

## Immunological Factors in Extracorporeal Circulation: A Systematic Review

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**Summary**

*circulation is a technology used in cardiovascular surgeries, very common in aortic disorders, heart and/or lung transplants and liver transplants. It consists of leaving the patient with an artificial basis of life, in which they occur through a device with disposable devices, which can supply the functions of the heart, kidneys and lungs, bringing oxygen and pumping blood throughout the individual's body. The objective Carry out a systematic review on heart disease and cardiopulmonary bypass, related to immunological factors. Methods were used that included a systematic review, where Health Sciences descriptors ( DeCS ) were used as a research tool in the databases PubMed /MEDLINE, Scientific Electronic Library Online - SciELO and Google Scholar. Articles in Portuguese were selected through a search strategy, 1,850 articles were found, being filtered through an association of descriptors, the summaries were read and then the full articles, where, based on the inclusion and exclusion criteria 17 scientific articles were obtained. It is concluded that, according to the clinical criteria established in this study, the most common heart diseases are myocardial diseases and ischemic heart disease. Patients who use extracorporeal circulation for a long time can trigger a systemic inflammatory process that can lead to risks or problems in the individual's life. Extracorporeal circulation is a category of controlled circulation, it is associated with immunological factors through the triggering of a wave of activation of cells responsible for the immune system, releasing inflammatory mediators.*

**Keywords:** Immunological factors; Extracorporeal circulation; Heart surgeries.

**Introduction**

The cardiovascular system encompasses a complex set of vessels, in which blood circulates throughout the human body. Stimulated by the heart, the veins are responsible for the flow in the centripetal direction, and the arteries responsible for the flow in the centrifugal direction (MOTA, 2008; GUIZILINI, 2005). During cardiopulmonary bypass (CPB) all blood will circulate through an external circuit, and no longer through the cardiac veins and arteries. This procedure aims to keep the patient stable (alive) while the surgical procedure is performed ( BRAILE , 2010).

Some complications may arise during the use of CPB related to microcirculation. One of the causes is the formation of small bubbles in the bloodstream, where these bubbles settle in the capillaries causing obstruction, generating ischemia, inflammation, activation of the complement system, platelet aggregation and, as a consequence, there is the production of clots ( MOTA , 2008; GUIZILINI, 2005) .

During the maintenance of CPB, several inflammatory responses may occur that are established in the body, which can be divided into the initial phase, including their cellular

and humoral mechanisms; and the late phase, which is an effect of tissue injury after a period of ischemia-reperfusion. (MESQUITA, 2010; MIRANDA, 2004).

The inflammatory immune response in CPB influences humoral immunity, triggering many inflammatory mechanisms, in which there is the production of active kinins in the coagulation system, enabling the release of activated complement fragments that will cause an increase in kallikrein endotoxins . Thus, the activation of the fibrinolytic system occurs, increasing the adhesion of molecules and activating neutrophils ( MESQUITA, 2010 ) .

Da Costa Soares (2010) and Torrati (2012), portray that the systemic inflammatory response produced by CPB releases substances that impair coagulation and the immune response; increase venous tone; and produces and releases large amounts of catecholamines, altering blood fluid. This inflammatory response induces a circulation of fluids from the intravascular cavity to the interstitial space, resulting in changes in the ease of entry of vascular liquid substances and a reduction in oncotic pressure, leading to certain complications in the immediate postoperative period.

According to Mota (2008) and Machado (2011), CPB is responsible for the appearance of Systemic Inflammatory Response Syndrome (SIRS), also called post-perfusion syndrome, whose presence of several leukocytes and increased entry of substances into the vessel, lead to the accumulation of interstitial fluid, combined with organic lesions, mainly in the heart and lungs, contributing to the increase in causes capable of producing postoperative illness.

Thus, this study aimed to carry out a systematic review on heart disease and cardiopulmonary bypass (CPB) related to immunological factors. Methodologically in systematic review used a database, with articles published in the last 10 years in Portuguese, with inclusion and exclusion criteria, initially analyzing the title related to immunological factors and consistent with the proposed theme .

