Systematic or Integrative Review

RISK FACTORS FOR MEDIASTINITIS AFTER CORONARY ARTERY BYPASS GRAFTING SURGERY: AN INTEGRATIVE REVIEW

FATORES DE RISCO PARA MEDIASTINITE APÓS REVASCULARIZAÇÃO DO MIOCÁRDIO: REVISÃO INTEGRATIVA

FACTORES DE RIESGO PARA MEDIASTINITIS TRÁS LA REVASCULARIZACIÓN MIOCÁRDICA: REVISIÓN INTEGRADORA

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ABSTRACT

This integrative literature review aimed to identify risk factors related to the development of mediastinitis in adult patients undergoing coronary artery bypass surgery. The following databases were searched for primary studies: Medline, CINAHL, LILACS and EMBASE. The final sample comprised 18 studies. The most frequently identified risk factors were diabetes mellitus (DM) and obesity, followed by surgical reintervention, chronic obstructive pulmonary disease (COPD) and old age. We found that the risk factors most frequently associated with mediastinitis were DM, obesity, surgical reintervention, COPD and age over 65 years. These data also suggest the need for further research on preventable and controllable risk factors, i.e., those related to the surgical procedure itself.

Keywords: Mediastinitis; Myocardial Revascularization; Thoracic Surgery; Risk Factors.

RESUMO

Esta revisão integrativa da literatura teve como objetivo identificar os fatores de risco relacionados à ocorrência de mediastinite em pacientes adultos submetidos à cirurgia de revascularização do miocárdio. Para a busca dos estudos primários, foram utilizadas as bases de dados Medline, CINAHL, LILACS e EMBASE. A amostra foi constituída por 18 estudos. Os fatores de risco mais frequentemente identificados foram diabetes mellitus (DM) e obesidade, seguidos por reintervenção cirúrgica, doença pulmonar obstrutiva crônica (DPOC) e idade avançada. As evidências permitiram identificar que os fatores de risco mais frequentemente associados à ocorrência de mediastinite foram DM, obesidade, reintervenção cirúrgica, DPOC e idade maior de 65 anos e identificam a necessidade de se investir em pesquisas sobre fatores de risco passíveis de prevenção e controle, ou seja, os relacionados ao procedimento cirúrgico propriamente dito.

Palavras-chave: *Mediastinite; Revascularização Miocárdica; Cirurgia Torácia; Fatores de Risco.*

RESUMEN

Esta revisión integradora de la literatura ha tenido como objetivo identificar los factores de riesgo relacionados con la aparición de mediastinitis en pacientes adultos sometidos a cirugía de revascularización miocárdica. Para la búsqueda de los estudios primarios, se han utilizado las bases de datos Medline, CINAHL, LILACS y EMBASE. La muestra se ha constituido por 18 estudios. Los factores de riesgo más frecuentemente identificados han sido la diabetes mellitus (DM) y la obesidad, seguidos por la intervención quirúrgica, la enfermedad pulmonar obstructiva crónica (EPOC) y la vejez. Las evidencias han ayudado a identificar que los factores de riesgo más frecuentemente asociados con la incidencia de mediastinitis son la DM, la obesidad, la reintervención quirúrgica, la EPOC y la edad superior a los 65 años y muestran la necesidad de invertir en la investigación sobre los factores de riesgo posibles de prevenir y controlar, es decir, aquellos relacionados con el procedimiento quirúrgico en sí.

Palabras clave*: Mediastinitis; Revascularización Miocárdica; Cirugía Torácica; Factores de Riesgo.*

INTRODUCTION

Surgical site infection (SSI) is the third most common infection in health services in Brazil, where they have been found to account for 14-16% of cases of infection among hospitalized patients.[1]

Several different factors may be involved in the development of SSI, including those related to the contamination of the surgical site, to the number and virulence of colonies of contaminating microorganisms, to the surgical procedure itself and to the patient.[2]

According to the *Centers for Disease Control and Prevention*, SSIs are infections that occur within 30 days after operation or within one year if a prosthetic implant was used. They are classified into: a) superficial incisional SSI, when the infection involves only the skin and subcutaneous tissue; b) deep incisional SSI, when it involves deep soft tissues of the incision, such as fascial and/or muscle layers; c) organ/space SSI, when any organ or space any part of the anatomy other than the incision that was opened or manipulated during theoperative procedure is involved.[3] Mediastinitis is considered to be a severe infection of the organ/space.

