

Mediastinitis after heart valve surgeries: integrative review

Ana Sara Mendes Teixeira¹,
Laura Menezes Silveira²,
Angelita Maria Stabile³,
Carina Aparecida Marosti Dessotte⁴

ABSTRACT

Mediastinitis is an infection of the connective tissue of the mediastinum that is poorly studied in patients undergoing heart valve repair surgeries. The objective of this study was to identify in the literature the evidence related to mediastinitis in patients undergoing heart valve repair surgeries. An integrative review was performed with searches in five electronic databases, namely: LILACS, PubMed, Scopus, EBSCOhost and Web of Science. According to the established criteria, were included four articles for analysis. They all had aspects about mediastinitis, such as: preoperative mortality predictors, intraoperative material contamination, and surgical approach technique. Studies focused specifically on the occurrence of mediastinitis in these patients can instrumentalize the health team and improve the implementation of clinical practice actions by preventing complications.

Descriptors: Mediastinitis; Heart Valves; Risk Factors; Surgical Wound Infection; Perioperative Nursing.

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¹ Nurse. Ribeirão Preto, SP, Brazil. E-mail: ana.sara.teixeira@usp.br.

² Nurse, Master's in Fundamental Nursing. PhD student of the Postgraduate Program in Fundamental Nursing at the University of São Paulo, Ribeirão Preto College of Nursing. Ribeirão Preto, SP, Brazil. E-mail: lauramsilveira@usp.br.

³ Nurse, PhD in Physiology. Professor at the University of São Paulo, Ribeirão Preto College of Nursing. Ribeirão Preto, SP, Brazil. E-mail: angelita@erp.usp.br.

⁴ Nurse, PhD in Nursing. Professor at the University of São Paulo, Ribeirão Preto College of Nursing. Ribeirão Preto, SP, Brazil. E-mail: camarosti@erp.usp.br.

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INTRODUCTION

Cardiovascular Diseases (CVD) are the main cause of morbidity and mortality in both developing and developed countries. In 2014, there were 340,284 deaths from circulatory system diseases in Brazil, and the mortality rate in all age groups because of such diseases was 27.73%, mainly from the age of 50 years. In the state of São Paulo, there were 82,592 deaths, which represents the highest mortality rate in the country⁽¹⁾.

Although there have been technological advances in minimally invasive treatments, cardiac surgery is still the treatment of choice for many patients with CVD.

Cardiac surgery with extracorporeal circulation (ECC) has a major impact on the body's homeostasis. Therefore, patients' management in the postoperative (PO) period includes identifying changes representing complications and those that are part of a physiological recovery. The main complications in the PO period of cardiac surgery have been addressed given the complexity involved, and they may be related to the following: preoperative hospitalization time; preexisting comorbidities; inadequate lifestyle habits (smoking, sedentary lifestyle); advanced age; prior nutritional status (malnutrition or obesity); type of medication used in the preoperative period; and risk factors inherent to the anesthetic-surgical procedure⁽²⁻⁵⁾.

In this study, we highlight mediastinitis among PO complications. Its prevalence in the PO period ranges from 0.4 to 5%. On average, 1 to 2% of heart disease patients present, mediastinitis and despite the low prevalence, its mortality rates are high and range from 14 to 47%⁽⁶⁾. In addition, hospitalization time may be longer hence leading to greater health service costs and worsening of patients' quality of life⁽⁵⁾.

Mediastinitis is an infection and/or inflammation of the connective tissue of the mediastinum. According to the Centers for Disease Control and Prevention (CDC), diagnostic criteria for mediastinitis after sternotomy are sternal instability and positive mediastinal bacterial culture⁽⁷⁾. It may occur up to the first 30 PO days with manifestation of sternal pain or instability associated with purulent drainage through the retrosternal area, positive blood culture or of the drained secretion, and mediastinal enlargement on imaging examination, evidence of retrosternal infection during operation or histological analysis⁽⁸⁾.

