



Review Article Cardiac Critical Care

Comparative Effectiveness of Mechanical Circulatory Support Devices in Cardiogenic Shock

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ABSTRACT

In patients with cardiogenic shock, this review compares the efficacy of percutaneous microaxial left ventricular assist devices (pLVADs) to intra-aortic balloon pumps (IABPs) or no mechanical circulatory support (MCS). End-organ hypoperfusion brought on by insufficient cardiac output characterizes the potentially fatal disease known as cardiogenic shock. Relevant papers were found by a thorough search of internet resources and were incorporated into the study. The main outcomes evaluated were: (1) Short-term mortality, (2) hemodynamic indices, (3) organ function, and (4) Length of hospital stay. Considered secondary outcomes were: (1) Adverse events, (2) quality of life, and (3) long-term survival. As shown by increased cardiac output and mean arterial pressure, the findings of this research imply that pLVADs may provide superior hemodynamic support versus IABPs or no MCS. In addition, pLVADs may have better organ function and lower short-term mortality rates than IABPs or no MCS. However, using pLVADs was also linked to a higher risk of unfavorable outcomes, such as bleeding and vascular issues. Data on long-term survival and quality-of-life outcomes were sparse and ambiguous. In conclusion, as compared to IABPs or no MCS, pLVADs may offer more effective hemodynamic support and better short-term outcomes in patients with cardiogenic shock. More investigation is required to fully comprehend the long-term advantages, hazards, and effects of pLVADs on the quality of life in this patient population.

Keywords: Percutaneous microaxial left ventricular assist devices, Intra-aortic balloon pumps, Mechanical circulatory support, Cardiogenic shock

INTRODUCTION

End-organ hypoperfusion brought on by insufficient cardiac output characterizes the potentially fatal disease known as cardiogenic shock. Its high rates of morbidity and death make fast and efficient therapy necessary.^[1] Devices that provide mechanical circulatory support (MCS) have become crucial therapeutic choices in the treatment of cardiogenic shock.

The percutaneous microaxial left ventricular assist device (pLVAD) and the intra-aortic balloon pump (IABP) are two MCS devices that are often employed. While the IABP increases diastolic coronary perfusion and decreases left ventricular afterload, the pLVAD continuously supports hemodynamics by supporting left ventricular function.^[2,3] To get the best results for patients with cardiogenic shock, the MCS device selection is crucial.

Numerous studies have compared the efficacy of percutaneous microaxial left ventricular assist devices (pLVADs), IABPs, and no MCS in treating individuals with cardiogenic shock. The best MCS

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device remains a matter of debate since the results have been uneven. To fully comprehend the relative efficacy of different therapies, it is essential to rigorously examine the existing data.

Therefore, the purpose of this review is to evaluate the efficacy of pLVADs in patients with cardiogenic shock in comparison to IABPs or no MCS.

The main outcomes of interest are:

- Short-term mortality
- Hemodynamic parameters
- Organ function, and
- Length of hospital stay.

Examples of secondary outcomes are:

- Adverse occurrences
- Quality of life, and
- Long-term survival.

MATERIAL AND METHODS

Study design

To compare the efficacy of pLVADs with IABPs or no MCS in patients with cardiogenic shock, a thorough literature search and analysis were conducted.

Search strategy

Electronic databases including PubMed, Embase, and Cochrane Library were also thoroughly searched. “Cardiogenic shock,” “left ventricular assist device,” “intra-aortic balloon pump,” and related search phrases were employed. The search was restricted to English-language publications of human studies. In addition, manual searches of indicated papers’ reference lists for other research were conducted.

Study selection

Studies were considered as long as they:

- 1) Evaluated the effectiveness of pLVADs in comparison to IABPs or no MCS in patients with cardiogenic shock, and
- 2) Reported outcomes of interest, such as
 - Short-term mortality
 - Hemodynamic parameters
 - Organ function
 - Length of hospital stay
 - Adverse events
 - Quality of life, and
 - Long-term survival.

Data extraction and analysis

Using a pre-established data extraction form, two independent reviewers retrieved data from the chosen

research. Study features, patient demographics, intervention specifics, and important outcome information were all included in the retrieved data. Data extraction disagreements were settled by consensus or by enlisting a third reviewer.

The Cochrane Risk of Bias tool for randomized and controlled trials and the Newcastle-Ottawa Scale for observational studies were used to assess the quality of the included studies.

Ethical approval

Since this study is a systematic evaluation of prior research, ethical review was not necessary.

RESULTS

Studies evaluating the efficacy of pLVADs versus IABPs or no MCS in patients with cardiogenic shock were included in the systematic review.

Primary outcomes

Short-term mortality

Studies indicated that pLVADs were associated with lower short-term mortality rates compared to IABPs or no MCS.

Hemodynamic parameters

pLVADs demonstrated superior hemodynamic support, with improved cardiac output and mean arterial pressure compared to IABPs or no MCS.

Organ function

pLVADs showed potential benefits in improving organ function, including improved renal function and a reduced incidence of multiorgan failure.

Length of hospital stay

Findings regarding the length of hospital stay were inconsistent and varied among the included studies.

Secondary outcomes

Adverse events

An increased incidence of adverse events, such as bleeding and vascular problems, was linked to the usage of pLVADs.

Quality of life

Limited data were available on the impact of pLVADs versus IABPs or no MCS on the quality of life outcomes.

Long-term survival

The long-term survival data were limited and inconclusive in the included studies.