Mediastinitis post cardiac surgery remains an important SSI, especially in coronary artery bypass grafting (CABG) surgeries with the internal mammary artery graft.[4] A case-control study conducted with patients undergoing CABG in a Brazilian hospital has found that having deep sternal infection or mediastinitis increased the risk of death eightfold.[5]

Patient safety has been receiving increasingly more attention in the last decade. In the field of surgery, studies have been mainly focusing on the implementation of *check lists* for safe surgery. Thus, the conduction of this study was justified in order to reflect on other aspects that may be related to minimizing the risk of SSI and on the role of nurses as articulators of different health care provision teams. This integrative literature review aimed to identify risk factors related to the development of mediastinitis in adult patients undergoing CABG.

METHODS

This is an integrative literature review, defined as a specific review method that aims to provide a more comprehensive understanding of a particular topic to inform future practice.[6] The research was developed through the following steps: formulation of the research question,search for primary studies, data extraction, quality assessment of primary studies, analysis and synthesis of the results, and presentation of the findings.[7]

The formulation of the research question was based on the PICO strategy. PICO is an acronym for P = population (adult patients undergoing CABG); I = intervention or occurrence (risk factor); C = comparison with another intervention (not the aim of this study) or absence of the variable of interest (risk factor); O = outcome of interest (mediastinitis).[8] Thus, the guiding question of this integrative review was: "what risk factors are related to the occurrence of mediastinitis in adult patients undergoing CABG?"

A literature search for primary studies was conducted in Medline (via PubMed, *National Library of Medicine), CINAHL (Cumulative Index to Nursing and Allied Health Literature),* LILACS (Latin American and Caribbean Health Sciences) and EMBASE. In addition, we manually searched for references cited in the selected primary studies.

The following controlled descriptors, keywords, synonyms and Boolean operators were used in the database search:

Medline (MeSH – *Medical Subject Headings*: *Cardiac Surgical Procedures*) OR (*Procedure, Cardiac Surgical*) *OR* (*Procedures, Cardiac Surgical*) *OR* (*Surgical Procedure, Cardiac*) *OR* (*Surgical Procedures, Cardiac*) *OR* (*Surgical Procedures, Heart*) *OR* (*Cardiac Surgical Procedure*) *OR* (*Heart Surgical Procedures*) *OR* (*Procedure, Heart Surgical*) *OR* (*Procedures, Heart Surgical*) *OR* (*Surgical Procedure, Heart*) *OR* (*Heart Surgical Procedure*)))) *OR* ((*Thoracic Surgery*) *OR* (*Surgery, Thoracic*) *OR* (*Surgery, Cardiac*) *OR* (*Surgery, Heart*) *OR* (*Heart Surgery*) *OR* (*Cardiac Surgery*))) *OR* ((*Thoracic Surgical Procedures*) *OR* (*Procedures, Thoracic Surgical*) *OR* (*Surgical Procedures, Thoracic*) *OR* (*Thoracic Surgical Procedure*) *OR* (*Procedure, Thoracic Surgical*) *OR* (*Surgical Procedure, Thoracic*))) *OR* ((*Cardiovascular Surgical Procedures*) *OR* (*Procedure, Cardiovascular Surgical*) *OR* (*Surgical Procedure, Cardiovascular*) *OR* (*Surgical Procedures, Cardiovascular*) *OR* (*Cardiovascular Surgical Procedure*) *OR* (*Procedures, Cardiovascular Surgical*))) *OR* ((*Myocardial Revascularization*) *OR* (*Myocardial Revascularizations*) *OR* (*Revascularization, Myocardial*) *OR* (*Revascularizations, Myocardial*) *OR* (*Internal Mammary Artery Implantation*))) *AND Mediastinitis OR Mediastinitides OR* (*Mediastinum Inflammation*) *OR* (*Inflammation, Mediastinum*) *OR* (*Inflammations, Mediastinum*) *OR* (*Mediastinum Inflammations*))) *AND* ((*Surgical Wound Infection*) OR (*Infection, Surgical Wound*) *OR* (*Infections, Surgical Wound*) *OR* (*Surgical Wound Infections*) *OR* (*Wound Infections, Surgical*) *OR* (*Wound Infection, Postoperative*) *OR* (*Wound Infection, Surgical*) *OR* (*Infection, Postoperative Wound*) *OR* (*Infections, Postoperative Wound*) *OR* (*Postoperative Wound Infections*) *OR* (*Wound Infections, Postoperative*) *OR* (*Postoperative Wound Infection*) *OR* (*deep sternal wound infection*)).

