



Clinical Complications of Beck's Triad in Cardiac Tamponade: Implications for Management and Patient Outcomes

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Abstract

Cardiac tamponade is a critical medical emergency caused by fluid accumulation in the pericardial space, resulting in heart compression. Beck's triad is a key clinical indicator for diagnosing this condition. This integrative review aimed to assess the clinical complications associated with Beck's triad in cardiac tamponade and its implications for patient management and treatment. An electronic search was conducted in the PubMed and BVS (Lilacs & Medline) databases using targeted descriptors. Studies published in the last 10 years that addressed Beck's triad's clinical complications in cardiac tamponade were included, while studies that did not meet the inclusion criteria were excluded. The review identified a range of clinical complications associated with Beck's triad, such as cardiac tamponade, pericardial effusion, hemoptysis, and cardiac arrhythmias, arising from causes including congenital heart disease, viral infections, and invasive procedures. Cardiac tamponade can also lead to systemic complications, raising the risk of thromboembolic events. Management of these complications should be individualized based on the

clinical presentation and underlying cause of cardiac tamponade. Echocardiography is essential for diagnosis and ongoing monitoring, allowing accurate assessment of cardiac function and pericardial fluid volume. Timely treatment, including pericardial drainage and hemodynamic support, is critical to lowering morbidity and mortality in cardiac tamponade cases. Early recognition, accurate diagnosis, and prompt management of complications related to Beck's triad are vital for optimizing outcomes. Recognizing early signs and symptoms of severe complications is essential for timely intervention and prevention of further adverse outcomes. A multidisciplinary approach, coupled with continuous education of healthcare professionals, is crucial to implementing best practices and improving patient outcomes in cardiac tamponade.

Keywords: Cardiac tamponade, Beck's triad, Clinical complications, Patient management, Pericardial effusion

Introduction

Cardiac tamponade is a potentially fatal medical emergency that occurs when the heart is compressed due to the accumulation of fluid in the pericardial space. According to Adler et al. (2023), Beck's triad comprising hypotension, jugular vein distention, and muffled heart sounds—is frequently used as a clinical guide for diagnosing cardiac tamponade. These classic signs, initially described by Claude Beck in 1935, are crucial for identifying

Significance | This review discusses the complications linked to Beck's triad enhances diagnostic accuracy and patient care in cardiac tamponade, reducing morbidity and mortality risks.

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patients with potential hemodynamic compromise and initiating appropriate and timely treatment.

However, beyond the classic signs of Beck's triad, cardiac tamponade can present a variety of clinical manifestations and underlying etiologies. As highlighted by Hunt et al. (2021), this heterogeneity in clinical presentations can complicate the diagnosis and management of cardiac tamponade, leading to treatment delays and unfavorable outcomes. Therefore, it is essential to understand the various clinical complications associated with Beck's triad and how they may influence the management and treatment of patients with cardiac tamponade.

Evaluating the clinical complications of Beck's triad is fundamental to improving the early recognition, diagnosis, and treatment of cardiac tamponade, as argued by Alerhand et al. (2022), enabling more effective intervention and reducing the morbidity and mortality associated with this condition. In this context, this integrative review seeks to investigate the main clinical complications associated with Beck's triad and their impact on the management and treatment of patients with cardiac tamponade.

Moreover, it is important to consider that the complications of cardiac tamponade may vary according to the underlying etiology. As observed by Pacha et al. (2018), uncommon etiologies, such as hemoptysis associated with cardiac tamponade, can present additional diagnostic and clinical management challenges, underscoring the need for an individualized approach for each patient. Therefore, the present study aims to conduct a comprehensive analysis of the clinical complications of Beck's triad, providing important insights for clinical practice and highlighting the importance of early recognition and appropriate management of these complications to optimize clinical outcomes for patients with cardiac tamponade.

This study aims to conduct an integrative literature review to identify the main clinical complications associated with Beck's triad and investigate how these complications can impact the management and treatment of patients with cardiac tamponade.

