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Secondary closure of the sternum after healing of a postoperative mediastinitis using Sternal Closure Devices (Vitalitec International)

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Mediastinitis is a serious and potentially life-threatening complication in cardiac surgery occurring in 1-4-% [3]. It prolongs hospitalization time and increases the incidence of further complications. It also results in an increased early mortality of up to 14% as well as a threefold mortality increase within the first 4 postoperative years [1].
More than 20 independent risk-factors for the onset of mediastinits have been identified [14] so far. Obesity (BMI > 30kg/m2), diabetes mellitus, resternotomy, prolonged postoperative artificial respiration as well as cardiac reoperations are the most frequently documented risk factors [2, 4, 5, 6]. The use of the internal mammary artery also increases the risk to suffer from postoperative mediastinitis [6, 9, 19]. Female patients, who were treated for breast cancer have a higher risk of this complication [7]. A primary, non-infected instability can provoke subsequent mediastinitis. Loosening or breaks of transsternal wires are primarily caused by high mechanical stress to the sternal osteosynthesis. Repeated coughs or perioperative delirium with uncontrolled exertion of the upper extremities have already been identified adversely affecting the sternal osteosynthesis. [4, 6, 15, 16]. A non-infected instability, however, can successfully be treated by sternal re-rewiring, if necessary in combination with appropriate means or stabilize transverse fractures of the sternum. In a sternum with poor osseous quality as seen in elderly patients demonstrating osteoporosis longitudinal wire-reinforcement according to Robiczek is helpful to achieve proper and stable fusion of the sternal halfs.
In case of a mediastinitis primary rewiring without additional means is not indicated. Previously re-wiring was flanked by continuous retrosternal irrigation therapy with antibiotic solutions in such instances. Recurrent mediastinits requiring open treatment, however, was often seen. Recently, a primary vacuum treatment of the non-healing sternal wound either because of an infection or inactive tissue has been shown to markedly improve success and therefore outcome of the patients. Vacuum treatment has already become the treatment of choice in the fast majority of all deep and prolonged wound healing problems with the sternum involved. Vacuum treatment ensures an active drainage while simultaneously provoking tissue granulation and angiogenesis supported [8, 11, 12, 13]. Furthermore, vacuum stabilizes the otherwise open thorax thereby allowing almost normal active breathing. Stable, secondary closure of the sternum is then often possible after appropriate wound cleaning. The presternal soft part layers are mobilized and closed by simple, all-layer secondary sutures or plastic procedures for covering of the sternum in case of large defects.
Secondary closure of the sternum, however, bears risks. The preceding vacuum treatment typically causes granulation tissue, which hamper proper identification of important cardiac or pulmonary structures. In order to close the sternotomy with trans- or peristernal wires it is necessary to mobilize the dorsal edges of the sternum. This may become especially critical if the mammary artery used as a bypass graft cannot be readily identified. There is either the danger of injuring this artery during the retrosternal preparation or of occluding this graft by the transternal wires.

The Sternal Closure Device (SCD), which is manufactured by the company Vitalitec International and distributed by the company Fumedica Medical Technology, is suitable to reduce these risks. This device does not require retrosternal maneuvers, so that the retrosternal structures are not endangered. Device positioning and placement is entirely performed from the anterior sternal aspect thus avoiding the risk of damaging cardiac, pulmonary or vascular (IMA) structures. The considerable width of the cramps placed in the intercostal space diminishes the danger of fracturing or cutting through the compacta of the sternum. In contrast to sternal wires the rectangular profile of the device is rotation-stable thereby securing the achieved positioning of the sternal parts against each other and thus allows for undisturbed consolidation.

Sternal Closure Device (Vitalitec International)

On the basis of the following case report we present the treatment of a postoperative mediastinitis under special attention to the secondary closure of the sternum.

Patient F.I., male, 69 years old
Diagnoses:
Coronary three vessel disease (LAD 90%, RD 75%, RIM 80%, RMS 70%, RCA 100%)
insulin-requiring diabetes mellitus, COPD, sleep apnea syndrome, adiposity BMI 32,2 kg/m^2 (169 cm, 92 kg)

Operation 04/05/2009:
Quadruple revascularisation with the use of LIMA to LAD and vein grafts to RIM, RMS and RCA

Course:
ICU without any complications until the morning of 04/06/2009. Mask CPAP was necessary because of poor oxygenation due to the COPD.
IMC of 04/06 – 04/08/2009
A perioperative delirium requiring medical treatment was in the fore while supportive measures were required by using intermittent mask CPAP. After proof of a HIT type 2 anticoagulation was changed to argatroban.
The patient was transferred to the normal ward on 04/08/2009 for further mobilization. Rising inflammation parameters (leucocytes 10,5 - 12,7 gpt/l, CRP to 188 mmol/l), however, were conspicuous. A calculated antibiotic regimen was initiated with cefuroxim. On 04/30/2009 transthoracic echocardiography demonstrated pericardial effusion while at the same time sternal instability became apparent.