- **CINAHL (CINAHL Headings):** "*Myocardial Revascularization*" *OR* "*Surgery, Cardiovascular*" *AND* "*Risk Factors*" *AND* "*Surgical Wound Infection*" *OR* "*Mediastinitis*";
- **LILACS (DeCS – acronym for Descriptors in Health Sciences):** "Cirurgia Torácica" *OR* "Procedimentos Cirúrgicos Cardíacos" OR "Procedimentos Cirúrgicos Cardiovasculares" OR "Procedimentos Cirúrgicos Torácicos" *OR* "Revascularização Miocárdica" *AND* "Fatores de Risco" *AND* "Mediastinite" *OR* "Infecção de Ferida Operatória";

- **EMBASE (Emtree):** "*Heart Surgery*" *AND* "*Risk Factor*" *AND* "*Mediastinitis*" *OR* "*Surgical Infection*" *OR* "*Wound Infection*".

The review included articles published in English, Spanish or Portuguese between April 1999 and September 2013 and that assessed risk factors for the development of mediastinitis in adult patients (over the age of 18) undergoing CABG. It should be noted that the time period covered in this study was determined by the publication of the "*Guideline for prevention of surgical site infection*" by the CDC.[3] We excluded all articles that analyzed more than one surgical procedure, other sites of infection, and incisional and deep infection, as well as narrative reviews, letters to the editor and response letters.

The search for primary studies in the selected databases took place in September 2013 and was carried out by one of the authors, with the assistance of a librarian.

We identified 850 primary studies. The search strategies used in study are shown in Table 1.

Ninety-eight of the 116 pre-selected studies were excluded after reading the full paper, leaving 18 primary studies for inclusion in the review. The search strategies used in the databases and the exclusion criteria are presented in the flow diagram (Figure 1), as recommended by the PRISMA group.[9]

Table 1 - Number of studies identified in the databases (n = 850) and included in this integrative review, Ribeirão Preto, Brazil, 2013

Databases	Number of studies (n = 850)
Medline	312
CINAHL	282
EMBASE	228
LILACS	28

All selected articles were read in full. The following data were extracted from each of them: year of publication, language, country where the study was performed, authors, journal name, study design, level of evidence, risk factors for the development of mediastinitis, mediastinitis rate, and population/sample size.

We used a validated instrument to extract data from the primary studies included in this review.[10]

To minimize measurement bias (misinterpretation of study results and design), two researchers read the articles and completed the instruments independently. The latter were then compared. In case of disagreement, a third independent evaluator was consulted. This was the case for two scientific articles.