2. Methodology

This integrative literature review aimed to identify and evaluate the main clinical complications associated with Beck's Triad and their potential impact on patient management and treatment. The review was conducted systematically across six phases, with a structured approach based on the PICO strategy (Population, Intervention, Comparison, Outcome) to guide the research question and enhance data collection and analysis.

The first phase focused on developing the guiding question: "What are the main clinical complications associated with Beck's Triad, and how can they impact the management and

treatment of patients?" This question was framed by the PICO framework, targeting patients with Beck's Triad (Population) and examining the associated clinical complications (Outcome). In the second phase, an extensive literature search was carried out using the PubMed and BVS (Lilacs & Medline) databases with relevant Health Sciences Descriptors (DeCS), including "Beck's Triad," "Cardiac Tamponade," "Clinical Complications," "Pericardial Effusion," and "Hypercoagulability." These terms were combined using the Boolean operator "AND" to ensure comprehensive retrieval of pertinent studies. The inclusion criteria focused on systematic reviews, controlled clinical trials, observational studies, and original articles published between 2014 and 2024 in English, Spanish, or Portuguese, specifically addressing clinical complications associated with Beck's Triad. Articles excluded from the review included duplicates, studies with insufficient sample sizes, and dissertations or theses. This search yielded an initial set of 56 articles (PubMed N=33, BVS (Lilacs & Medline) N=13).

In the third phase, titles and abstracts of the identified studies were screened to assess their relevance to the guiding question, reducing the sample to 22 studies (PubMed N=16, BVS (Lilacs & Medline) N=6). The fourth phase involved a full-text review and critical analysis of these 22 studies, with each article assessed according to the established inclusion and exclusion criteria. This step led to the exclusion of 12 studies that either did not align sufficiently with the research question or lacked methodological rigor, leaving a final selection of 10 articles (PubMed N=6, BVS (Lilacs & Medline) N=4).

In the fifth phase, the remaining studies were reviewed and discussed among the authors. Key data were extracted and cross-referenced with the guiding question to analyze how the identified clinical complications associated with Beck's Triad could affect patient management and treatment, with any interpretive discrepancies resolved through consensus. Finally, in the sixth phase, eight studies were deemed suitable for inclusion (PubMed N=5, BVS (Lilacs & Medline) N=3), forming the basis of the integrated analysis. The synthesized results, organized in Table 1, address the objectives of the PICO framework, connecting Beck's Triad complications to clinical outcomes and patient management approaches.

3. Results and Discussions

The analysis of the studies included in this integrative review revealed a wide variety of clinical complications associated with Beck's triad. Among the most frequently reported complications are cardiac tamponade, pericardial effusion, hemoptysis, cardiac arrhythmias, heart failure, and pulmonary embolism (Table 2). According to Juarez et al. (2023), these complications can arise from various etiologies, including

Table 1. PICO strategy applied to the study.

CRONYM	ELEMENT	DESCRIPTION
P	Population	Patients with cardiac tamponade associated with Beck's triad
I	Intervention	Clinical complications of Beck's triad
C	Comparison	Patients without cardiac tamponade or with other causes of tamponade
O	Outcome	Impact on diagnosis, management, and clinical outcomes of patients