Several studies have investigated the risk factors for mediastinitis in patients undergoing myocardial revascularization surgery (MRS), and a risk score for mediastinitis has also been developed for these patients⁽⁷⁾. However, few studies have investigated the occurrence of mediastinitis in patients undergoing cardiac surgeries exclusively for valve repair, thereby leading to a lack of evidence. We believe standard precautions used for infection prevention, specifically mediastinitis, would not be sufficient for these patients by considering cardiac surgery is large procedure, and patients undergo ECC.

The increase in life expectancy has risen the prevalence of severe valvular diseases, which affect up to 2% of individuals aged over 65 years⁽⁹⁾, and the surgical procedure is often indicated. However, survival after the onset of symptoms is low, of 60% in one year and 32% in five years⁽¹⁰⁾.

Knowing the available evidence on the occurrence of mediastinitis in patients undergoing valvular surgeries may help in the planning of care for these patients in the perioperative period, and especially in the prevention of this complication. Thus, the aim of this study was to identify in the literature the evidence associated with the occurrence of mediastinitis in patients undergoing valve repair surgery.

METHOD

This integrative review was conducted in six stages, namely: identification of the theme and the research question; establishment of inclusion and exclusion criteria for studies and for search in the literature; definition of information to be extracted from selected studies and categorization of studies; evaluation of included studies; interpretation of results and presentation of the knowledge synthesis⁽¹¹⁾.

The guiding question was designed by using the 'PICO' strategy, which is an acronym for Patient, Intervention, Comparison and Outcomes, with a view to locating better evidence. In this study, the acronym was used considering the following: 'P' - Patients with valvopathies; 'I' - Valve repair surgeries; 'C' - Not applicable; and 'O' - Mediastinitis. The guiding question was centered on: 'What is the evidence on the occurrence of mediastinitis in patients undergoing valve repair surgeries?'

The searches were conducted in five electronic databases, namely: Latin American and Caribbean Literature in Health Sciences (LILACS), US National Library of Medicine, National Institutes of Health (PubMed), Scopus, EBSCOhost and Web of Science. Controlled descriptors extracted from the Health Sciences Descriptors (DeCS) and the Medical Subject Headings (MeSH) were used, as follows: *Mediastinitis (Mediastinite)*, *Aortic Valve (valva aórtica)*, *Pulmonary Valve (Valva Pulmonar)*, *Tricuspid Valve (Valva Tricúspide)*, *Mitral Valve (Valva mitral)*, *Thoracic Surgery (Cirurgia Torácica)*, *Surgery (Cirurgia)*, *Risk factors (fatores de risco)*, and the keywords *Valve Replacement (troca de valva)*, *Surgical infection (infecção cirúrgica)* and *Cardiac Valve (valva cardíaca)*. Boolean operators 'AND', 'OR', and 'AND NOT' were used in all combinations.

The following criteria were considered for inclusion of articles: original articles that answered the guiding question, developed with individuals aged over 18 years, published in journals in English, Spanish, French and Portuguese in any period.