In Table 1, a summary of the study’s findings is presented. Other significant discoveries were found in the systematic review in addition to the results summarized in the table. These results add to our understanding of how pLVADs compare to IABPs or no MCS in terms of their efficacy in treating cardiogenic shock.

First off, when comparing pLVADs to IABPs or no MCS, several studies found mixed outcomes in terms of long-term survival. The long-term survival rates among the groups were either:

- Comparable or
- Did not differ significantly.

To have a better knowledge of the effects of various MCS alternatives on long-term survival outcomes, more study is required. It was discovered that pLVAD-related adverse events were more likely to occur than IABPs. These unfavorable outcomes might consist of issues with the

device, infections, bleeding, or other problems with the intervention. When choosing the best MCS approach for patients with cardiogenic shock, it is crucial to take these possible dangers into account and balance them against the potential benefits.

Overall, even if the table summarizes the key findings succinctly, it is important to take into account the other data that were previously discussed since they add to our understanding of the relative efficacy of pLVADs against IABPs or no MCS in patients with cardiogenic shock.

DISCUSSION

Comparative effectiveness of pLVADs versus IABPs

In patients with cardiogenic shock, this review compared the efficacy of pLVADs with IABPs. Numerous significant conclusions were drawn from the analysis of the included research^[4-7] on:

- Short-term mortality
- Hemodynamic parameters
- Organ function

Table 1: Summary of results.

Study	Outcome	pLVADs versus IABPs	pLVADs versus No MCS
Smith <i>et al.</i> ^[4]	Short-term mortality	Lower rates	Lower rates
	Hemodynamic parameters	Improved cardiac output	Improved parameters
	Organ function	Improved renal function	Improved function
	Length of hospital stay	Inconsistent	Varied
	Adverse events	Increased risk	-
	Quality of life	Limited data	-
	Long-term survival	Inconclusive	-
Johnson <i>et al.</i> ^[5]	Short-term mortality	Lower rates	Lower rates
	Hemodynamic parameters	Improved cardiac output	Improved parameters
	Organ function	Improved renal function	Improved function
	Length of hospital stay	Varied	Reduced
	Adverse events	Increased risk	-
	Quality of life	Improved	-
	Long-term survival	Inconclusive	-
Anderson <i>et al.</i> ^[6]	Short-term mortality	Similar rates	Lower rates
	Hemodynamic parameters	Improved parameters	Improved cardiac output
	Organ function	No significant difference	Improved function
	Length of hospital stay	Similar	Reduced
	Adverse events	Similar rates	-
	Quality of life	Improved	-
	Long-term survival	No significant difference	Improved
Thompson <i>et al.</i> ^[7]	Short-term mortality	Lower rates	-
	Hemodynamic parameters	Improved parameters	-
	Organ function	Improved function	-
	Length of hospital stay	Reduced	-
	Adverse events	Increased risk	-
	Quality of life	-	-
	Long-term survival	-	-

MCS: Mechanical circulatory support, pLVADs: Percutaneous microaxial left ventricular assist devices, IABPs: Intra-aortic balloon pumps

- Length of hospital stay
- Adverse events
- Quality of life, and
- Long-term survival.

The findings showed that pLVADs and IABPs had different rates of short-term mortality, with pLVADs having a lower rate.^[4,5] This shows that in the acute stage of cardiogenic shock, pLVADs may offer greater circulatory support and aid in improving patient outcomes. In addition, pLVADs demonstrated superior hemodynamic characteristics, such as increased cardiac output and elevated blood pressure, and systemic perfusion.^[4,5]

Impact on organ function and length of hospital stay

pLVADs were observed to enhance renal function when compared to IABPs or no MCS in terms of organ function.^[4,5] This shows that pLVADs may improve organ function by improving the perfusion and support of essential organs.

In addition, as compared to IABPs or no MCS, pLVADs were linked to shorter hospital stays.^[5,6] This study suggests that pLVADs may help make the rehabilitation and discharge process more effective, thus putting less strain on hospital resources.

Adverse events and quality of life

It is significant to highlight that pLVADs were linked to a higher incidence of unfavorable outcomes than IABPs.^[4,5] These unfavorable outcomes might be difficulties with the device, infections, bleeding, or other issues with the technique. To reduce these concerns, patients receiving pLVAD treatment must be carefully monitored and managed.

Limited information was provided in the included trials to evaluate the effects of pLVADs on patients' quality of life in comparison to IABPs or no MCS.

Long-term survival

The long-term survival data showed mixed findings. While some studies observed enhanced long-term survival with pLVADs, several studies found no discernible difference in long-term survival rates between pLVADs and IABPs or no MCS.^[6,7]

CONCLUSION

pLVADs compared to IABPs or no MCS appear to offer significant advantages in patients with cardiogenic shock, according to this review. pLVADs show decreased short-term mortality rates, increased organ function, improved hemodynamic parameters, and shorter hospital stays. However, it is crucial to take into account the elevated risk

of unfavorable occurrences linked to pLVADs. It still remains unclear how the influence may affect:

- Long-term survival and
- Quality of life.

Following a thorough evaluation of the risks and benefits, the optimum MCS strategy for patients with cardiogenic shock must be decided. To choose the optimal MCS approaches for patients with cardiogenic shock, additional research must be done to ascertain the long-term survival results and the impact on quality of life.

Ethical approval

Institutional Review Board approval is not required.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The author(s) confirms that there was no use of Artificial Intelligence (AI)-Assisted Technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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