Operation 04/30/2009
Rethoracotomy and removing of pericardial effusion. The sternum was not primarily closed because of suspected deep sternal wound infection. Continuous vacuum-assisted closure was established. Treatment was necessary at the ICU from 04/30 to 05/04/09 and then at the IMC because of prolonged respiratory insufficiency. The microbiological investigation of the intraoperatively retrieved swab could isolate coagulase-negative staphylococci. We started a respective antibiotic therapy using tazobactam. Furthermore, pulmonary therapy with intermittent mask CPAP, several haemodialysis because of temporary renal insufficiency, and pharmacological therapy of the delirium with haloperidol, melperon and clonidine was performed. On 05/08/2009 a repeated wound smear again revealed coagulase-negative staphylococci, which only reacted sensitively to vancomycine, teicoplanine, rifampicin, linezolid and tigecycline. For this reason the antibiotic therapy was changed to tigecycline. Changes of the vacuum sealing were performed regularly every three days. After conditioning of the mediastinal wound definitive secondary closure of the sternum was carried out on 05/15/2009.

Operation 05/15/09

Secondary closure of the sternum, two Sternal Closure Devices (SCD) in the 2nd and 3rd intercostal space, additionally three wires, one drainage retrosternal, two redon drainages presternal.

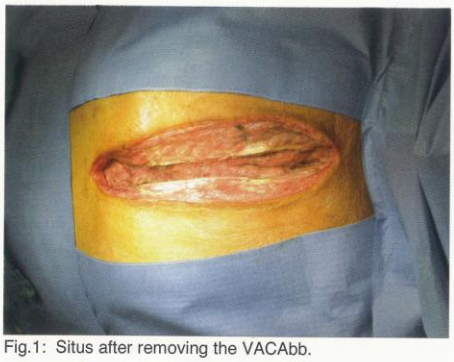

Fig.1: Situs after removing the VACAbb.