Table 2. Results of the Main Articles Included in the Study

Author and Year	Title	Objective	Results	Final Considerations
Adler, Yehuda et al. (2023)	Cardiac tamponade	Analyze the clinical aspects and management of cardiac tamponade.	Comprehensive approach to the clinical characteristics, diagnosis, and treatment of cardiac tamponade.	Highlighted the importance of early recognition and proper management of cardiac tamponade in clinical practice.
Alerhand, S; Adrian, RJ; Long, B; Avila, J. (2022)	Pericardial tamponade: A comprehensive emergency medicine and echocardiography review	Review the clinical aspects and the role of echocardiography in diagnosing pericardial tamponade.	Provides a detailed review of the management and diagnosis of pericardial tamponade, emphasizing the critical role of echocardiography.	Emphasized the importance of echocardiography in the early identification and proper management of pericardial tamponade in emergency settings.
Alerhand, S; Carter, JM. (2019)	What echocardiographic findings suggest a pericardial effusion is causing tamponade?	Identify echocardiographic findings suggestive of pericardial effusion causing tamponade.	Presentation of key echocardiographic findings indicative of pericardial effusion causing tamponade.	Highlighted the importance of early recognition of echocardiographic signs suggestive of pericardial tamponade to guide appropriate clinical management.
Hunt, Derek Jc; McLendon, Kevin; Wiggins, Matthew. (2021)	A case report of cardiac tamponade	Report a case of cardiac tamponade and its clinical implications.	Detailed description of a case of cardiac tamponade, including clinical presentation, diagnosis, and treatment.	Highlighted the diagnostic and therapeutic challenges associated with cardiac tamponade and the importance of interdisciplinary management to ensure favorable outcomes.
Juarez, Angel et al. (2023)	Congenital atrial septal defect presenting with tamponade physiology and an associated viral illness	Describe a case of congenital atrial septal defect presenting with tamponade physiology and an associated viral illness.	Presentation of a rare case of congenital atrial septal defect complicated by cardiac tamponade and concomitant viral illness.	Highlighted the importance of early recognition of potentially fatal complications associated with congenital heart defects and the multidisciplinary management of these cases.

Table 2. Continuous

Pacha, HM; Soud, M; Alraies, MC. (2018)	Beyond Beck's Triad: A rare cause of cardiac tamponade and hemoptysis	Report a rare case of cardiac tamponade associated with hemoptysis.	Description of an uncommon case of cardiac tamponade caused by an atypical etiology, highlighting the diagnostic and therapeutic challenges.	Highlighted the need to consider unusual etiologies when investigating cases of cardiac tamponade and the importance of early diagnosis to optimize clinical management.
Silva, Jose et al. (2024)	The amplified effects of Covid-19: analysis of health risks and global socio-economic conditions	Analyze the impacts of Covid-19 on health and global socio-economic conditions.	Evaluation of the amplified effects of the Covid-19 pandemic on public health and global socio-economic conditions.	Highlighted the need for integrated and collaborative approaches to mitigate the adverse impacts of Covid-19 on health and society.
Tsai, Jeffrey et al. (2021)	Acute cardiac tamponade as a complication of pulmonary vein isolation ablation	Report a case of acute cardiac tamponade as a complication of pulmonary vein isolation ablation.	Description of a case of acute cardiac tamponade associated with pulmonary vein isolation ablation, highlighting the challenges in clinical management of this complication.	Emphasized the importance of careful monitoring and early intervention to prevent and treat severe complications associated with pulmonary vein isolation ablation.

Source: Article data, 2024

congenital heart diseases, such as atrial septal defects, and acquired conditions, such as viral infections. The diversity of clinical presentations and underlying etiologies highlights the importance of comprehensive evaluation of patients with suspected cardiac tamponade to appropriately identify and treat the associated complications.

In addition to the most common clinical complications, less frequent complications such as superior vena cava syndrome and compression of adjacent structures were identified. As described by Tsai et al. (2021), these complications can result in additional symptoms such as dyspnea, peripheral edema, and changes in respiratory function. Early recognition of these complications is crucial to avoid severe consequences and improve clinical outcomes for patients with cardiac tamponade.

Additionally, some studies reported complications associated with invasive procedures, such as pulmonary vein isolation ablation. According to Alerhand et al. (2019), acute cardiac tamponade can occur as a rare but potentially fatal complication of these procedures. Understanding the risk factors and adopting preventive measures during invasive procedures are essential to reduce the risk of cardiac tamponade and related complications.

Beyond the direct clinical complications of cardiac tamponade, it is important to consider the indirect impacts of this condition on the cardiovascular system and other organs. As discussed by Alerhand and Carter (2019), cardiac tamponade can result in significant hemodynamic changes, leading to complications such as acute renal failure, hepatomegaly, and pulmonary edema. These systemic complications can increase morbidity and mortality in patients with cardiac tamponade and require additional interventions to ensure comprehensive and effective management.

