

Vacuum Assisted Closure in the Management of Exposed Hardware for Skeletal Fixation: A Challenging Case



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Abbreviations: ICU : Intensive Care Unit; VAC : Vacuum Assisted Closure Therapy; WI : Welch Index

Introduction

Pectus excavatum is a depression of the sternum and of costal cartilages, with reduction in the anteroposterior diameter of the thorax. It is the most common chest wall deformity requiring surgical correction. As described into the literature by many authors [1], metal supports for internal fixation to stabilize the sternum in the new corrected position are commonly used with an open approach. This sternochondroplasty procedure is performed under general anesthesia. The patient is placed in supine position with arms along the body. The skin incision is clamshell-like. Topographical landmarks for incision are the nipple in men and the inframammary fold in women. The osteochondral plane is exposed through the bilateral division of the sternal and rib insertions of the pectoralis major and the rectus abdominis muscles. The entire soft tissue plane (subcutaneous, skin and muscles) is mobilized and elevated en-block to avoid fluid collection and seroma formation in the early postoperative period.

The costal cartilages are isolated after the division of the perichondrial sheet with a knife, and are mobilized circumferentially from the perichondrium with a curvilinear Duyens elevator. For each rib, two 0.5cm wedge resections of cartilage are performed: the medial one is performed at the level of the chondro-sternal junction, and the lateral one is performed at the beginning of the posterior rotation of the rib. This point usually represents the chondro-costal junction. This procedure is repeated bilaterally from the third to the seventh costal cartilage. After completing costal resections, the sternum is set free. The xiphoid process is also resected, and a blunt digital dissection of the posterior aspect of the sternum is achieved. The final mobilization of the sternum is obtained through a transversal osteotomy of the anterior table of the sternum [2,3].

This sternal division is usually performed just above the beginning of the sternal depression. Occasionally, two sternal osteotomies are required to achieve adequate mobilization. This osteotomy is critical and must be performed carefully in a manner that preserves the continuity of the deep Skeletal layer. Once the rib cartilages are excised and the sternum is divided, the whole anterior part 1 of the chest wall is elevated anteriorly in an overcorrected position. The new anatomical conformation is stabilized with wires. First, a Kirshner wire is inserted longitudinally through the sternum. A 2.3millimeter thick Kirshner wire is inserted from the lower end of the sternum, and it is pushed proximally through the transversal osteotomy. Next, a 2.5millimeter thick Rush wire is located horizontally at the base of the sternal body and is secured with two pericostal sutures laterally and to the caudal end of the Kirshner wire, with reinforcement required to stabilize the anterior chest wall in the correct position and to prevent hardware migration.

The sternal osteotomy and the perichondrial sheets are now sutured with absorbable sutures. The suture of the perichondrial sheet is essential to avoid an over-rated cartilage hypertrophy that will result in a poor cosmetic outcome. A mediastinal drain is inserted in the retrosternal plane, and the surgical procedure is completed with the sutures of the muscles: first, the pectoralis major fibers are approximated to the sternal borders, and the rectus abdominis is then secured at the inferior part of the pectoralis major. Two additional Redon drains are inserted into the soft tissue plane bilaterally, and the skin is sutured with a cosmetic intradermic suture. The mean operating time for this surgical procedure is 2 hours. A postoperative stay in an intensive care unit (ICU) is unnecessary in most cases. In the postoperative period, the patient

should remain in the supine position without rotation or flexion of the chest for at least 3 days. The drains are usually removed on postoperative day 4 or 5, once mediastinal or pleural complications are excluded. The mean hospital stay is 7 days. The hardware is usually removed between 6 and 12 months postoperatively. The longitudinal wire is removed first, and subsequently, the horizontal one is removed. Both wires are removed under local anesthesia through small incisions and limited exposure [2,3].

Case Report

A 23-year-old man underwent surgical correction of a severe pectus excavatum deformity at our institution. Surgery was performed according to the reported technique. In the immediate 2 postoperative period, a minimal bilateral pneumothorax occurred and was conservatively treated with bed rest until complete resolution. The hospital stay was otherwise uneventful, and the patient was discharged on postoperative day 7. Four weeks later, the patient returned to our Hospital for the dehiscence of the wound in presence of serum. The hardware was exposed. Microbiological samples from the wound were negative. The patient was afebrile and presented no significant general symptoms. A therapy with Piperacillin/Tazobactam was started. The patient was then referred to the Plastic Surgery Unit. Multiple debridement procedures in association to Vacuum Assisted Closure Therapy (VAC) were advised after a multidisciplinary counsel involving infectivologists and a detailed analysis of the wound. The patient was taken to the OR every two days. Every time the wound was debrided and washed with 5 liters pulsatile jet irrigation system. Next a VAC dressing foam was applied to fill all the undermined area and the skin was sutured almost completely over the sponge. A small spot of dressing remained exposed to allow for the suction pad to be applied. Negative pressure was set at 125mm Hg.

This treatment allowed for a significant improvement of the local condition of the wound within the first 10 days. Vascularized and healthy granulation tissue began to grow over the sternum and resected ribs, still being the hardware exposed. The effective response to VAC therapy after surgical debridement and wound irrigation led us to attempt a salvage procedure. The decision of not removing the hardware was taken and a closure of the wound was thus performed. A full thickness fasciocutaneous abdominal flap was harvested and superiorly advanced to close the defect. The postoperative course was uneventful, and the patient was discharged 7 days after closure. At the 1 year follow up, the chest wall was clinically and radiologically stable, the surgical scars were well settled, and no hardware exposure occurred. Hardware removal was then performed under general anesthesia 14 months after wound closure. At one year follow-up after hardware removal, the patient showed no deformity recurrence, Welch Index (WI) is 2.56, and stable and cosmetically acceptable scars.

Discussion

VAC therapy is a well-established technical resource in managing complicated wounds. With tissue mechanical deformation, VAC therapy increases arteriolar dilatation, blood flow and oxygenation. It also reduces edema and the bacterial bioburden, allowing for

granulation tissue to grow and support healing [3,4]. Hardware exposure in presence of a contaminated wound usually requires generous debridement and hardware removal on a standard practice basis [6]. In the presented case, hardware removal would have determined a skeletal collapse with failure of the corrective procedure and subsequent permanent deformity. For this reason all our efforts were to maintain the internal fixation. A literature analysis revealed no standard management of complications associated to this specific sternochondroplasty procedure. Thus, a conservative approach was considered and successfully attempted. From the reconstructive standpoint, a number of procedures have been described to restore medial chest wall defects. These include both pedicled and free flaps, both with muscle or fasciocutaneous. The "reconstructive ladder principle" suggests the simple procedure being considered first to avoid donor site morbidity and further complications associated to more sophisticated procedures [7,8]. With respect to this concept, a reverse abdominoplasty flap allowed for a tension-free closure, no additional scars and a good skin match. This aspect is of great relevance when considering the high expectations of these types of young patients.

Conclusion

Sternochondroplasty is a standard procedure for the correction of pectus excavatum deformity. Wound complications in the presence of hardware may be devastating functionally, aesthetically and psychologically, given the high expectations of these patients. A successful salvage approach has been described. Personalized care, multidisciplinary counseling and prompt surgical planning are 4 recommended for managing such complications. Hardware salvage and eventual stable deformity correction may be achieved by combining VAC therapy, multiple debridement procedures and flap closure.

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