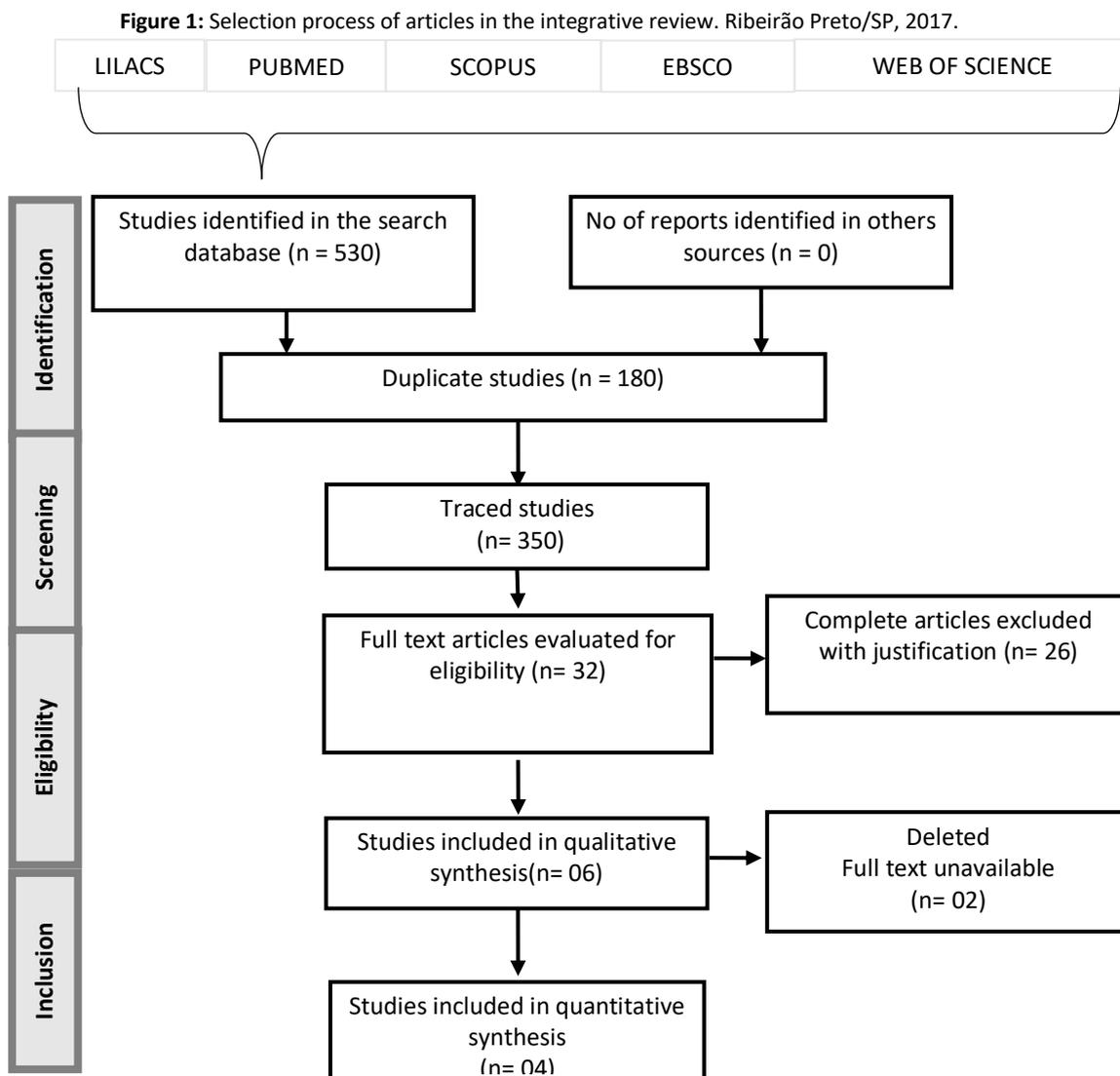
The following criteria were adopted for exclusion of articles: publications that did not fit the classification of the level of evidence used⁽¹²⁾, editorials, letters to the editor, dissertations, clinical cases, theses, literature reviews and articles in which the text was unavailable.

The search was conducted in December 2016. For data collection of the eligible studies, a validated instrument was adapted, and it included the identification of the article, authors, type of publication, methodological details, sample details, intervention, results and recommendations/conclusions⁽¹³⁾. The selected publications were classified according to the methodological outline and the level of evidence. The summary of data will be presented descriptively.

RESULTS

In searches conducted in the databases, were identified 530 articles on the subject, of which 180 articles were duplicated and excluded. According to the established eligibility criteria, 350 articles were tracked by reading of title and abstract, and 32 articles were selected for analysis of the full text. Of these, 28 were disregarded for the following reasons: 25 did not answer the guiding question, because they generalized the results based on samples of patients undergoing diverse cardiac surgeries, such as MRS and correction of aortic diseases; a secondary study and two studies in which texts were not available. Note that the corresponding authors of articles

with unavailable texts were contacted by e-mail, but no response was obtained. The trajectory for selection of publications is shown in Figure 1.