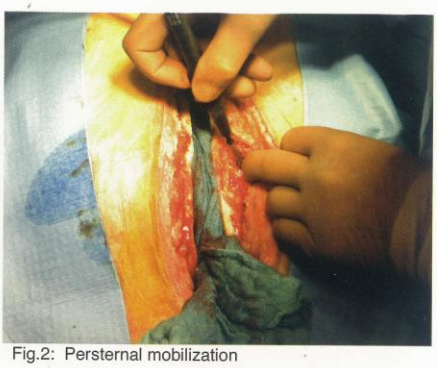

Fig.2: Persternal mobilization

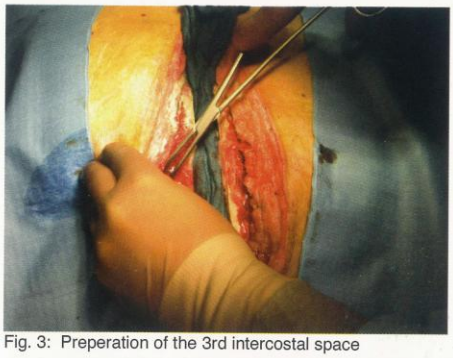

Fig. 3: Preperation of the 3rd intercostal space

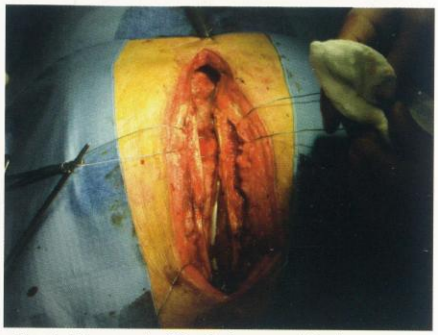

Fig. 4: Placement of the drainage and 3 wires

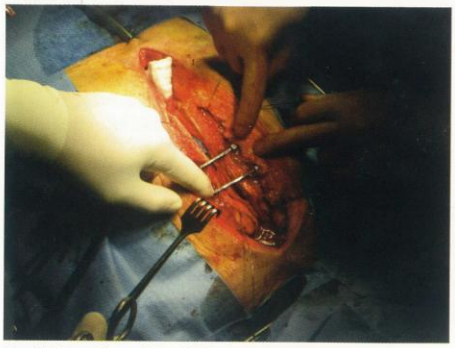

Fig. 5: Insertion of the SCDs into the 2nd and 3rd ICS

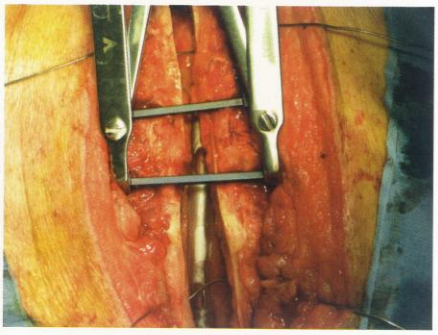

Fig. 6: First tightening of the SCDs

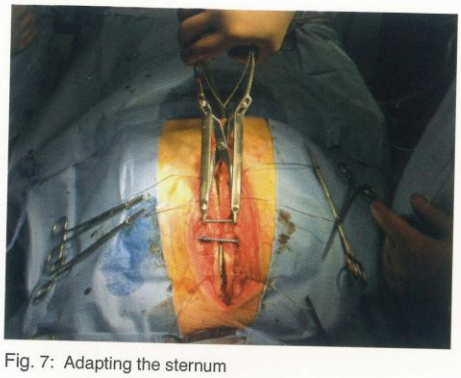

Fig. 7: Adapting the sternum

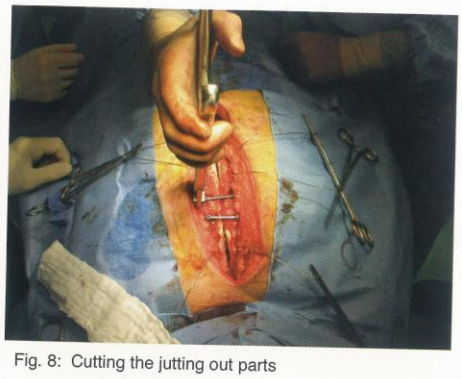

Fig. 8: Cutting the jutting out parts

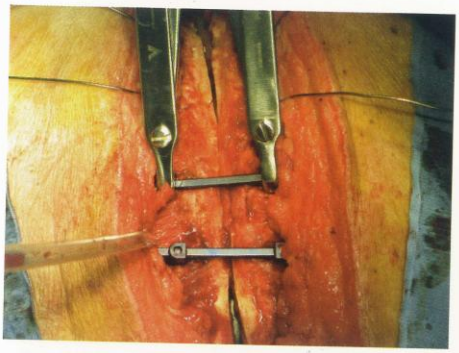

Fig. 9: Repeated tightening of the SCDs

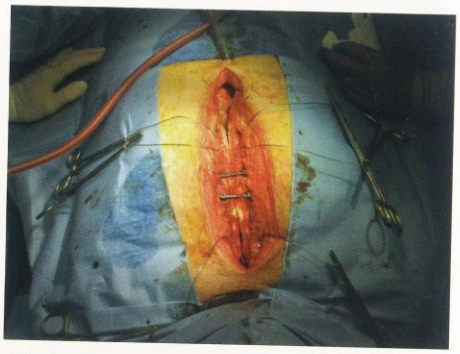

Fig. 10: Situs before closing the wires

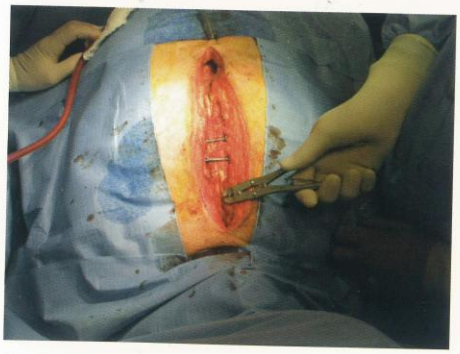

Fig. 11: Situs after closing the wires

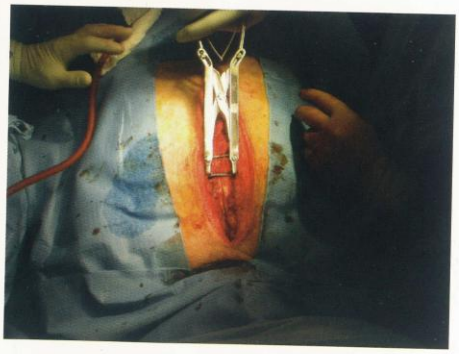

Fig. 12: Readjusting the SCD

Fig. 13: Final cutting of the jutting out parts

Fig. 14: Persternal drainage and closure of the fascia

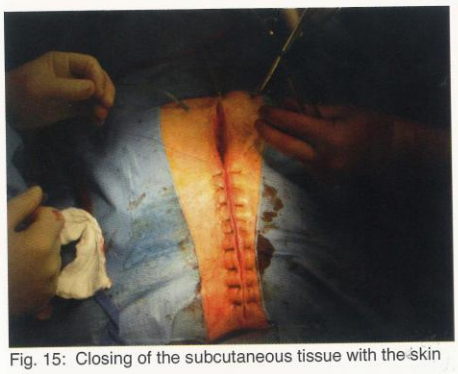

Fig. 15: Closing of the subcutaneous tissue with the skin

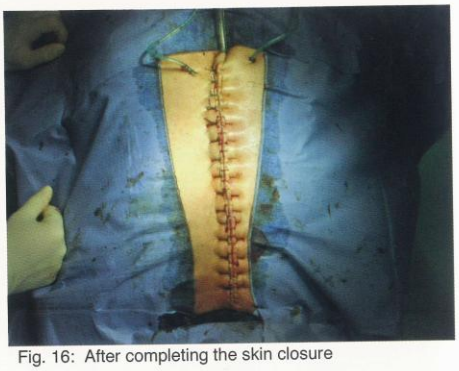

Fig. 16: After completing the skin closure

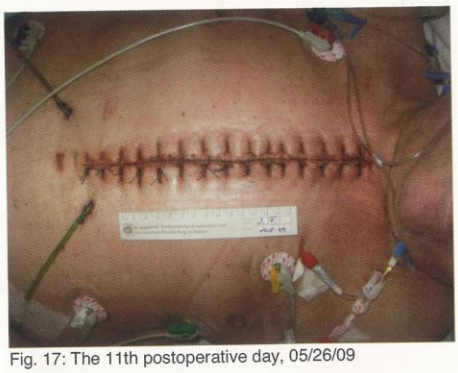

Fig. 17: The 11th postoperative day, 05/26/09

Fig. 18: 6 days after removinh the skin sutures

The retrosternal drain was removed on the 3rd po. day after cessation of the secretion. The two presternal redon drainages were left for 10 days and the skin threads were removed on the 12th po. day. Antibiotic therapy with tigecyclin was continued until 05/30/2009. The secondarily closed wound healed primarily and the sternum remained stable during the observed period. On 06/04/2009 the patient was moved back to the assigning hospital for further convalescence.