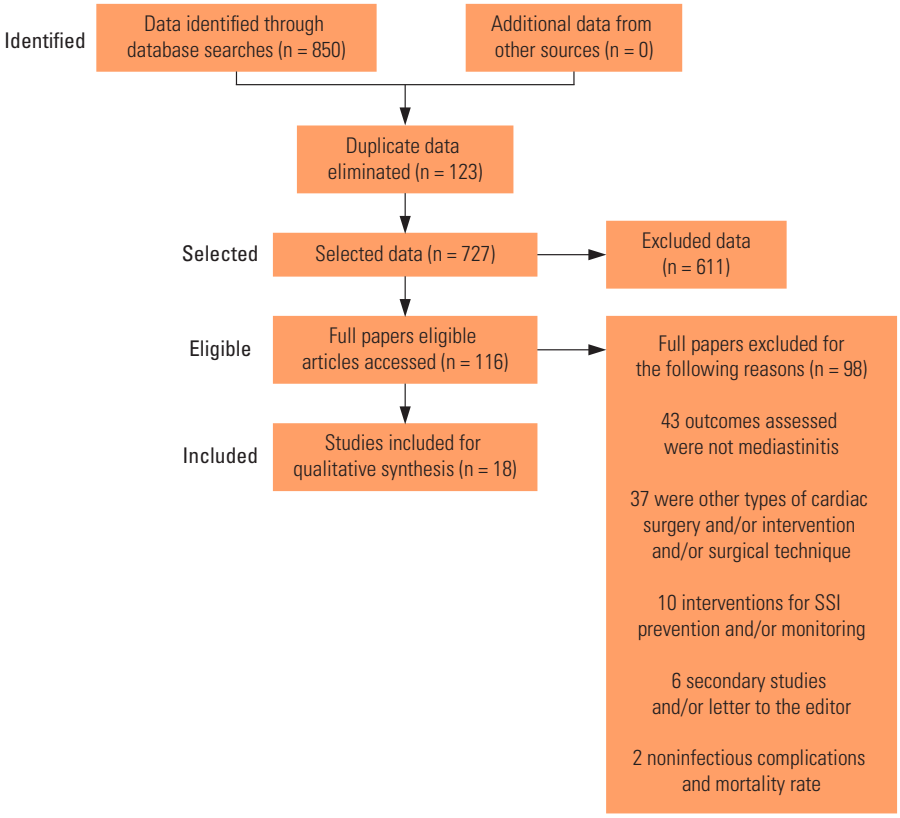

Figure 1 - Flow diagram (selection strategy) of included studies, according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, Ribeirão Preto, SP – Brazil, 2013.

RESULTS

All included articles were classified as evidence level IV. In this review, the evidence was appraised and rated according to a seven-level system as follows: Level I – evidence derived from a systematic review or meta-analysis of randomized controlled trials or clinical practice guidelines based on randomized controlled trials; Level II – Evidence derived from at least one well-designed, randomized control trial; Level III – Evidence derived from well-designed clinical trials without randomization; Level IV – Evidence derived from well-designed cohort and case-control studies; Level V – Evidence derived from a systematic review of descriptive and qualitative studies.; Level VI – Evidence derived from a single descriptive or qualitative study; Level VII – Evidence derived from opinions of respected authorities or reports of expert committees.[7]

16 (88.9%) articles were published in the English language. There was a concentration of articles published in 2010 (5/27.8%). Most studies (7 / 38.9%) were conducted in the United States of America, and published in the following journals: *Cardiovascular Surgery, Infection Control and Hospital Epidemiology, Annals of Thoracic Surgery, Chest, Perfusion e The Journal of Thoracic and Cardiovascular Surgery* (Table 2).

The most frequently identified risk factors were diabetes mellitus (DM) (15/83.3%), followed by obesity (12/66.7%), chronic obstructive pulmonary disease (COPD) (6/33 3%), surgical reintervention (5/27.8%) and old age (5/27.8%). 17 (94,4%) studies were classified as evidence level IV. 9 (50,0%) studies were classified as prospective cohort studies and 8 (44,4%) studies as retrospective cohort studies. The rate of mediastinitis after CABG ranged from 0.2 to 5.6% (Table 3).

DISCUSSION

In recent years studies focusing on patient safety have been receiving increasing attention, as it is now believed by many that they can provide information for decision making by health managers and members of the health care team.

In this context, accurate knowledge of surgical site infection rates and risk factors factors for SSI is also useful for the creation and implemention of measures that will contribute to improve the provision of care and prevent this serious postoperative complication in cardiac surgery.[29] It is believed that by understanding and learning about this topic, nurses would be able to build a body of knowledge based on scientific evidence and use it in clinical practice to provide safe care to patients.

This review of the literature evidenced high rates of mediastinitis.[12,16,21,25,28] This situation justifies the growing concern about an infectious complication which prolongs hospital stays, increases hospital costs as well as the number of procedures and tests performed, and has a negative impact on the quality of life of affected patients.[14]

Table 2 - Distribution of publications included in the literature review, according to year of publication, country where the study was performed, author and journal, Ribeirão Preto – SP, Brazil, 2013

