Work in progress report - Thoracic general

Surgical repair of pectus excavatum in young adults using the DualMesh 2-mm Gore-Tex®

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Abstract

We present our surgical technique and clinical outcome of the surgical repair of pectus excavatum using the DualMesh 2-mm Gore-Tex®, in 21 young adults. The main symptom was the exercise limitation in 15 patients. There were no postoperative complications and excellent cosmetic results were achieved. We can confirm that DualMesh seems to be the ideal material to support the sternum in its corrected position. Its advantages are the strength to stabilize well the chest wall, the quality to be detached easily from the pericardial surface even in the case of urgent median sternotomy due to its particular surfaces, the resistance to infection and the ability to be left in place permanently.

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1. Introduction

Pectus excavatum (PE) is the most common congenital deformity of the chest wall, with an incidence of 1:400 live births [1]. The indications for surgical correction of PE are controversial; they may be indicated at different ages and for different reasons, such as relief of cosmetic and psychological problems [2–4] or cardiorespiratory difficulties [5], or promotion of normal growth of the thorax [6].

The most popular surgical technique is the Ravitch technique, with a wide variety of different materials applied to provide posterior support to the sternum [7]. We present the early results of our surgical technique, a modified Robicsek technique, based on Ravitch’s stages, with the use of DualMesh 2-mm Gore-Tex® to support the sternum posteriorly.

2. Materials and methods

2.1. Patients

Between March 2000 and March 2003, surgical repair of PE using the DualMesh 2-mm Gore-Tex® was performed in 21 male patients, average age 21 years (range 19–27). Preoperative evaluation included an ECG, echocardiography, spirometry, chest radiography, chest computed tomography scan and routine blood tests. The deformity was symmetrical in nine cases and asymmetrical in the rest. Although various measurement techniques and methods for grading the severity of the depression have been reported, none of them has been widely accepted. We prefer to use the criteria of Kowalewski, which divide PE cases in severe, moderate and mild [8]. The severity of deformity in our patients was moderate in 16 and severe in five cases.

The main symptom was the exercise limitation in 15 patients, palpitation in ten, slight dyspnea in eight and asthma symptoms in three. There were six patients with coexistence of scoliosis. Ten patients had a family history of PE. Echocardiography revealed mitral valve prolapse in six patients, mitral insufficiency in four (1 + /4 +) and preexcitation syndrome in one. Right bundle branch block was detected on ECG in nine patients. All patients had severe...
psychological and cosmetic problems concerning their deformity.

2.2. Surgical technique

The surgical technique is based on the three stages of the Ravitch technique: mobilization of the soft-tissue structures and subperichondrial resection of abnormal costal cartilages, correction of the concavity by anterior sternal mobilization and sternal osteotomy and fixation of the sternum in the corrected position. Furthermore, the placement of the mesh retrosternally is based on the Robicsek technique [9].

The axial midline skin incision over the deformity was the incision of choice. The use of the Harmonic Scalpel (Ethicon®) and blunt dissection to detach the pectoralis major and rectus abdominis muscles was necessary for low muscle injury. As well as the Langerbeck, Williger and Doyen raspatories, it seemed that the McDonald raspatory was very useful for the subperiosteal dissection of costal cartilages. We did not waste time in performing a meticulous classic subperichondrial resection, but left just enough perichondrium behind to ensure the regeneration of the ribs. Guided by the degree of depression, the costal cartilages were bilaterally resected, taking care that a small portion of the cartilage was left attached to the bony rib. The mean number of excised cartilages in our patients was 4.5 (range 3–6).

Transverse V-shaped osteotomy was subsequently carried out on the anterior wedge of the depressed section of the sternum, but not through the posterior lamina.

After the xiphoid process was detached, the sternum was immobilized with a dressing forceps and the loose retrosternal connective tissues were mobilized bluntly and detached from the sternum. We took care to protect the internal mammary arteries and their branches. We sutured the anterior sternal lamina with non-absorbable sutures in a figure-of-eight manner.

