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Korte protokol artikler

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The association between serial measurements of cardiac parameters on ultrasound and prognosis in adult emergency department visits: a systematic review protocol

Abstract

Introduction

Emergency department (ED) visits are often due to dyspnea or chest pain caused by underlying cardiopulmonary diseases. Point-of-care cardiac ultrasound is often used in the primary patient evaluation integrated with clinical assessment. However, standard follow-up solely relies on symptoms, vital signs, and laboratory findings.

Objective

The objective of this systematic review is to examine the association between serial changes in dynamic cardiac ultrasound parameters and prognosis in adult ED visits.

Methods

Studies with adult ED visits who underwent cardiac ultrasound at least twice during admission will be included. Mechanically ventilated patients will be excluded. A systematic search will be performed on PubMed, Cochrane, Embase, Scopus, Web of Science, and Google Scholar. The grey literature will be sought in ProQuest. Ongoing trials will be sought in ClinicalTrials, and the International Clinical Trials Registry Platform. The risk of bias will be assessed according to the study design using the Joanna Briggs Institute critical appraisal tools. Results will be synthesized in a meta-analysis if applicable; otherwise, in narrative form.

Discussion

The results are anticipated to provide new insights on how to monitor and guide treatment based on serial measurements of cardiac function on ultrasound.

Keywords: Emergency department; monitoring; prognosis; serial measurements; cardiac ultrasound; PoCUS; point-of-care ultrasound

Systematic review registration number: PROSPERO, CRD42024524740.

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Introduction

Emergency department (ED) visits are frequently prompted by dyspnea and chest pain, indicative of cardiopulmonary diseases such as acute heart failure, pulmonary embolism, and acute coronary syndromes (1).

Point-of-care ultrasound (PoCUS), particularly focused cardiac ultrasound (FoCUS) and lung ultrasound (LUS), is important in the ED for the swift evaluation of these patients, enabling clinicians to assess cardiopulmonary conditions and guide immediate diagnostic and treatment decisions (2–4).

While FoCUS and LUS are established for initial assessment, standard follow-up relies on observing symptom progression, vital signs, and medical test results. A systematic review has synthesized the implications of serial changes in B-lines on lung ultrasound and inferior vena cava diameter, presenting promising findings related to patient outcomes (5). Building on this knowledge, there is potential for other dynamic ultrasound findings on cardiac ultrasound, e.g., ejection fraction (EF), tricuspid annular plane systolic excursion (TAPSE), and the right ventricular-to-left ventricular (RV/LV) ratio, to enhance patient management. However, while ultrasound-guided treatment has proven effective for rapidly reducing dyspnea (6), the implications of longitudinal changes in cardiac parameters have only been investigated in small studies. In a pilot study, combined FoCUS and LUS demonstrated a larger decongestion in acute heart failure patients, thereby reducing mortality and rehospitalization (7). Additionally, serial TAPSE and RV dilatation monitoring in diagnostically undetermined dyspneic patients could detect developing pulmonary embolism (8). Despite these advances, comprehensive data on the longitudinal impacts of cardiac ultrasound parameters on patient outcomes are still lacking.

The objective of the systematic review is to examine the association between serial measurements of dynamic parameters (TAPSE, EF, and RV/LV ratio) assessed through cardiac ultrasound and prognosis (mortality, readmissions, length of stay, and intensive care unit transfers) in adult ED visits. Additionally, the trend in these parameters during admission will be investigated.

Methods

The systematic review will adhere to the Joanna Briggs Institute methodology for systematic reviews of effectiveness (9) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (10,11). Before commencing the review, it has been registered with PROSPERO (CRD42024524740).

Eligibility Criteria

Participants: We will include studies on adult ED visits aged 18 years or older, while studies only on mechanically ventilated patients will be excluded due to the potential impact of mechanical ventilation on cardiac function.

Intervention: Studies assessing serial changes in dynamic parameters (EF, TAPSE, and RV/LV ratio), were measured using cardiac ultrasound (e.g., echocardiography or focused cardiac ultrasound) at least twice during the hospital admission.

Comparator: Specific comparator criteria are not imposed; our focus is on assessing dynamic cardiac parameter changes during admission.

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Outcomes: This review will consider studies that report the following clinical outcomes: Mortality, readmissions, length of hospital stay, and intensive care unit transfers during admission, and trends in serial changes in EF, TAPSE, and RV/LV ratio during hospital admission.

Types of Studies: Randomized and non-randomized controlled trials, observational studies (cohort and case-control), and conference abstracts (based on these types of study designs) will be considered for inclusion, excluding other systematic reviews. Both published and unpublished trials will be included. No language restrictions will be imposed, as articles in unfamiliar languages will be translated.

Search Strategy

The search strategy was developed in collaboration with a research librarian and combined specific text words and their synonyms and index terms, such as MESH terms in PubMed. The basic search string will consist of keywords from the research question: "Focused cardiac ultrasound/echocardiography" AND "serial/repeated/monitoring" AND "emergency/hospitalization/admission". This search strategy will be adapted for each information source included. Additionally, the reference lists of selected studies will be screened, and citation-searching will be done on PubMed, Embase, Scopus, and Web of Science to find further relevant studies.