Year	Country where the study was performed	Author	Journal
2013	USA	Itagaki S, Cavallaro P, Adams DH, Chikwe J[11]	Cardiovasc Surg
2011	Brazil	Sá MPBO, Soares EF, Santos CA, Figueiredo OJ, Lima ROA, Escobar RR *et al.*[12]	Braz. J. Cardiovasc. Surg.
2010	Jordan	Al-Zaru IM, Ammouri AA, Al-Hassan MA, Amr AA[13]	J Clin Nurs
2010	England	Ariyaratnam P, Bland M, Loubani M [14]	Interact Cardiovasc Thorac Surg
2010	Netherlands	Elenbaas TWO, Hamad MAS, Schönberger JPAM, Martens EJ, Zundert AAJV, Straten AHMV[15]	Ann Thorac Surg
2010	Brazil	Magedanz EH, Bodanese LC, Guaragna JCVC, Albuquerque LC, Martins V, Minossi SD *et al.*[16]	Braz. J. Cardiovasc. Surg.
2010	Norway	Risnes I, Abdelnoor M, Almdahl SM, Svennevig JL[17]	Ann Thorac Surg
2008	Iran	Hoseini MJ, Naseri MH, Teimoori M [18]	Pak J Med Sci
2007	USA	Fakih MG, Sharma M, Khatib R, Berriel-Cass D, Meisner S, Harrington S, Saravolatz L[19]	Infect Control Hosp Epidemiol
2007	Iran	Omran AS, Karimi A, Ahmadi SH, Davoodi S, Marzban M, Movahedi N *et al.*[20]	BMC Infect Dis
2007	USA	Savage EB, Grab JD, O'Brien SM, Ali A, Okum EJ, Perez-Tamayo A *et al.*[21]	Ann Thorac Surg
2005	USA	Toumpoulis IK, Anagnostopoulos CE, DeRose Jr JJ, Swistel DG[22]	Chest
2004	USA	Groom RC, Rassias AJ, Cormack JE, DeFoe GR, DioDato C, Krumholz CK *et al.*[23]	Perfusion
2003	England	Lu JCY, Grayson AD, Jha P, Srinivasan AK, Fabri BM[24]	Europ J Cardio-thoracic Surg
2003	France	Tavolacci MP, Merle V, Bouchart VJF, Litzler PY, Tabley A, Bessou JP *et al.*[25]	J Hosp Infect
2000	USA	Braxton JH, Marrin CAS, McGrath PD, Ross CS, Morton JR, Norotsky M *et al.*[26]	Ann Thorac Surg
2000	USA	Trick WE, Scheckler WE, Tokars JI, Jones KC, Reppen ML, Smith EM, Jarvis WR[27]	J Thorac Cardiovasc Surg
2000	Taiwan	Wang FD; Chang CH[28]	J Cardiovasc Surg

Table 3 - Distribution of articles according to level of evidence, study design, number of participants, mediastinitis rate and risk factors for the development of mediastinitis, Ribeirão Preto – SP, Brazil, 2013

Level of evidence	Study design	Number of participants	Mediastinitis rate	Risk factors
IV	Retrospective cohort study	1.526.360	1.4%	Obesity, DM, COPD, female gender, heart failure, CRF[11]
IV	Retrospective cohort study	500	5.6%	Obesity, DM, smoking, CPB, use of pedicled ITA grafts[12]
IV	Retrospective cohort study	206	2.0%	Obesity, DM, surgery duration, IAB use[13]
IV	Prospective cohort study	7.602	0.6%	Obesity, DM, COPD, old age[14]
IV	Prospective cohort study	11.748	0.9%	Obesity, DM, COPD, old age, CPB, preoperative AF, preoperative elevated CPR, AMI, surgical reintervention, use of bilateral ITA grafts[15]
IV	Retrospective cohort study	2.809	3.3%	Obesity, DM, COPD, surgical reintervention, postoperative polytransfusion, stable class IV angina (according to the NYHA criteria) or unstable angina[16]
IV	Case-control study	18.532	0.6%	Obesity, DM, COPD, old age, female gender, blood transfusion, left coronary stenosis[17]
IV	Retrospective cohort study	3.578	0.2%	Obesity, DM, surgery duration, peripheral vascular disease and ICU stay ≥ 72 hours[19]
IV	Retrospective cohort study	9.201	0.2%	Female gender, surgery reintervention for bleeding and SAH[20]
IV	Retrospective cohort study	120.793	2.8% e 1.7%	Obesity, DM, female gender, peripheral vascular disease and recent AMI[21]
IV	Prospective cohort study	3.760	1.1%	DM, preoperative hemodynamic instability, preoperative dialysis CRF, use of bilateral ITA grafts, postoperative sepsis and/or endocarditis[22]
IV	Prospective cohort study	7.243	1.1%	DM, temperature > 37.9º C during CPB[23]
IV	Prospective cohort study	4.228	0.7%	Obesity, use of bilateral ITA grafts, surgical reintervention, longer mechanical ventilation times, stable class ≥ 3 angina (according to the NYHA criteria)[24]
IV	Prospective cohort study	256	4.3%	DM and use of bilateral ITA grafts[25]
IV	Prospective cohort study	15.406	1.2%	Obesity, DM, COPD, old age, peripheral vascular disease, low ejection fraction, triple vessel disease, kidney failure, HF, urgent or emergency surgery[26]
IV	Prospective cohort study	350	1.7%	DM (preoperative blood glucose level ≥ 200 mg/dL), use of antibiotic prophylaxis (cefuroxime ≥ 2 h before incision) and use of staples for skin closure[27]
IV	Prospective cohort study	620	2.7%	Surgery reintervention for bleeding and surgery duration28
VI	Retrospective cohort study	1.014	1.2%	Obesity, DM, age, stable class III or IV angina (according to the NYHA criteria)[18]