## Results and Discussion

Initially, 1,850 publications were identified, which were obtained from keyword associations. Of these, 450 were selected from PubMed / MEDLINE, 1,057 from Google Scholar, 343 from SciELO. Thus, 17 articles referring to the topic in question were obtained after analyzing the inclusion and exclusion criteria.

After selecting the studies, 1,833 articles were excluded, presenting aspects and summaries that were unrelated to the topic covered and pre-established criteria for heart disease, cardiopulmonary bypass (CPB) related to immunological factors.

Once the 17 articles were selected, their summaries, methodology and conclusion were read, based on the objective of the present study and pre-established criteria . As a result, 9 articles were excluded, resulting in a final exclusion of 1,842, leaving 8 articles to be analyzed in the present study, as shown in table 1.

**Table 1:** Search and Results in Databases

| Data base                                    | Found | Initial Deletion | Analysis | Deletion after Analysis | Final Deletion | Inclusion |
|--|-------|------------------|----------|-------------------------|----------------|-----------|
| SciELO -Scientific Electronic Library Online | 343   | 338              | 5        | 3                       | 341            | two       |
| PubMed /MEDLINE                              | 450   | 449              | 1        | 0                       | 449            | 1         |
| Academic Google                              | 1,057 | 1046             | 11       | 6                       | 1052           | 5         |
| Total  | 1850  | 1883             | 17       | 9                       | 1842           | 8         |

In relation to the methodological study, the results of research on the proposed topic were used, identified based on their authors, year of publication, with the aim of characterizing the studies in terms of results, as shown in table 2.

**Table 2:** Characterization of Studies, Regarding Results (n=08).

| Author/year            | Article title  | Result  |
|------------------------|--|---|
| Lobo Filho, 2001       | Vineberg procedures : proposal for a technical variation.  | Of all the methods used for myocardial revascularization, only the Vineberg method demonstrated to be effective from a functional and physiological point of view   |
| Miana et al., 2004     | Risk factors for bleeding after cardiac surgery in adult patients.                                   | Patients who underwent emergency operations and those who had thrombocytopenia needed improvement in their preoperative clinical conditions.  |
| Gomes, 2005            | Enio. Years of extracorporeal circulation in Brazil.   | With the emergence of Extracorporeal Circulation (ECC), new possibilities were established for curing heart diseases and improving quality of life.   |
| Nogueira et al., 2008. | Quality of life after surgical myocardial revascularization with and without cardiopulmonary bypass. | Some patients did not have the assessment completed due to several things that prevented them from carrying out the assessments, one of which was loss of follow-up or refusal to participate in the study, even difficulties in understanding the questionnaire and death. |

|                              |  |  |
|------------------------------|--|--|
| Da Costa Soares et al., 2010 | Clinical profile of the systemic inflammatory response after pediatric cardiac surgery with cardiopulmonary bypass.      | Based on clinical criteria, it is plausible to identify that patients with low weight and who have been using CPB for a longer period of time have a high risk of developing SIRS-CPB. |
| Ax et al., 2011              | Assessment of cytokine levels and lung function in patients undergoing cardiac surgery with cardiopulmonary bypass.      | In this study, an increase in cytosine levels in blood and bronchoalveolar lavage after CPB was observed.  |
| Godinho et al., 2012         | Myocardial revascularization surgery with cardiopulmonary bypass versus without cardiopulmonary bypass: a meta-analysis. | CPB techniques are in progress and offer special advantages and disadvantages in certain groups and subgroups of patients.   |
| Dos Reis Freitas, 2017       | hydroelectrolyte imbalance.  | Changes in electrolytes (sodium, potassium, calcium and magnesium, among others) can present major risk factors for patients with heart problems.                                      |

According to Costa Soares, et al., ( 2010), extracorporeal circulation is controlled and is essential in most heart surgeries. Braile, (2010) adds that extracorporeal circulation has created new opportunities for curing heart diseases, without possibilities of treatment.

