

OPEN TECHNIQUE IN THE TREATMENT OF DEEP STERNAL WOUND INFECTIONS - SELF-EXPERIENCE STUDY

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ABSTRACT

Introduction. Sternal wound infections occur in 1% to 3% of patients undergoing cardiac surgery. The aim of this study is to present results in the treatment of patients with deep sternal wound infection by open surgical technique.

Patients and Methods. Five patients [3- female, mean age: 69,6 years (SD - 4,96)] with deep sternal wound infections after open cardiac surgery, treated from January 2013 to December 2014 were included in this study. All patients met the El Oakley's criteria for DSWI. Open surgical technique was used for the treatment of DSWI. Purulence, derided soft tissue and bone, the tips of the wires were cultured and Gram stained. The risk factors, outcome (death), hospital stay (in days) and time to secondary wound healing (in days) were analyzed.

Results. Type III B of the deep sternal wound infection was determined for the all five patients (based on the El Oakley's classification) — cases with presentation of sternal infection at 2 to 6 weeks after open cardiac operation, with one or more risk factors. Obesity, as a risk factor, was established in all patients. Hypertension and diabetes were determined in four, respectively in three patients. Staphylococcus aureus was determined in all of patients. The mean hospital stay (in days) was 68,6 (SD - 14,77) and the mean time of completely wound healing was 99,6 days (SD - 10,24). It wasn't death up to the time of patients's observation (up to the completely secondary healing of their sternal wound).

Conclusion. This clinical study presents the opportunities of the “open technique” for the treatment of deep sternal wound infections — subtype IIIB. Despite relatively long time of hospitalization and time to secondary wound healing, open technique is suitable and successful method of surgical treatment of DSWI, especially in elderly patients with two and more risk factors.

Key words: *sternal wound infections, sternal osteomyelitis, open technique.*

Introduction.

Sternal wound infections occur in 1% to 3% of patients undergoing cardiac surgery. They remain a significant problem because of extended hospitalization(s) with medical staff involvement required for wound healing, patients discomfort, high cost and significant mortality [1,2,3,4].

Sternitis, mediastinitis, wound complication and wound infection have been used synonymously to denote sternal wound infections. For the purpose of comparing data from various reports, sternal wound complications were classified by El Oakley and colleagues as follows: 1. mediastinal dehiscence in the absence of infection; 2. mediastinal wound infection: 2A — superficial sternal wound infection (confined to the subcutaneous tissue), 2B — deep sternal wound infection (mediastinitis) — associated with sternal osteomyelitis. Superficial sternal wound infection is considered a minor complication in cardiac surgery. Deep sternal wound infection (DSWI) is one of the most feared complications in patients undergoing cardiac surgery [4]. DSWI are classified into four subtypes, based on the time of first presentation and whether previous attempts at treating have failed: type I — presenting within 2 weeks after operation in the absence of risk factors; type II - presenting at 2 to 6 weeks after operation in the absence of risk factors; type IIIA – type I in the presence of one or more risk factors; type IIIB – type II in the presence of one or more risk factors; type IVA – type I, II or III after one failed therapeutic trial; type IVB - type I, II or III after more than one failed therapeutic trial; type V – presenting for the first time more than 6 weeks after operation.

There is a lack of agreement regarding the best treatment method of deep sternal wound infections. Several surgical techniques were developed over the last decades for the treatment of DSWI: open wound dressing, closed irrigation, closed suction drainage, vacuum-assist drainage, autologous vascularized flap

[5,6,7,8]. The aim of this study is to present results in the treatment of patients with deep sternal wound infection by open surgical technique.

Patients and Methods.

Five patients with deep sternal wound infections after open cardiac surgery, treated from January 2013 to December 2014 were included in this study. All patients met the El Oakley’s criteria for DSWI. Patients exhibited erythema and swelling of the sternotomy wound, draining sinus tract accompanied by drainage of purulent fluid, infected sternum and foreign bodies (sternal wires) at the soft subcutaneous tissue (fig. 1, fig. 2). Changes in the topography of the sternal wires were established by conventional chest roentgenograms. These findings were accompanied by fever, tachycardia and leukocytosis.

