How-to-do-it

New minimally invasive technique for correction of pectus carinatum

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Abstract

We describe a new video-assisted operative technique for correction of pectus carinatum (PC) using a modified Nuss procedure. A new design of the steel bar was developed, so that it could be introduced and placed in a suitable position through very small skin incisions. Substantial modifications were introduced in the bar length and shape aimed at facilitating insertion and subsequent removal when required. All the surgical manoeuvres took place under direct vision using a 30° thoracoscope. Single unilateral fixation of the bar in a subpectoral pocket provided satisfactory stabilisation without the need for lateral stabilisers. Adequate correction of the deformity was achieved with minor postoperative scars. Our results support the view that minimally invasive surgical repair should be preferred over open surgery for correction of pectus carinatum in young adults and children.

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1. Introduction

Although non-surgical treatment of pectus carinatum (PC) using a compressive brace offers highly satisfactory results in children and teenagers [1,2], this approach is not regarded as helpful for adults. The Ravitch open-surgery procedure [3] has been the standard surgical approach to PC for decades, until Abramson introduced his minimally invasive technique in 2005 [4] and Kálmán reported his results with a modified Nuss procedure applied to PC patients in 2009 [5]. However, open operative procedures continue to be extensively used worldwide, despite requiring large anterior visible incisions. Here, we report the results of using a new video-assisted technique for minimally invasive repair of pectus carinatum (MIRPC), modified from the Nuss procedure, in young adult patients.

2. Surgical technique

We selected a male patient and a female patient, aged 20 and 17 years, respectively, both with malleable PC chest deformities and psychologically affected.

Surgery was performed under general anaesthesia with selective bronchial intubation and epidural block. With the patient in the supine position, we measured the distance between the external edges of both areolas and selected a steel bar 2 cm longer than that distance. The bar was then bent with a mild curvature at both ends. The operative procedure required 2-cm bilateral peri-areolar (male patients) or sub-mammary (female patient) incisions for introducing both the thoracoscopic port and the prosthesis.

The pectus introducer, followed by the steel bar, were introduced into the patient’s chest from the right side under direct vision, and were advanced to exit the pleural space just right lateral to the mammary vessels. Just after crossing the midline above the sternum, the mid-body of the sternum was strongly depressed to facilitate redirecting the introducer/bar so that it could be pushed through the opposite intercostal space and reach the left pleural space (Fig. 1). This step was monitored with a video camera placed at the left chest cavity, to avoid injury to the mammary vessels, lung or mediastinum. No osteotomy or chondrotomy was performed. Once the bar was introduced, the chest adopted a correct and stable shape so that stabilisers were not necessary. The left end of the bar was fixed into position by attaching it to the costal arch with metal wires to prevent lateral displacement. The right end was left free in the pleural space. No chest drains were required (Videos 1 and 2).

As soon as the bar was placed in position, complete remodelling of the deformity was achieved in both patients (Fig. 2) and no further bars were needed. The operative times were 90 min and 40 min; the difference was related to the learning curve. Both patients were discharged from the hospital 4 days after surgery and resumed their regular activities 40 days thereafter. They were advised to delay low-impact aerobic exercises for 2 months and not to initiate vigorous athletic activities or weight-training before 6 months from surgery. In a follow-up visit that took place 6
months after surgery, both patients remained asymptomatic and the excellent cosmetic outcomes resulted in remarkably high patient satisfaction. Surgery to remove the bars will be scheduled for a date 3 years after the corrective surgery.

3. Discussion

The MIRPC has comparable advantages to those of the Nuss procedure used to repair pectus excavatum [6,7]. However, unlike the surgery required for minimally invasive repair of pectus excavatum (MIRPE), our procedure was rather safe, without the risk of injury to the heart or the great vessels, since we crossed the midline externally to the sternum.

Our procedure was straightforwardly based on the relatively short length and mild bending of the bar, which made it possible to insert it and to place it into position through small incisions. The cosmetic results were highly satisfactory since the peri-areolar and sub-mammary scars were barely noticeable.

Regarding previously reported results of MIRPC, the procedure used by Abramson [4] yielded better results than open surgery, in terms of cosmetic outcome. However, the extra-thoracic fixation of the steel bar opposing the thrust force exerted by the carinatum chest constituted an ‘unbalanced’ system that required large posterolateral fixation plates. In our procedure, the intra- and extra-thoracic placement of the bar resulted in a ‘balanced’ system, since the sternal force exerted on the bar tended to keep it in a suitable position so that stabilisers were not needed.

We agree with Kálmán [5] on the suitability of the intra-extra-thoracic placement of the steel bar for purposes of stability. However, whereas this author used a relatively long and curved bar, which had to be fixed on both posterolateral costal arches, we designed a shorter and less-bent bar, which only acted on the anterior chest wall. The rationale for this modification was that the lateral component of a longer bar actually does not provide substantial additional support while entailing higher risk of accidental rotation.

Finally, sub-mammary and peri-areolar incisions were found to be effective, and cosmetically more acceptable than the lateral incisions proposed by Abramson and Kálmán [4,5]. The sub-mammary approach has the additional advantage that incisions for future removal of the bar are not necessary [8].

In conclusion, it is our opinion that the open-surgery modified Ravitch technique should be applied only to patients with non-malleable or very asymmetric chest-wall deformities. The choice of a minimally invasive technique for the correction of PC should be based on the principles of safety and cosmetic results. Our new MIRPC technique meets these essential principles and produces remarkable patient satisfaction.

References

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.ejcts.2010.05.024.