The Sternal Closure Device is suitable to stabilize the sternum without the necessity of retrosternal preparation and mobilization thereby avoiding injury to cardiac, pulmonary and vascular structures.

Utilization of the device is also possible in the 1st and the 4th ICS and thus additional wires are not always necessary. As the contact area of the cramps with the sternum is rather large cutting through the lamina compacta of the sternum can be prevent. In contrast to sternal wires the rotation-stability of the device allows for proper consolidation of the sternum in the desired position once it has been achieved.

The stabilization of the sternum without additional wires is possible in case of complete retrosternal adhesions. In Fig. 19 we demonstrate a sternal closure by using three Sternal Closure Devices in the 1st, 2nd and 4th ICS exclusively. Because of a transverse fracture of the left sternal half no SCD was placed in the 3rd ICS.
Closure of the presternal tissues was performed by all-layer capturing sutures of the mobilized presternal subcutaneous tissue and of the skin. The presternally inserted redon drainages were left for eleven days until the secretion had ceased.
The patient could be discharged with unimpaired healing and stable sternum on the 17. po. day after the secondary closure of the chest wall.

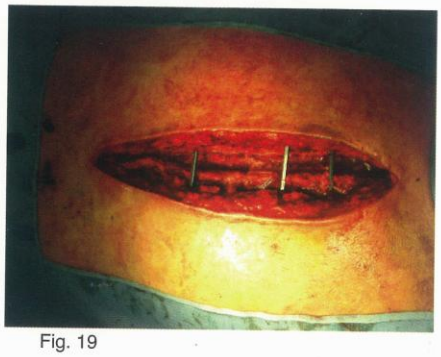

Fig. 19

Twelve patients with a deep sternal wound infection after cardiac surgery have already been treated in our department according to the described technique from July 2008 to December 2009. None of these patients required further invasive therapy after the secondary sternal closure. All patients could leave the department of cardiac surgery after unimpaired healing with a stable sternum.

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