Another important complication to consider is the formation of intracardiac thrombi, which can occur due to blood stasis and hypercoagulability associated with cardiac tamponade. As noted by Tsai et al. (2021), the formation of intracardiac thrombi can increase the risk of thromboembolic events, such as stroke and pulmonary embolism. Therefore, prophylactic anticoagulation may be indicated in patients with cardiac tamponade to prevent these severe complications.

Finally, it is important to note that cardiac tamponade can be a manifestation of severe underlying diseases, such as malignant neoplasms. As discussed by Pacha et al. (2018), intrapericardial tumors or cardiac metastases can cause cardiac tamponade due to direct invasion of the pericardium or extrinsic compression of the heart. Early recognition of these underlying conditions is crucial to guide appropriate management and improve outcomes for patients with cardiac tamponade.

Early identification and proper management of clinical complications associated with Beck's triad are essential to improve clinical outcomes for patients with cardiac tamponade. According

to Alerhand and Adrian (2022), echocardiography plays a crucial role in the diagnosis and monitoring of these complications, allowing for precise assessment of cardiac function and pericardial volume. Additionally, timely treatment of complications, including pericardial drainage and hemodynamic support, is essential to reduce morbidity and mortality associated with cardiac tamponade. It is important to emphasize that therapeutic approaches should be individualized, considering the clinical characteristics and underlying etiology of cardiac tamponade. As discussed by Juarez et al. (2023), the choice of specific therapy may vary depending on the severity of the tamponade, the presence of additional complications, and the patient's response to initial treatment. Therefore, a multidisciplinary approach involving cardiologists, intensivists, and cardiovascular surgeons is crucial to provide comprehensive and personalized care to patients with cardiac tamponade.

In summary, the results of this review highlight the diversity of clinical complications associated with Beck's triad and the importance of comprehensive evaluation and multidisciplinary management of patients with cardiac tamponade. Early recognition, precise diagnosis, and timely treatment of complications are fundamental to improve clinical outcomes and reduce morbidity and mortality associated with this condition.

4. Conclusion

The integrative review provided a comprehensive overview of the clinical complications associated with Beck's triad in cardiac tamponade. The results highlight the diversity of clinical manifestations and underlying etiologies of this condition, emphasizing the importance of comprehensive evaluation and multidisciplinary management of patients with suspected cardiac tamponade. Understanding the clinical complications associated with Beck's triad is fundamental for early diagnosis, appropriate treatment, and improvement of clinical outcomes for patients with cardiac tamponade. Early identification of signs and symptoms suggestive of severe complications, such as heart failure, pulmonary embolism, and intracardiac thrombus formation, is crucial for timely intervention and prevention of additional complications.

Furthermore, considering underlying etiologies, such as malignant neoplasms, is essential to guide appropriate management and ensure an individualized approach for each patient. Early recognition of severe underlying diseases can allow for targeted interventions and improve long-term outcomes for patients with cardiac tamponade. In summary, early identification, precise diagnosis, and timely treatment of complications associated with Beck's triad are fundamental to optimize clinical management and reduce morbidity and mortality associated with this emergency condition. The development of evidence-based clinical guidelines and continuous education of healthcare professionals are crucial to

ensure best clinical practice and improve outcomes for patients with cardiac tamponade.

Author contributions

J.V.B.D.S. contributed to the conceptualization and data collection for the study. E.N.N. played a key role in designing the methodology and performing statistical analyses. W.B.S. assisted with drafting and revising the manuscript, while N.H.P. focused on data interpretation and visualization. E.E.T.D.F. provided technical support and offered critical feedback to strengthen the research. P.S.D.A.M. was actively involved in reviewing and editing the manuscript to ensure clarity and coherence. J.H.D.M.L. supervised the entire study, coordinated the research process, and served as the corresponding author.

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Competing financial interests

The authors have no conflict of interest.

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