ITA: internal thoracic (or mammary) artery. DM: diabetes mellitus. COPD: chronic obstructive pulmonary disease. CRF: chronic renal failure. SAH: systemic arterial hypertension. IAB: intra-aortic balloon. AMI: acute myocardial infarction. AF: atrial fibrillation. CRP: C-reactive protein. CPB: cardiopulmonary bypass. ICU: intensive care unit. NYHA: New York Heart Association (angina classification).

This review has shown that the main risk factors for the development of mediastinitis after CABG were DM, obesity, surgical reintervention, COPD and age over 65 years.

As diabetes mellitus is considered to be a modifiable risk factor, treatment strategies for strict glycemic control during the perioperative period should be adopted, in order to improve the clinical status of diabetic patients undergoing cardiac surgery[30] and consequently minimize the development of mediastinitis.

Recent studies have identified a significant association between hyperglycemia and increased incidence of mediastinitis, sepsis and an increase in both hospital and ICU length of stay. Glycemic control and the use of intravenous insulin have shown better clinical outcomes (with regard to mediastinitis) in patients undergoing CABG surgery.[16,31] Trained nurses may be able to recognize early signs and symptoms of hyperglycemia and help control it in a dynamic and effective way. In addition, they would be able to monitor the clinical condition of patients, ensure safe drug delivery to patients (right patient, right medication, right dose, right route, right time, right expiration date, right approach and right registration) and provide continuing education to all team members.

With regard to obesity, the etiology relates to increased postoperative mechanical loads, facilitated bacterial contamination, and failure to adjust antibiotic doses to body mass, an error that leads to inappropriately low tissue antibiotic concentrations.[32,33]

Another reason why obesity bears a highly elevated risk for mediastinitis seems to be due to the spreading of skin edges by high lateral traction forces in supine position as well as by the folding of the distal third of the incision in the sitting position in combination with ample colonization of (inframammary) skin folds with skin flora.[34] As obesity is a modifiable risk factor, it is important that weight reduction measures are implemented preoperatively. As a member of the surgical team, the nurse should provide continuing health education to patients and their families. They should advise them about healthy and proper eating, healthy lifestyle practices, consumption of daily

calories and encourage physical activity (when the patient is authorized to physically exercise), in order to accomplish an effective therapeutic communication.

In Brazil, a study[35] that analyzed 9,136 cardiac surgeries performed at a specialized hospital identified a mediastinitis rate of 0.5%. Additionally, in the multivariate analysis, the main independent risk factors for mediastinitis were obesity (OR = 6.49, 95% CI: 2.24-18.78), smoking (OR=3.27, 95% CI: 1.04 to 10.20), length of ICU stay longer than two days (OR = 4.50, 95% CI: 1.57-12.90) and infection at another site (OR = 8.86, 95% CI: 1.86-42.27). Patients with mediastinitis had a mortality rate of 23%.

