surg* 1995;**38**:379–381.
- Mingorance MA, Casado FC, Mendias JV, López-Tello CS, de la Cruz JP. Cardiac injury from an air gun pellet: a case report. *Eur J Pediatr Surg* 1999;**9**: 184–185.
- DeCou JM, Abrams RS, Miller RS, Touloukian RJ, Gauderer MW. Life-threatening air rifle injuries to the heart in three boys. *J Pediatr Surg* 2000;**35**: 785–787.
- Levent E, Arslan MT, Özyürek AR, Atay Y, Alayunt A, Parlar A. Cardiac perforation due to crochet hook: a pediatric patient with penetrating cardiac injury. *Mortality* 2003;**5**:7.
- De Raet J, Mees U, Vandekerckhof J, Hendrikx M. Penetrating pediatric cardiac trauma caused by fall on a pencil with normal echocardiography. *Interact Cardiovasc Thorac Surg* 2004;**3**:634–636.
- Sola JE, Cateriano JH, Thompson WR, Neville HL. Pediatric penetrating cardiac injury from abuse: a case report. *Pediatr Surg Int* 2008;**24**:495–497.
- van As A, Brink J. Missed stabbed heart in an infant. *Injury Extra* 2005;**36**:445–446.
- Demetriades D, van der Veen BW. Penetrating injuries of the heart: experience over two years in South Africa. *J Trauma* 1983;**23**:1034–1041.
- Asensio JA, Soto SN, Forno W, Roldan G, Petrone P, Gambaro E, Salim A, Rowe V, Demetriades D. Penetrating cardiac injuries: a complex challenge. *Surg Today* 2001;**31**:1041–1053.