

Inadvertent Puncture of Dilated Right Ventricle During Transversus Thoracic Muscle Plane Block: Lessons Learnt

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ABSTRACT

The transversus thoracic muscle plane (TTP) block is gaining widespread recognition in cardiac surgery, particularly in facilitating fast-tracking. Here, we report a case of inadvertent puncture of the right ventricle (RV) during the administration of ultra sound-guided (USG) TTP block in a 3-year-old child posted for atrial septal defect (ASD) closure and mitral valve repair. We also discuss the care that should be taken to avoid such complications and such cases require extra caution during TTP block.

Keywords: Haemopericardium, right ventricular puncture, transversus thoracic muscle plane block

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INTRODUCTION

Transversus thoracic muscle plane (TTP) block is an effective technique for reducing postoperative pain and opioid consumption in adults^[1] as well as pediatric^[2] cardiac surgery. Minor complications have been reported with ultrasound-guided (USG) TTP block and further prospective studies are required to substantiate its safety.

Here, we report a case of inadvertent puncture of the right ventricular wall while administering a TTP block for an atrial septal defect (ASD) closure and mitral valve repair, in a 3-year-old child.

A 3-year-old boy was incidentally detected to have a large ASD with moderate mitral regurgitation while being evaluated for pneumonia. Since the inferior vena cava rim was deficient and the child had moderate

mitral regurgitation, he was scheduled for open surgical closure of the ASD with mitral valve repair. After routine induction and endotracheal intubation under standard ASA monitoring, we proceeded to give a TTP block for post-operative analgesia and fast-track extubation after surgery.

The block was administered under USG guidance using a linear transducer (Esaote, Italy). The transducer was placed in a sterile plastic cover. Under aseptic precautions, a 5 cm, 21 G hypodermic needle was inserted in a parasagittal position 1 cm lateral to the sternum using an in-plane technique. However, during injection in the fifth left intercostal space, the tip of the needle was not visualized. Hence, the approximate position of the needle tip was ascertained using hydro-dissection, which revealed the separation of tissue planes between the internal intercostal muscle and transversus thoracic muscle. No blood could be aspirated before deposition of 0.4 ml/kg

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of 0.25% levobupivacaine into the fascial plane. The pleura could be seen getting displaced down during injecting the drug. Mild tachycardia was noted immediately after the block; however, the blood pressure remained stable. During the transesophageal echocardiographic evaluation before cardiopulmonary bypass, we noticed a 10 mm and 5.8 mm pericardial effusion anterior to the right ventricle (RV) and posterior to the left ventricle, respectively [Figure 1 and Video 1]. There were no signs of cardiac tamponade. When the pericardium was opened, freshly collected blood came out of the pericardial cavity. A puncture mark was seen on the anterior surface of the right ventricular wall just underneath the site of the TTP block [Figure 2]. The injury site was very close to the course of coronaries as well, although no coronary artery was injured. Since the needle injury mark on the RV was superficial and small in size, surgical intervention was not required to address it. The ASD closure procedure went on uneventfully and the child could be fast-tracked and weaned from ventilator early.

Transversus thoracic muscle plane block is an effective technique for fast-tracking in adult as well as pediatric cardiac surgery. It reduces the opioid requirement in both intraoperative and postoperative periods. Here, the local anesthetic solution is administered in the fascial plane between the internal intercostal muscle and the transversus thoracic muscle. It blocks the region supplied by anterior cutaneous branches of T2-T6 internal intercostal nerves. The block being a superficial one is easy to perform and does not require position change. It is usually devoid of hypotension and bradycardia as seen with the central neuraxial blockade. One potential drawback of using a TTP block could be interference with the surgical plane while harvesting the internal mammary artery, resulting in the failure to spread

the injectate evenly throughout the targeted thoracic levels.^[3] Other major complications that could be encountered with this block are hematoma formation, injury to the internal mammary artery, puncture of pleura and pericardium, pneumothorax, hemopericardium, and injection site infection.^[4] In a study, by Abdelbaser and Mageed,^[5] one patient had a pleural and pericardial puncture that were attributed to loss of sonographic visualization of the needle tip during needle advancement, similar to our case. Though the hydro-dissection is considered one of the techniques to locate the needle tip position, it is not always a fool-proof method of confirmation, as was seen in our patient. We would like to emphasize upon following learning points from our experience to prevent this complication in the future:

