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# Vulnerable Sternum. A New Concept to Propose Some Elements Related with Postoperative Mediastinitis Risk

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## Abstract

The sternum is a unique, odd and flat bone. Median longitudinal sternotomy constitutes the incision of excellence for cardiovascular surgery because of its unsurpassed exposure of the heart and large vessels. When performing it, the most important consideration is to do it exactly in the midline. Paramedian sternotomy can lead to sternal instability and dehiscence. Postoperative mediastinitis is defined as a deep infection of the surgical site after longitudinal median sternotomy. It can involve the sternum. There are many risk factors for postoperative mediastinitis that are classified into pre operatives, intra operatives and post operatives. Despite the importance attached to the correct sternal opening and closure, often they are not mentioned among the risk factors for postoperative mediastinitis. Nor other elements of the sternum are listed but these may cause dehiscence and postoperative mediastinitis. For better organization and understanding, in addition to facilitating vigilance over them, the author and a team have included these elements in a new concept: Vulnerable sternum. It is the one susceptible or vulnerable to dehiscence whether in a septic environment or not and some elements compose it.

***Keywords:*** *Sternum; Postoperative Mediastinitis; Risk Factors; Median Sternotomy*

### Sternum and median sternotomy

The sternum is a unique, odd and flat bone. It covers the ribcage in front and fulfills an important protective function. It has three fundamental parts: manubrium, body and xiphoid appendix.

The median longitudinal sternotomy constitutes the incision of excellence for cardiovascular surgery because of its unsurpassed exposure of the heart and large vessels. It was described by Milton since 1897 [1,2]. His employment in cardiac surgery is reported by Shumaker and Lurie in 1953 for a pulmonary valvulotomy. Four years after the first successful cardiac surgery with cardiopulmonary bypass, even most surgeons continued to use Clamshell's bilateral transverse incision. Dalton and his associates attribute the systematic use of longitudinal median sternotomy for cardiac surgery, to the testimony, practice and experience of Julian because he and his colleagues in 1957 generalized their employment, presented their advantages and reported the superiority of this access over thoracotomy [2,3].

When performing median sternotomy, the most important consideration is to do it exactly in the midline. Paramedian sternotomy can lead to sternal instability and dehiscence [3].

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**Sternal closure**

There are various methods for closure median sternotomy. The most used is the closure with stainless steel suture number five or six. Between six and eight single points are placed, at least two of them in the sternal manubrium [4]. Points in figure in eight can be used. Of these, usually four are given, and according to Reed M. in "Thoracic incisions", these are recommended because they avoid the perpendicular shear that normal ones exert [2]. In the body of the sternum, the points can be passed through the intercostal spaces, just by the upper edge of the rib to avoid lesions of the vascular-nervous package [4]. Also can be used the method described by Robicsek in 1977. It has been a technique for reinforced closure with excellent results, and some modifications have been proposed [2,3].

**Postoperative mediastinitis**

Postoperative mediastinitis is defined as a deep infection of the surgical site after longitudinal median sternotomy. It can involve the sternum, which would be osteomyelitis, and lead to partial or total loss of bone. It also includes organ/space infection, that is in mediastinum, it encompasses prepericardial tissues, such as remnants of the thymus, fat and mediastinal pleura or the pericardial cavity itself, with pericardium, cardiac tissues and large vessels. It constitutes a serious form of nosocomial infection, which requires an early and aggressive medical-surgical therapeutic action, due to its high lethality [5-12].

The risk factors for postoperative mediastinitis are divided into pre operatives, intra operatives and post operatives.

**Pre operatives**

Advanced age, female sex, diabetes mellitus, chronic obstructive pulmonary disease, smoking, obesity, prolonged preoperative stay, positive nasal exudate, chronic renal failure, severe anemia, left ventricular dysfunction, left ventricular ejection fraction depressed, functional class III or IV of the New York Heart Association, poor preoperative preparation, diagnosis of infection in the month prior to surgery, immunosuppressive treatment, immunodeficiencies, malnutrition and psychic depression.

**Intra operatives**

Learning curves in the surgical team, coronary surgery, use of both internal mammary arteries, especially if pedicules are used, emergency surgery, inadequate antimicrobial prophylaxis, prolonged extracorporeal circulation, excessive use of bone wax and electrocautery, transfusion of more than two units of blood products, inadequate sternal closure, presence of intraoperative complications (ventricular arrhythmia, hemorrhage that forced the reexploration of the patient, use of intra-aortic counterpulsation balloon and low cardiac output.

**Post operatives**

Prolonged stay in the postoperative intensive care unit, prolonged mechanical artificial ventilation, prolonged times with bladder catheter, with central venous catheter, with thoracic drainage, reoperation in the immediate postoperative period, bleeding, need for blood transfusion and presence of postoperative complications (arrhythmias, pacemaker requirement for more than 48 hours, low postoperative cardiac output, ventricular dysfunction with inotropic support for more than 24 hours, use of intra-aortic counterpulsation balloon, cardiac tamponade, pulmonary edema, respiratory failure, acute perioperative myocardial infarction, pneumothorax or pleural effusion that need of drainage by pleurotomy, pericardial effusion, postoperative pneumonia, postoperative hyperglycemia, acute postoperative renal dysfunction, endovascular sepsis, multiorgan failure [1,8,12-29].

**New concept**

Despite the importance attached to the correct sternal opening and closure, often they are not mentioned among the risk factors for postoperative mediastinitis. Nor other elements of the sternum are listed but these may cause dehiscence and postoperative mediastinitis.

For better organization and understanding, in addition to facilitating vigilance over them, the author and a team have included these elements in a new concept: Vulnerable sternum.

Concept: The one susceptible or vulnerable to dehiscence whether in a septic environment or not.

Elements that compose it:

- Osteoporosis.
- Obese women and large breast.
- Incorrect sternal opening, outside the midline or by costal cartilage.
- Multiple sternal fractures caused by the sternal retractor or internal mammary artery dissection.
- Sternal reopening for any reason.
- Repeated sternal dehiscence without infection.
- Cough accesses in the postoperative period.
- Polipnea in the postoperative period.
- Incorrect bath in bed.
- Presence of xeromas or haematoma of the surgical wound.
- Superficial sepsis of the surgical wound without sternal dehiscence.

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