Could the novel ‘double-hole’ technique be an alternative for the inflow occlusion method?

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Abstract

Background: Inflow occlusion on beating heart and cardiopulmonary bypass techniques have been proposed for the removal of foreign material, such as stents, catheters and mass lesions, from cardiac chambers. However, both techniques are not devoid of disadvantages and complications. In this article, we define an alternative, novel ‘double-hole’ technique, which is based on opening the right atrium without cardiopulmonary bypass.

Methods: Bovine hearts were obtained from a local supermarket. Two purse-string sutures were placed in the right atrium using 2-0 braided, non-absorbable polyester suture material, one close to the auricle, and the other close to the interatrial septum. The guidewire of a haemodialysis catheter was inserted through the superior vena cava into the right atrium and passed all the way through the right ventricle.

Results: We suggest that the double-hole technique may be useful, especially in revision cases with adhesions. Further research should be performed to document the efficacy and safety of this method.

Conclusion: We are aware that further extensive research is necessary to investigate the utility of this novel technique in contemporary cardiovascular surgery. We believe the double-hole technique has the potential to become a safe, practical and effective measure in the future.

Keywords: inflow occlusion, foreign body, extraction, double-hole technique, extracorporeal circulation.
with the clamp every time, and the two pieces of wire were removed, where after the right atrium was closed with snares.

Discussion

IOBH is a well-known but uncommonly used technique to remove mass lesions and foreign material such as pacemaker leads and catheters from the right atrium.1 In this technique, blood flow from the superior and inferior vena cavae to the right atrium is prevented by occlusion with snares, and the right atrium is then opened. This method has significant disadvantages, such as bleeding, hypotension, air embolism, difficulty of surgical exposure, and the necessity to be performed in a short time. Cardiac and neurological complications may occur due to systemic and cerebral malperfusion, particularly in occlusions of more than three minutes.2

CPB may be required, particularly in cases with complicated right atrial material. This necessity arises owing to co-morbidities of the patient, extension of the material, and the potential for pulmonary embolism. Studies have demonstrated that the use of CPB is particularly common in cases with co-existence of extracardiac tumours and large, invasive right atrial thrombus.4-6 Both IOBH and CPB techniques may be used in the extraction of intracardiac pacemaker leads,6 and in tracheal stent implantation.7

CPB can alternatively be used for these interventions, but widespread inflammatory response, length of operation and intubation times, and duration of intensive care unit and hospital stays are limitations of the technique.3 These limitations become even more apparent in cases with co-morbidities.1 To overcome these disadvantages, we have developed a novel double-hole technique for the removal of foreign material (e.g. catheters, pacemaker leads) in a bovine heart model.

In the IOBH technique, the superior and inferior vena

Fig. 1. A. Two purse-string sutures are placed, one close to the auricle and the other close to the interatrial septum. The left index finger is inserted into the ventral hole and a closed clamp is inserted into the dorsal hole. B. The clamp is opened inside the right atrium. The clamp is closed after the left index finger pushes the wire between the jaws of the clamp. The wire held by the clamp is extracted.

Fig. 2. A. The extracted wire is cut into two pieces. B. Removal of the distal part of the wire.
cavae should be free from the surrounding tissue. A polyester tape is placed around each vena cava to provide occlusion of inflow. Complications such as bleeding and air embolisation may be minimised in the double-hole technique since it involves less traumatic and more haemostatic steps such as a purse-string suture, a smaller hole for clamp insertion, and gentler manipulation with the finger.

The technique we describe is easy and practical to perform. While the wire is manipulated with the left index finger, it can easily be grasped repeatedly with the clamp in the right hand. Results of our preliminary report indicate that the double-hole technique could be a safe and effective option for the extraction of pacemaker leads and catheters from the right atrium. We suggest that this technique may be especially useful in revision cases with adhesions. Further research should be performed to document the efficacy and safety of this method.

The main limitation of this experimental study is that the right atria of the bovine heart are much smaller than those of a human heart. Larger atriae may cause more difficulty during surgery. Secondly, the usefulness of this procedure may in fact be limited to wires that are partly trapped in the right atrium, and hence this would include pacer wires and ‘errant’ guidewires. It may not be appropriate for guidewires having left the right atrium and travelled to the right ventricle or pulmonary artery.

**Conclusion**

We believe the double-hole technique has the potential to become a safe, practical and effective measure in the future. Further extensive research is necessary to investigate the utility of this novel technique in contemporary cardiovascular surgery. We plan to assess this technique in an *in vivo* model to corroborate its potential as a less-invasive extraction procedure in future research.

**References**