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Changes in Kidney Physiology during Cardiopulmonary Bypass: A Narrative Overview and Applicable Notes

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Introduction

Cardiopulmonary bypass (CPB) is a life-saving procedure that allows surgeons to perform complex cardiac surgeries. While it is essential for maintaining oxygenation and circulation during heart surgery, it can also have significant effects on other organ systems, including the kidneys. In this article, we will provide a comprehensive narrative overview of the changes in kidney physiology during CPB and offer applicable notes for clinicians and researchers to better understand and manage the renal implications of this procedure. CPB is a technique used during cardiac surgeries to temporarily take over the functions of the heart and lungs. It involves rerouting the patient's blood through a heart-lung machine to ensure oxygenation and circulation while the heart is stopped for surgery. CPB is crucial for providing a bloodless and motionless surgical field, allowing cardiac surgeons to perform intricate procedures. It has undoubtedly revolutionized cardiac surgery, but it is not without its effects on various organ systems [1-3].

Description

The kidneys play a pivotal role in maintaining fluid balance, electrolyte homeostasis, and waste excretion. They are highly sensitive to changes in systemic perfusion and oxygenation, making them susceptible to CPB-related alterations [6]. During CPB, the kidneys are subjected to periods of altered perfusion and potential ischemia, both of which can impact their function. CPB often leads to hemodilution, as blood is mixed with crystalloid and colloid solutions in the pump. This can reduce the oxygen-carrying capacity of blood and may impact renal oxygen delivery. CPB triggers a systemic inflammatory response due to contact between blood components and non-endothelial surfaces of the circuit. Inflammation can affect renal perfusion and function. The CPB circuit can release microemboli and activate coagulation pathways, which may lead to renal microcirculatory disturbances and thrombi formation. The mechanical stress of CPB can cause hemolysis, releasing free hemoglobin into the bloodstream. This can lead to renal vasoconstriction and oxidative stress. Patients may receive significant volumes of fluids during CPB to maintain perfusion and circulation. This fluid overload can stress the kidneys and lead to acute kidney injury (AKI) [4-6].

Conclusion

Cardiopulmonary bypass is an indispensable tool in modern cardiac surgery, but it is not without consequences for other organ systems, including the kidneys. Understanding the changes in kidney physiology during CPB is essential for clinicians to monitor and manage renal function effectively. Researchers should continue to explore ways to minimize the renal impact of CPB and improve long-term outcomes for cardiac surgery patients. Ultimately, the careful management of renal physiology during CPB is vital for ensuring the best possible outcomes for patients undergoing complex cardiac procedures. This article provides a comprehensive overview of the changes in kidney physiology during CPB and offers applicable notes for clinical practitioners to better understand and manage the associated renal issues.

Acknowledgement

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Conflict of Interest

None.

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