The subtype of DSWI (using El Oakley’s classification) was determined on the base of the time of presentation (after cardiac operation) and the presence or absence of risk factors [4].

Open surgical technique for the treatment of DSWI.

The first surgical approach consisted of reopening of the operative wound. The sternum was assessed for fractures and devitalized bone. Sternal wires were removed (fig. 3). Debridement of soft tissue and devitalized bone was made by curettes. Purulence, derided soft tissue and bone, the tips of the wires were cultured and Gram stained. The wound was copiously irrigated with warm saline and antiseptic solutions (povidone-iodine solution). The wound was covered by sterile dry gauze.

After the described above primary surgical approach, the sternal wound kept open and treated with daily dressing change every day and waiting for its spontaneous closure by granulation (secondary wound healing – fig. 4). Just in case, dressing of the sternal wound was changed two times per day.

The outcome (death), hospital stay (in days) and time to secondary wound healing (in days) were analyzed.



Figure 1. Inflammation of soft tissues and sternum with displacement foreign bodies (sternal wires) in elderly woman.



Figure 2. Draining sternal sinus tracts with purulent fluid in elderly woman.

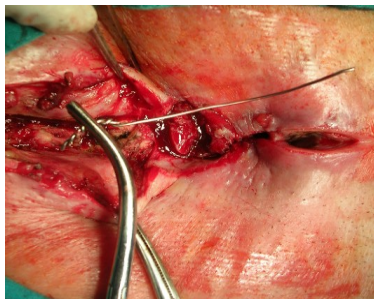


Figure 3. The process of removing the sternal wires.



Figure 4. Spontaneous closure the sterna wound by granulation.

Results

Demographic and surgical data are shown in table 1.

Demographic and surgical data / (SD - standard deviation, n - number of patients).	Table 1
sex male / female	2 / 3
age: mean (SD)/(in years)	69,6 (4,96)
range (in years)	48 -70
risk factors:	n
obesity	5
diabetes mellitus	3
smoking	1
hypertension	4
hospital stay (in days) / (SD)	68,6 (14,77)
time to wound healing (in days)	99,6 (10,24)
death	no

Type III B of the deep sternal wound infection was determined for the all five patients (based on the El Oakley’s classification) — cases with presentation of sternal infection at 2 to 6 weeks after open cardiac operation, with one or more risk factors. Obesity, as a risk factor, was established in all patients. Hypertension and diabetes were determined in four, respectively in three patients.

For every one patient it was established that separation of the sternal halves was limited to a lower portion of the sternum. It wasn’t determined flail chest or paradoxal breathing because of sternal disruption.

Associated microorganisms cultured from derided tissues are shown in table 2. Staphylococcus aureus was established in all five patients.

Isolated microbial agents in deep sternal wound infection.	Table 2
microorganism:	n (number of isolates)
<i>Staphylococcus aureus</i>	5
<i>Staphylococcus epidermidis</i>	2
<i>Pseudomonas aeruginosa</i>	3
<i>Enterococcus</i>	2

It wasn’t death up to the time of patients’s observation — up to the completely secondary healing of their sternal wound (covering the sternal wound with skin scar).

Discussion

Deep sternal wound infection (DSWI) is considered as one of the most feared complication in patients undergoing cardiac surgery. Early diagnosis and treatment of DSWI may prevent the

spread of infection to the prosthetic materials used in cardiac repair, with its devastating sequelae [1-4].