Thus, the study carried out by Lobo Filho (2001) shows that there are several publications presenting the effectiveness of the Vineberg surgical procedure. According to Dallan , et al 2009, the Vineberg technique consists of direct revascularization of the “mammary” artery in the myocardium, surgically treating patients with marked and disseminated coronary artery disease . The choice of this technique is to obtain indirect myocardial perfusion, through the connection between two arteries, which can be performed without the aid of extracorporeal circulation. It is believed that the implementation of this new technique, with the use of the “introducing sheath”, will result in this procedure being used more frequently, both isolated and associated with myocardial revascularization.

In the study developed by Souza,( 2004) a technique was used with the use of a hemoconcentrator device on patients during the surgical procedure. This equipment consists of a CPB pump with model BEC 2000 made up of four modules (arterial, cardioplegia and two aspirators) and oxygenators used in adults/pediatrics. It was prepared in the recirculation line with a “Y” shunt for the system that stops heartbeats during cardiac surgery, considering that this technique can improve the treatment of the individual during the CPB process.

Nogueira, et al. ( 2008) used an anesthetic technique, unified at the Heart Institute (InCor) of the Hospital das Clínicas of the Faculty of Medicine of the University of São Paulo (FMUSP), this method was used in cardioplegic patients to protect the myocardium, with a substance to neutralize the anticoagulant action of heparin in cases of severe bleeding.

Guizilini (2005) mentions that surgery, without cardiopulmonary bypass, can reduce morbidity and mortality in elderly individuals undergoing myocardial revascularization surgery. At this age, the rate of problems is much lower than in

patients operated on without CPB, taking into account that the length of stay in hospital is also very short.

Miana, et al., ( 2004) shows that bleeding continues to be one of the main causes of morbidity in patients undergoing cardiac surgery. This can occur during prolonged periods of cardiopulmonary bypass and interventions in individuals, acutely, outside their considered healthy state.

Reis Freitas (2017), emphasizes that cardiac surgeries with CPB can involve major complications for the individual’s life, such as respiratory disorders, arrhythmias, edema, acute kidney problems and infections.

According to Torrati (2012), CPB causes a systemic inflammatory response, releasing substances that impair coagulation and the immune response, presenting an increase in venous tone and altering the blood flow in the bloodstream. The effects of CPB can cause edema, breathing complications, neurological disorders, among others.

For Machado, et al., (2011) inflammation caused by extracorporeal circulation can be understood as a protective response, with the main objective of ending the initial cause of cellular injury (bacteria, toxins, trauma, etc.). The latter presents, as a consequence; cellular necrosis and tissue necrosis. In this way, it is understood that the inflammatory response consists of a systemic action that occurs even in the absence of infection, and is known as systemic inflammatory response syndrome (SIRS).

According to Mesquita, et al., (2010), they emphasize that CPB triggers a generalized deficiency in immune response cells, three to seven days after surgery. The cellular immune response is impaired, which increases the risk of infections. Platelets will be activated by the use of CPB and as a consequence their number and function will be reduced.

## Conclusion

It is concluded that, according to the clinical criteria established in this study, the most common heart diseases are myocardial diseases and ischemic heart disease.

Extracorporeal circulation is a category of controlled circulation, it is associated with immunological factors through the triggering of a wave of activation of cells responsible for the immune system, releasing inflammatory mediators. On the other hand, CPB also produces a systemic inflammatory response, releasing substances that impair coagulation and the immune response. It was plausible to identify that patients who use CPB for a long time can trigger a systemic inflammatory process, an infectious process, in addition to presenting changes in lung function.

Therefore, the importance of understanding and understanding studies on the process and use of extracorporeal circulation is assessed. Professionals need continuous knowledge, which can exercise their craft in an interdisciplinary and/or multidisciplinary way, in order to guarantee the safety and treatment of patients undergoing cardiac surgery procedures.

The need for studies on the occurrence of infection in critically ill patients who use CPB was highlighted, in an attempt to establish a good quality of treatment in relation to risk factors, with the aim of directing means of prevention and control, appropriate.

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