Under strict aseptic technique, a sheath of DualMesh was placed ‘tight as a drum’ under the sternum with the textured surface in contact with it, and was anchored with multiple heavy non-absorbable sutures to the lateral tips of all divided costal cartilages or to the left perichondrium (Figs. 1 and 2).

Initially, we placed a mediastinal drainage device with negative pressure under the DualMesh, but later on, we chose to establish a wide communication between the right pleural and retrosternal space, to ensure appropriate drainage of blood or serum of the entire operative area for a day or two, using an intracostal water-seal catheter.

The previously detached edges of pectoralis major and rectus abdominis muscles were sutured in the anterior sternal surface. Finally, the skin was closed in layers with absorbable sutures. Intravenous antibiotic administration was carried out for 2 days.

3. Results

There were no complications. The mean postoperative period was 6 days (range 4–8). We instructed the patients to avoid contact sports, such as football or basketball, for 1 year and encouraged them to swim or lift weights after a period of 3 months. Postoperative follow-up took place at the first month with physical examination and a chest radiograph, and at the sixth month with complete evaluation, including an ECG, echocardiography, spirometry, chest radiography and routine blood tests. All patients were satisfied with the cosmetic results of the surgery and achieved full physical activity at the end of follow-up (Fig. 3). We noticed that 18 patients (four with severe and 14 with moderate deformity) had clear clinical improvement of their symptoms, while mitral insufficiency was not detected in echocardiography at the end of follow-up.

4. Discussion

PE is frequently asymptomatic in young children. Complaints for symptoms and especially for exercise limitation or palpitation are reported by adolescents. Therefore, correction is preferably performed before the age of puberty [10]. Furthermore, some surgeons suggest that early operation allows normal structural development of the chest [2,6]. On the other hand, others believe that the young adulthood is the ideal age for operation because they find better results and lower rate of recurrence than that of childhood [11]. Despite differing opinions, ultimately cosmetic and psychological reasons are responsible for surgery in young adults, even though they are asymptomatic or they have a moderate deformity [2–4,12,13].
authors believe that surgery has no physiologically significant effect on cardiac function and cardiorespiratory response to exercise [2,14]. Others have proved that more than 90% of patients have improvement in exercise tolerance, endurance, and cardiac and respiratory symptoms postoperatively [5], but this improvement is not explained by changes in cardiorespiratory function [2,5,14]. We noticed that 85.7% of our patients had improvement at the end of the 6-month follow-up, while mitral regurgitation in four of them has not been detected since.

Our experience demonstrates that the DualMesh 2-mm Gore-Tex® is the ideal material for posterior sternal support in cases of surgical repair of PE. This mesh has the particularity of two different surfaces: one smooth for minimal tissue attachment and the other textured for tissue ingrowth. The use of the textured surface adjacent to the posterior sternum causes creation of adhesions between them, while the smooth surface provides no adhesions with the pericardium. Therefore, it may be in place permanently and it can be detached easily from the pericardium, even in
case of an urgent sternotomy. It seems to be resistant to infections, but we think that strict aseptic manipulations during its placement are an essential condition for uneventful recovery, independent of the administration of antibiotics.

The main serious, yet rare, complication is bleeding, which is usually caused by injury to the mammary artery or its branches. In these cases, the patient should be returned to the operating room where removal of the mesh with adequate bleeding control would be necessary. A new mesh should be placed afterwards.

Regarding the wound drainage, we now prefer to use a chest tube, after a wide communication is established between the adjacent pleural cavity and the retrosternal space. Although we used other drainage devices in the beginning, we agree with Robicsek that only in this way can the appropriate drainage of blood or serum be ensured [9].

In conclusion, the surgical repair of PE using this technique can be recommended as a successful procedure for the young adult patients. DualMesh seems to be the ideal material to support the sternum in its corrected position. Its advantages are the strength to stabilize the chest wall, the quality to be detached easily from the pericardial surface even in case of urgent median sternotomy due to its particular surfaces, the resistance to infection and the ability to be left in place permanently. Despite the excellent cosmetic results at the end of the 6-month follow-up, further follow-up is needed to establish them.

References