Treatment of DSWU varies from simple prolonged antibiotic therapy to complete sternectomy combined with a major plastic procedure. Several surgical techniques were developed over the last decades for the treatment of DSWI: open wound dressing, closed irrigation, closed suction drainage, vacuum-assist drainage, autologous vascularized flap. There is a lack of agreement regarding the best treatment method of DSWI. The aim of this study is to present the open technique in the treatment of DSWI, even though historically it's the first definitive method and nowadays is abandoned by many authors [5-10]

A large number of clinical conditions have been identified as risk factors for DSWI including: obesity, diabetes, smoking, hypertension, chronic obstructive airway disease, steroid therapy [2,7]. This study analyzed the risk factors for DSWI and established that obesity (body mass index $\geq 30\%$) was the most common risk factor — determined in all five patients. It's known that risk factors have an additive effect for DSWI. Three risk factors (obesity, diabetes and hypertension) were established in three of the patients. It's considered that the presence of diabetes increases the risk of DSWI by fourfold.

Sternal infections after sternotomy is now much more common than primary infection of the sternum. *Staphylococcus aureus* remains the commonest cause of the secondary sternal osteomyelitis [3,4,9]. It was confirmed by this study - *Staphylococcus aureus* was established in derided tissues of all five patients. Sternomediastinitis after open cardiac surgery is considered as a hospital-acquired infection, result of bacterial colonization of the sternal bone and soft tissue wound. Microbiological analysis in DSWI confirms the diagnosis and also facilitates early and specific antimicrobial therapy.

As was mentioned above there isn't so called "gold standard" in the treatment of sternal osteomyelitis [5-8]. At this point of view in the management of sternal wound infections is accepted the El Oakley's classification of postoperative sternomediastinitis [4]. DSWI is classified into five subtypes based on the time of first presentation, the presence or absence of risk factors and whether previous attempts at treating the condition have failed.

In this study all five patients were classified as type III B sternomediastinitis. Many of the authors consider that patients with types IIIA and IIIB may benefit from a wound debridement and closure with major pectoral muscle flap — "*autologous vascularized flap*" method. There is no difference in the initial stage of the "*open technique*" and "*autologous vascularized flap*" — debridement of sternal bone and soft tissues. The purpose of debridement is to remove necrotizing bone and soft tissues and fibrotic peel and to ensure growing of fresh granulations. Sternal wound debridement can be performed several times, that depends of the severity of the sternal bone infection. After debridement, in "*autologous vascularized flap*" method, the sternal wound is covered by muscle flap (most commonly by *m. pectoralis major*). The purpose of the muscle flap is to ensure short time of sternal wound healing and stability of the sternum.

In "*open technique*" after debridement, the sternal wound is kept open and treated with daily dressing change every day and waiting for its spontaneous closure by granulation (secondary wound healing). One shortcoming of the "*open technique*" is its long time of hospitalization and of completely secondary healing of the sternal wound, which was demonstrated in this study. Sternal instability and high mortality are considered as another shortcoming of the "*open technique*". This study presented cases of DSWI - subtype IIIB, in which separation of the sternal halves was limited to a lower portion of the sternum — without sternal instability. Sternal instability occurs when the integrity of the sternocostal cage is interrupted along at least two vertical lines instead of one as occur in the sternotomy. No death was established in this study, which denies the attitude for a high mortality in "*open technique*" for treatment of DSWI.

"*Open technique*" is a method of treatment of DSWI that overcomes the shortcomings described in patients with "*autologous vascularized flap*". The half of patients with autologous flap

note serious sternal discomfort after flap repair, probably due to intercostal nerve irritation. Creation of potential dead space under muscle flap with bacterial growing and failure of the covering the sternum is another serious concern in patients with autologous flap. Another shortcoming in autologous flap method is possible deterioration of respiratory function. This shortcoming can explain the decision to use the open technique for the treatment of elderly patients with DSWI - subtype IIIB, with the presence of one or more risk factors.

Conclusion.

In conclusion, this clinical study presents the opportunities of the “*open technique*” for the treatment of deep sternal wound infections — subtype IIIB. Despite relatively long time of hospitalization and time to secondary wound healing, open technique is suitable and successful method of surgical treatment of DSWI, especially in elderly patients with two and more risk factors.

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