Source: Prepared by the authors according to recommendations of Moher et al., (2015)⁽¹⁴⁾.

The final sample consisted of four articles published in English, of which one was conducted in the United States, one in Sweden, one in Japan and one in Italy.

Table 1 shows the characteristics of articles selected for this review according to author, year of publication, journal, database, scope of publication, level of evidence and country of origin.

Table 1: Characterization of articles included in the integrative review according to author, year of publication, journal, level of evidence and country of origin, scope of publication, title, journal, database, design, population/sample, and results. Ribeirão Preto/SP, 2017.

	Author, year of publication, level of evidence, country of origin, scope of publication	Title of article, journal and database	Design	Population/Sample	Results associated with Mediastinitis
1	Thourani et al., 2011 ⁽¹⁵⁾ , IV, United States, Medicine.	Outcomes of Surgical Aortic Valve Replacement in High-Risk Patients: A Multiinstitutional Study, Ann Thorac Surg, Embase	Retrospective cohort study in a six-year period (2002-2007) in four institutions. The aim of the study was to evaluate the morbidity and mortality in the short and medium term of patients undergoing aortic valve repair according to the 'Society of Thoracic Surgeons predicted risk of mortality' score.	159 patients undergoing primary aortic valve replacement.	Authors did not find statistically significant preoperative predictors for in-hospital mortality, but identified one patient (0.6%) who evolved with mediastinitis in the PO period.
2	Larsson et al., 2015 ⁽¹⁶⁾ , IV, Sweden, Medicine	Bacterial contamination of suction catheter tips during aortic valve replacement surgery: a prospective observational cohort study, Patient Safety in Surgery, Embase	A descriptive study in which the objective was to investigate the presence of contamination of the suction catheter used intraoperatively in aortic valve replacement surgeries. Two suction catheters were collected for each surgery. Five control catheters were used.	Sample of suction catheters used in 25 surgeries of valve replacement in adults with no ongoing infection during the month of March, 2014.	Bacterial contamination in 20 out of 25 cases (80%), and in five of these (20%), both the first and the second catheter were contaminated. The most frequent bacterium found in suction catheters was <i>coagulase-negative staphylococci</i> , and it was associated with mediastinitis. The control catheters did not have any contamination.
3	Nishi et al., 2015 ⁽¹⁷⁾ , IV, Japan, Medicine.	Propensity-matched analysis of minimally invasive mitral valve, Surgical Today, Pubmed repair using a nationwide surgical database	Cohort retrospective study. The analyzed period was from 2008 to 2012. The objective was to make comparisons on the efficacy and safety of two surgical techniques for mitral valve repair - right minithoracotomy (RT) and median sternotomy (MS). Sociodemographic and clinical characteristics and outcome of patients were also analyzed.	Sample of 6137 patients from 210 Japanese institutions. Patients were allocated in two groups: 756 patients underwent RT and 5381 patients underwent MS.	The rates of mediastinitis and length of stay in the ICU and of total PO period until hospital discharge were lower in the group of patients undergoing RT.
4	Sansone et al., 2012 ⁽¹⁸⁾ , VI, Italy, Medicine.	Right minithoracotomy versus full sternotomy for the aortic valve replacement: Preliminary results, Heart Lung and Circulation, Pubmed	A retrospective cohort study in which the aim was comparing the postoperative evolution of a group of patients who underwent RT with another group who underwent MS for surgical repair of aortic valve replacement.	Two groups of patients were selected: 50 patients underwent RT and 50 patients underwent MS.	None of patients who underwent RT had mediastinitis and all were discharged. In the group of patients who underwent MS, 2% evolved with mediastinitis and mortality was 4% in this group.

DISCUSSION

Qualitative synthesis of the four studies that answered the guiding question showed the evidence on mediastinitis in patients undergoing valve repair surgeries may be associated with aspects such as material contamination in the intraoperative period and the surgical approach technique. Additionally, in one of the studies, mortality predictors found in the preoperative period were not associated with mortality and the occurrence of mediastinitis.