1. Always visualize the needle tip before advancing the needle when operating at deeper planes in the vicinity of the pericardium.
2. Echogenicity of the needle is crucial for visualizing the course of the needle through tissue planes during the blockade.
3. Hydro-dissection may be regarded as a surrogate method for identifying the correct location of the bevel of the needle. Needle penetration through the tissue planes creates a track on its path. Fluid injected through the needle may spread retrogradely in that track producing hydro-dissection proximal to the actual position of the needle tip.
4. In patients presenting with symptoms of palpitation or in those with significant enlargement of the right ventricle, a cautious approach should be adopted during TTP blockade on the left side of the sternum. In our patient, the injury was very close to the course of the coronaries as seen in Figure 2. Coronary artery

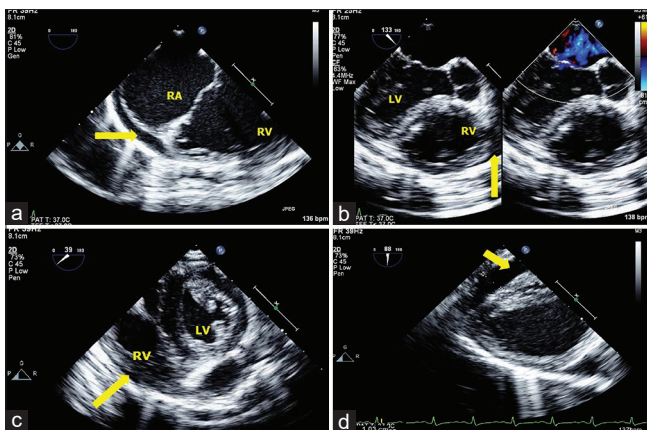


Figure 1: A rim of pericardial effusion is seen (yellow arrows) in (a) mid-esophageal (ME) 4-chamber right ventricular focused view, (b) ME long axis view, (c) transgastric midpapillary short axis view, and (d) transgastric 2-chamber view

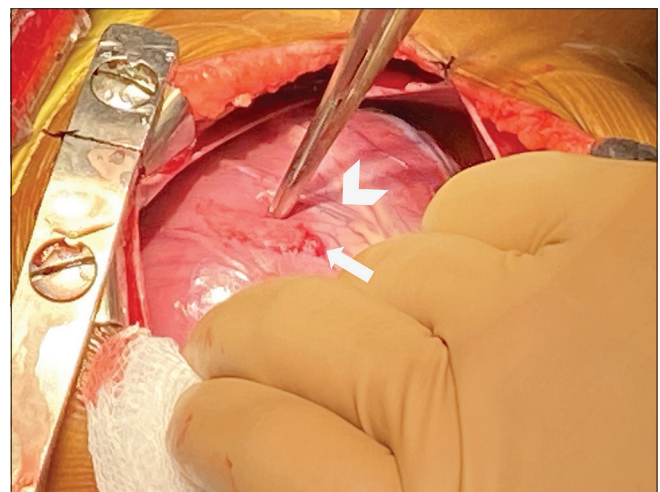


Figure 2: The site of needle injury (white arrow) is seen on the surface of the right ventricle, which is close to a branch of the coronary artery (white arrowhead)

injury can be catastrophic, and this fact should be kept in mind before proceeding with TTP block in patients with enlarged right ventricles. Using other regional analgesia methods such as erector spinae block or Pecs-2 block may be a better option to avoid pericardial or ventricular injury in such scenarios.

5. Always screen for any pericardial effusion using transthoracic or transesophageal echocardiography after administering the TTP block.

To conclude though a simple and effective technique of postoperative pain relief, the TTP block may be associated with complications such as cardiac injury and hemopericardium. This complication should be anticipated in patients with an enlarged right ventricle, which remains close to the anterior chest wall and caution should be exercised to follow the tip of the needle during the TTP blockade, without relying on the technique of hydro-dissection. Due consideration should be given to execute alternate regional techniques to avoid any myocardial or coronary artery injury.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and

other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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