Hvad ved vi?

- Fokuseret hjerteultralyd (FoCUS) er en integreret del af den initiale undersøgelse hos mange akutte kontakter, især ved åndenød og brystsmerter

Information sources

A systematic search will be performed on PubMed, Cochrane, Embase, Scopus, Web of Science, and Google Scholar. The grey literature will be sought in ProQuest. Ongoing trials will be sought in Clinical Trials and the International Clinical Trials Registry Platform (ICTRP), and authors will be contacted for preliminary results.

Study Selection

Identified studies will be imported into Covidence (Veritas Health Innovation, Melbourne, Australia) for duplication check, screening, and data extraction. Two reviewers (VVV and WWW) will independently screen titles and abstracts against the inclusion criteria. Potentially relevant studies will have their full texts retrieved and assessed by the same two reviewers. Reviewer disagreements will be resolved through discussion or consultation with a third reviewer (XXX). Interrater reliability between the two reviewers will be reported. The study selection process will be presented in a Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram (10).

Risk of bias in studies

Eligible studies will undergo critical appraisal by two independent reviewers (YYY and ZZZ) using standardized critical appraisal instruments provided by Joanna Briggs Institute for experimental, quasi-experimental, and observational studies (9). Authors of papers will be contacted to request missing or additional data for clarification when necessary. The critical appraisal results will be presented in a table with a narrative description. Regardless of their methodological quality, all studies will be included in data extraction and synthesis.

Data Extraction

Two independent reviewers (VVV and WWW) will extract data using the inbuilt function in Covidence and according to a predefined data collection form. Any discrepancies will be resolved through discussion or consultation with a third reviewer (XXX). Authors will be contacted to obtain missing or additional data when needed. Data will include general information (authors, year, country, and funding), methods (study design, single- or multicenter study), cohort (age, sex, sample size, and symptoms/diagnoses), intervention (cardiac ultrasound scanning protocol, and scanning interval), and primary (mortality, readmissions, length of hospital stay, and intensive care unit transfers) and secondary outcomes (changes in EF, TAPSE, and RV/LV ratio). The extracted data will be represented in a table.

Data Synthesis

Statistical meta-analysis will be conducted using RevMan V5.4.1 (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark), and effect sizes will be expressed as odds ratios for dichotomous data or weighted (or standardized) mean differences for continuous data, along with their 95% confidence intervals. Heterogeneity will be assessed using chi-square (χ^2) with a p-value cutoff at 0.10 due to the test's low power (12), and an I^2 statistic over 50% will be considered indicative of substantial heterogeneity. Subgroup and sensitivity analyses will be performed in patients with a final diagnosis of acute heart failure, pulmonary embolism, and shock (cardiogenic and hypovolemic) because it is anticipated that dynamic changes in cardiac parameters are especially seen in these conditions. In cases where statistical pooling is not possible, a narrative synthesis with tables and figures will be presented. Publication bias will be assessed using funnel plots if 10 or more studies are included in a meta-analysis. Statistical tests for funnel plot asymmetry (Egger test, Begg test, Harbord test) will be performed where appropriate.

Assessing Certainty in the Findings

An overall assessment of the robustness of evidence will be conducted using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) approach (13). The results will be presented in a Summary of Findings (SoF) table, where the certainty of the evidence for each outcome will be rated. Two independent reviewers (VVV and WWW) will perform this evaluation. Any disagreements will be resolved through discussion or by involving a third reviewer (XXX). The SoF will be created using GRADEpro (McMaster University, ON, Canada).

Discussion

In the systematic review following this review protocol, we aim to explore the implications regarding the use of serial cardiac ultrasound in the ED/hospital setting. Our focus on the changes in EF, TAPSE, and RV dilatation in relation to patient outcomes is expected to provide new insights that could have implications in clinical practice.

Hvad tilføjer denne artikel til vores viden?

- Ved FoCUS kan en række dynamiske parametre vurderes, herunder venstre og højre hjerte-halvdels funktion, der antageligt ændrer sig allerede i akutfasen i takt med patientens kliniske tilstand

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The anticipated findings of this review may enhance the understanding of PoCUS, particularly its application beyond immediate diagnosis to ongoing patient management in ED settings. This could lead to more informed clinical decision-making, especially in the monitoring and treatment of patients with cardiopulmonary symptoms. Additionally, our review is likely to identify areas where further research is necessary, especially in understanding the long-term implications of changes in cardiac parameters.

It is crucial to note that these anticipated outcomes are speculative at this stage and dependent on the systematic review results. The findings may confirm or refine these expectations or present new challenges and perspectives. As with any review, the conclusions drawn will be limited by the quality and scope of the studies included. Nonetheless, this protocol sets the stage for a systematic review that seeks to contribute to the body of knowledge in emergency medicine and the practical application of PoCUS in patient care.

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