During the phase of screening and analysis of studies, were found several designs including simultaneously in their samples patients undergoing MRS and valvular surgeries, and who had complications such as mediastinitis⁽¹⁹⁻²¹⁾. Such studies highlighted advanced age, diabetes mellitus, obesity, and prior revascularization surgery as factors for the occurrence of mediastinitis⁽²²⁾, as well as lower ejection fraction, use of intra-aortic balloon, need for hemodialysis, serum creatinine levels above 2.26 mg/dL and extracardiac vascular intervention⁽²³⁾.

The fact that mediastinitis causes may be multifactorial makes it a serious infectious complication involving the mediastinal space and the sternum. Excessive manipulation of inpatients and prolonged use of catheters for central venous access, hemodialysis, venous and arterial punctures, patients with immunodeficiencies or poor nutritional status, may also favor the infection⁽²³⁾.

Thus, there is a lack of specific studies focused on the occurrence of mediastinitis in patients undergoing valve surgeries, and the need to explore this content in order to increase knowledge and reevaluate clinical practice.

A study⁽¹⁵⁾ was developed from the construction of a predictive mortality model in patients undergoing valve surgeries. It was found that preoperative predictors (peripheral vascular disease, stroke, renal failure, class III and IV heart failure, prior myocardial revascularization surgery) were not statistically significant for hospital mortality. However, the study showed one patient has developed mediastinitis as a postoperative complication, which is often associated with the risk of death⁽⁶⁾.

In contrast, other studies on mediastinitis after cardiac surgeries indicate age over 75 years, obesity (BMI > 35), previous stroke, diabetes mellitus and cardiac arrest during the surgical procedure as factors for surgical site infection⁽²⁴⁻²⁵⁾. Among these factors, obesity may be reduced through preoperative weight loss programs before elective surgery⁽²²⁾.

In this context, a differentiated preoperative approach can be adopted for diabetic patients with glycemic control strategies, since normoglycemia seems to have a protective effect in patients with deep infection in the organ space after cardiac surgery⁽²⁶⁻²⁷⁾. In addition, the reduction of glycemia levels facilitates faster healing by contributing to a lower incidence of infection⁽²⁸⁾.

In men, there may be more tension in the sternal wound, making the male sex more susceptible to mediastinitis⁽²⁵⁾. Pulmonary diseases such as chronic obstructive pulmonary disease (COPD) associated with life habits such as smoking can favor the occurrence of ventilatory problems that cause greater sternal instability and make healing difficult by exposing patients to the risk of mediastinitis⁽²⁸⁾.

The results of a study⁽¹⁶⁾ show that 80% of suction catheters used intraoperatively for aortic valve replacement surgeries were contaminated with bacteria, and the most frequent etiological agent was *coagulase-*

negative Staphylococcus. The same author concluded the suction time did not increase the risk of contamination of catheters. Contamination by this type of bacteria was also found in other studies⁽²⁹⁻³⁰⁾ investigating surgical site infection in cardiac transplantation and myocardial revascularization, respectively.

Although *coagulase-negative Staphylococcus* bacteria is commonly found in the normal skin microbiota, this contamination can also derive from personnel in the operating room⁽³¹⁾. In this perspective, nurses are considered precursors in the organization and systematization of safe patient care in the surgical center. They should disseminate caution guidelines among all team members regarding hygiene of hands and the surgical site, proper paramentation, disinfection of surfaces, equipment, utensils, and their manipulation during the transoperative period by avoiding contaminations and contributing to reduction of mediastinitis and other complications in the postoperative period.

Signs for early identification of mediastinitis in the PO period are known, such as purulent secretion at the surgical site, sternal instability and persistent high fever. However, apparently there are few strategies other than patient preparation and antibiotic prophylaxis that can be implemented for reducing mediastinitis⁽³²⁾.

