Anterior Chest Wall Elevation Using a T-Fastener Suture Technique During a Nuss Procedure

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The most critical part of the Nuss procedure is the passage of the introducer across the anterior mediastinum without cardiac injury. For patients with severe pectus excavatum, passing the introducer can be difficult and hazardous. We describe a technique that resembles a use of T-fastenerlike suture material to elevate the anterior chest. The elevation of the chest allows safe, blunt anterior mediastinal dissection before the passage of the introducer. The risk of intraoperative cardiac perforation is minimized.


Intraoperative cardiac perforation during a Nuss procedure is rare, but it remains a life-threatening complication [1]. The cardiac perforation occurs during the passage of the introducer across anterior mediastinum, which is usually done without direct visualization. Eliminating this complication is paramount because the Nuss procedure is often done for cosmetic improvement. We describe a technique that resembles the use of T-fastener suture material to elevate the anterior chest before passing the introducer across the mediastinum.

Technique
The patient is positioned supine. The arms are placed in adducted position next to the chest. To have access to the lateral chest, several folds of blankets are placed under the patient’s back to elevate the chest, allowing the arms to be in the lower position on the operating table. Having the arms adducted also facilitates the attachment of the Thompson rail clamp (Thompson Surgical Instrument, Traverse City, MI) or Rultract Skyhook System (Rultract, Cleveland, OH) since the arm rests are not needed. Furthermore, with the arms in adducted position, the concern for brachial plexus nerve injury is mitigated. Bilateral lateral transverse chest incisions are made for the insertion of the sternal bar. Through the right lateral chest incision, a 5-mm port is inserted directly through the rib space into the chest cavity and observed as it enters the chest lateral to the sternum. Once the proper position is determined, a 16G angiocatheter is inserted. The needle within the angiocatheter is removed leaving the angiocatheter in place. Through the angiocatheter, a size 5 Fiberwire suture (Arthrex, Naples, FL) is passed into the thorax. A Maryland grasper or tonsil clamp is then directly placed into the lateral chest wound (not through the port) to retrieve the Fiberwire suture through the lateral chest incisions (Fig 1). The suture is then tied to a metal plate with three holes (3.5 mm wide-angle, low-profile reconstruction plate 3 holes; Synthes Corp, Monument, CO). An umbilical tape is tied to the outer hole of the metal plate, which will be used to remove the plate later (Fig 2). The metal plate is pulled through the rib space into the chest cavity and observed to lie against the underside of the anterior chest wall. The same maneuver is done on the contralateral side to create two T-fastener sutures that are used to elevate the anterior chest from both sides of the sternum. The sutures are attached to a Thompson retractor crossbar or Rultract Skyhook crossbar. Once the sutures are tied to the crank system, the anterior chest is elevated to the desired height so that the chest concavity is effaced (Fig 3).

With the anterior chest elevated with the T-fastener crank system, two laparoscopic peanut dissectors are passed into the left lateral chest incision through the open incision. While under thoracoscopic observation, the two peanut dissectors are used to bluntly dissect the anterior mediastinum to create a tunnel from the left to the right chest cavity (Fig 4). The dissection is very simple and needs only a gentle downward and lateral sweeping movement to clear the areolar tissues between the sternum and the pericardium. At the end of the dissection, the thoracoscope will easily pass through the anterior mediastinum to visualize the contralateral chest cavity (Fig 5).
Comment

Various methods have been proposed to elevate the sunken anterior chest of pectus excavatum patients to lessen the cardiac complication rate. One of the earliest methods reported was using a vacuum bell suction device to elevate the chest [2]. That was followed by a method proposed by Park and colleagues [3] known as the Crane technique. This method involves placing a metal wire suture through the sternal cortex and attaching the suture to a crank system. It is a simple, effective method, but it occasionally causes sternal fracture. Two additional methods reported after the Crane technique were manual elevation techniques [4, 5]. These methods require an assistant to hold up the chest using handheld retractor-type instruments during the passage of an introducer. These two techniques are also effective maneuvers, but they are limited by the strength of the assistant to hold up the chest. The most recent method, reported by Johnson and associates [6], uses a sternal lifter that is placed under the sternum through a subxiphoid incision. This method requires an incision on the anterior chest to put the lifter in place.

The advantages of the T-fastener method are threefold. First, it requires no specialized equipment. The metal plate and the Fiberwire suture can be found in most operating rooms that provide orthopedic surgical service. Second, no incision needs to be made on the anterior chest. The needle hole created by the placement of the...
16G needle requires no suture closure. In fact, it does not require any dressing. Third, it is a secure system that does not cause any fracture or tear to the anterior chest structure. The strength of the system is such that the patient can be elevated off the operating table.

There is one disadvantage to the T-fastener suture technique. After the introducer has traversed the mediastinum under vision and the sternal bar has been positioned, removal of the metal plate is necessary. To retrieve the metal plate, the previously placed umbilical tape that has been tied to the end hole of the metal plate is pulled. Occasionally, the umbilical tape will lie underneath the sternal bar, preventing the metal plate from coming out. In this situation, a grasper is inserted through the lateral incision to grab the metal plate directly to pull it out.

We have found that once the sunken chest has been elevated, the anterior mediastinum can be bluntly dissected without difficulty (Fig 4). Using endoscopic peanut dissectors, the areolar tissues between the sternum and the heart is gently pushed away. This maneuver is done entirely under thoracoscopic vision. It is possible at the end of the dissection to pass the thoracoscope through the anterior passage into the contralateral chest without any hindrance. Passing of the introducer is also done under thoracoscopic vision; thus, the safety of the heart during this move is assured.

Elevation of the anterior chest during the Nuss procedure should become a routine part of the procedure. Several effective methods have been reported in the literature that will lessen the cardiac perforation risk. We hope that one of these methods will be utilized by surgeons to improve the safety of the Nuss procedure for future patients.

References