A case-control study[36] found (through logistic regression) that obesity, DM, COPD, preoperative hospitalization longer than one week, pulmonary hypertension, preoperative myocardial infarction and reoperation were risk factors associated with the development of mediastinitis. Thus, in order to prevent this complication, which is associated with a considerable increase in mortality rates, preventive measures such as the elimination of controllable risk factors deserve special attention.

Regarding the preoperative risk factors for mediastinitis, surgery planning should focus on the risk factors presented by the patient, such as DM, COPD and obesity. Thus, when possible, preventive care measures, such as weight loss, glycemic control and COPD control should be maximized and implemented. In order to minimize the development of this kind of infection, health care activities for this patient group should be properly assessed and monitored.

There is a need for changes in the current health scene in Brazil, starting by an in-depth reflection about health education as a social practice which goes (above all) beyond the biological model. Thus, modifiable risk factors such as obesity and smoking should be addressed in intervention programs, making individuals more responsible for their health-related choices.

Surgical reoperation was also identified as a predictor of mediastinitis. A 10-year study assessed 18,752 patients who had undergone CABG and/or heart valve surgery and found that 566 individuals (3.0%) have required reoperation. This group of patients had an eightfold higher risk of death.[37]

This study reveals the need for the construction of knowledge and to seek strategies and tools to improve the quality of the care provided by nurses during the perioperative period of CABG surgery, in order to reduce infectious complications and their impact on the lives of patients, through the application of scientific evidence, and the provision of safe and humane care. It also evidenced the need for further studies focusing on modifiable risk factors such as those directly related to the surgical procedure itself, like preoperative shaving, hypothermia during surgery, antisepsis products, among others.

We emphasize that it is fundamental to continuously monitor the results, the implementation of control and prevention measures, the care dynamics and the labor process. In addition, all involved health professionals should receive continuing education and emphasis should be placed on promoting effective communication between health care providers and managers in order to obtain sustainable and valid results.

It is important to highlight that the development of mediastinitis after CABG surgery is multifactorial, as it involves patient-related factors (lifestyle habits, comorbidities, age, gender), environmental factors (cleaning and hygiene conditions, adequate ambient temperature in the operating theater, existence of an adequate work process) and factors related to the surgical team (surgical technique, patient management for infection prevention, hand hygiene, preoperative shaving time, proper dressing techniques, safe medication administration, effective and therapeutic communication). Hence it can be said that it may extend well beyond the perioperative period.

The nurse manages the care for patients and, because he/she also works with health education, he/she is able to provide information on various procedures, including heart surgeries. This provision of knowledge and the establishment of an effective interaction between patients and the health care team is beneficial for both the patient and his family, because it minimizes their feelings of anxiety and fears.[38]

Thus, nurses can assist patients by offering support and by identifying/acknowledging their needs and/or perceptions of the treatment received. This can be done through dialogue, acceptance, therapeutic listening and guidance, and may help improve the knowledge and skills that are necessary in order to maintain an adequate health behavior at this particular moment of time.[39]

Although the studies' designs were adequate for the identification of risk factors (cohort and case-control) and this integrative review could identify major risk factors for the development of mediastinitis after CABG associated with individual factors, further research is needed to test the association of variables related to the surgical procedure and the environment, through more robust designs (such as multicenter trials) and new analytical models (such as the hierarchical analysis), which would be advantageous for the planning and management of care in this setting.

As limitations of this study, we identify:

1. not using a tool for assessing the quality of studies;
2. the non-inclusion of articles written in other languages;
3. the exclusive inclusion of articles in which the assessment of risk factors for the development of mediastinitis in patients undergoing CABG was explicitly stated in the objectives section of the paper. We realize that some articles may have been missed during the search stage;
4. finally, the search for articles has been performed by only one researcher, while two independent evaluators analyzed the selected studies.

Nevertheless, this review revealed gaps in knowledge, especially regarding the need to assess risk factors associated with infection control measures, which can be more easily modified in short time.

CONCLUSION

We found that the main risk factors for the development of mediastinitis after CABG were diabetes mellitus, followed by obesity, COPD, reoperation and old age (over 65 years).

The identification of risk factors for the development of mediastinitis can contribute to the implementation of nursing care through the promotion of lifestyle changes (when possible). In addition, it may contribute to reduce mortality and promote better general health and functional state.

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