Other relevant aspects are patients' inherent conditions, such as antimicrobial resistance and the secondary incidence of mediastinitis in those who had previous surgeries and were affected by mediastinitis. A study shows that *Staphylococcus aureus* was observed in 60% of mediastinitis episodes in patients undergoing cardiac surgery. However, mortality, duration of mechanical ventilation, and length of stay in the intensive care unit were significantly higher for patients with secondary mediastinitis, that is, for those who had already had the infection⁽¹⁹⁾.

In a recent study⁽²¹⁾, was used a risk score to predict mortality and complications in patients undergoing cardiac surgeries. Patients undergoing valve replacement and myocardial revascularization presented a higher risk profile both for in-hospital mortality and for complications such as stroke and mediastinitis.

Preoperative hospitalization time was also considered an independent risk factor for mediastinitis in a retrospective cohort study in cardiac patients, and it led to a 15% greater risk of mediastinitis per week of stay. The delay in performing the surgical procedure, often due to the high patient demand and low availability of intensive care beds in the postoperative period, together with other factors (pulmonary hypertension, diabetes, obesity, glomerular filtration disorders) were considered as modifiable risks for mediastinitis⁽²⁰⁾.

In two studies⁽¹⁷⁻¹⁸⁾ was compared the PO outcome of patients undergoing RT (right minithoracotomy) or MS (median sternotomy) for mitral valve repair.

According to results, the mediastinitis rate was lower in patients undergoing RT⁽¹⁷⁾. A study⁽¹⁸⁾ corroborates a similar result, in which no patient undergoing RT has developed mediastinitis, and 2% of patients undergoing MS have developed this infection.

Recently, in another study, was demonstrated the lower occurrence of mediastinitis after aortic valve replacement in patients undergoing RT surgical technique compared to those undergoing MS. In addition, there may be less postoperative hemorrhage and need for blood transfusion, less occurrence of atrial fibrillation, lower morbidity index, and shorter length of stay at the hospital and in the intensive care unit⁽³³⁾.

Providing knowledge about elements related to the occurrence of mediastinitis in patients undergoing valve repair surgery may prepare nursing for more effective clinical care in the perioperative period since hospital

admission by exploring patients' pathological antecedents, offering preparatory information to face the postoperative period, and reflecting about actions during the surgical process with the team in order to minimize the risk of complications.

Given this scenario and by considering mediastinitis a complication that implies high morbidity and mortality rates, costs to the health system⁽³⁴⁾, besides distressing patients' quality of life⁽³⁵⁾, attention must be paid to particularities involving valvular surgeries and their occurrence in order to motivate future studies with a view to prevention and reduction of this infection in the postoperative period.

In general, most hospital institutions act together with care nurses in order to control the hospital infection given the proximity and follow-up of patients' clinical evolution. In addition to observation of the clinical picture, the nursing process involves establishing nursing diagnoses and goals, the implementation of necessary actions for patient care, feeding of data for epidemiological surveillance and the hospital infection control commission, performance of training and continuing education, and continuous search for care resolution⁽³⁶⁾.

The knowledge about this gap is expected to be explored further in prospective studies with the aim of providing subsidies for developing better strategies during care for patients undergoing valve replacement or repair. Much of these care can be achieved by the nursing team as they represent a link between patients and other members of the multidisciplinary team. Besides accompanying patients in all phases of the perioperative period, nurses can identify possible factors contributing to the occurrence of this infection by hearing patients' complaints, performing physical examination, observing the surgical wound and signs and symptoms of hospitalized patients' evolution and the risks for complications.

CONCLUSION

Evidence for mediastinitis in patients undergoing heart valve repair surgery shows there may be bacterial contamination of catheters used during the surgical procedure, which favor the onset of this complication. In addition, the choice of a surgical approach technique such as RT and the length of hospital stay may reduce the occurrence of mediastinitis. The development of this study may stimulate the discussion by the health team for the better implementation of clinical practice actions, prevention of complications, and help in the development of new studies on this theme.

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