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Hemodynamic Impact of the Trendelenburg Position: A Systematic Review and Meta-Analysis

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Likhvantsev, VV[1]; Landoni, G[2]; Berikashvili, LB[3]; Polyakov, PA[4]; Yadgarov, MY[5]; Ryzhkov, PV[6]; Plotnikov, GP[7]; Kornelyuk, RA[8]; Komkova, VV[9]; Kuznetsov, IV[10]; Smirnova, AV[11]; Kadantseva, KK[12]; Shemetova, MM[13].

Corresponding author:
Valery Likhvantsev

lik0704@gmail.com

Author Affiliation:
Department of Clinical Trials, Federal Research and Clinical Centre of Intensive Care Medicine and Rehabilitology, Moscow, Russia.

ADMINISTRATIVE INFORMATION

Support - Nil.

Review Stage at time of this submission - Risk of bias assessment.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 26 January 2024 and was last updated on 26 January 2024.

INTRODUCTION

Review question / Objective The aim of our study is to systematically evaluate impact of Trendelenburg position on hemodynamic parameters in adult patients.
(i) population: adult patients positioned in both supine and Trendelenburg positions.
(ii) intervention (exposure): Trendelenburg position.
(iii) comparator: Supine position.
(iv) outcomes: At least one of the following outcomes in the article: stroke volume, stroke volume variation, stroke volume index, cardiac output, cardiac index, mean arterial pressure, heart rate, systemic vascular resistance, central venous pressure, mean pulmonary artery pressure, left ventricular end diastolic volume, left ventricular end systolic volume.
(v) study design: prospective interventional studies.

Rationale The Trendelenburg position, established by Friedrich Trendelenburg in the late 19th century, is known for its 'autotransfusion' effect, which theoretically increases cardiac preload and output according to the Frank-Starling law. However, current clinical evidence regarding its effectiveness is limited and lacks consensus, particularly in critical care scenarios such as septic shock or severe blood loss. This gap necessitates a thorough evaluation of the position's influence on hemodynamic parameters in adult patients. Our research aims to clarify its practical utility and potential role in clinical practice, as these findings could significantly impact clinical strategies and patient outcomes in acute and critical care settings.

Condition being studied The Trendelenburg position involves positioning a person supine, with an incline of more than 5 degrees, elevating the legs above the head.

METHODS

Search strategy A systematic literature search of studies was conducted in PubMed and Medline by

two independent investigators. Both backward and forward snowballing methods were also used for an exhaustive search (Litmaps service). Language or year restrictions were not applied.

Participant or population Adult patients (without restrictions on age, sex, race, or ethnicity) positioned in both supine and Trendelenburg positions.

Intervention Trendelenburg position.

Comparator Supine position. The supine position refers to a lying posture where the body is flat on the back with the face and torso facing upward.

Study designs to be included We included prospective interventional studies.

Eligibility criteria Prospective studies comparing the hemodynamic characteristics of patients in the horizontal supine position (T0) and Trendelenburg position (T-) were reviewed. Studies were excluded if they met one of the following criteria: 1) were review articles, case reports, or letters to the editor; 2) involved the combination of the Trendelenburg position and carboperitoneum, 3) reported no outcome data.

Information sources PubMed, MEDLINE, and databases from Litmaps service (Crossref, Semantic Scholar, OpenAlex).

Main outcome(s) The primary outcome for this study will be stroke volume (SV).

Additional outcome(s) Stroke volume variation (SVV), stroke volume index (SVI), cardiac output (CO), cardiac index (CI), mean arterial pressure (MAP), heart rate (HR), systemic vascular resistance (SVR), central venous pressure (CVP), mean pulmonary artery pressure (MPAP), left ventricular end-diastolic volume (LVEDV), left ventricular end-systolic volume (LVESV).

Quality assessment / Risk of bias analysis The internal validity and risk of bias of the included studies will be assessed by two independent investigators using the 'Quality Assessment of Diagnostic Accuracy Studies' (QUADAS-2) tool.
Publication bias and small-study effects will be assessed using Egger's test and funnel plot analysis. The certainty of evidence will be assessed with the GRADE systematic approach.

Strategy of data synthesis Data extraction was performed by three independent authors. The data extracted included first author, year of publication, journal, design, blinding of participants, number of centers, sample size, country, mean age, sex, tilt angle, time interval between onset of Trendelenburg position and collection of hemodynamic parameters, and values for the 12 studied outcomes. We will convert the data to the mean ± standard deviation (SD) format if needed.
STATA 17.0 software (StataCorp LLC, Texas, US) will be used to calculate and visualize the results of the meta-analysis. Inter-study heterogeneity will be evaluated using the I-squared (I2) statistic and the Cochrane Q test; declared random-effects model (restricted maximum–likelihood, REML) will be used. The effect sizes for the quantitative data will be expressed in mean difference (MD) format with 95% confidence intervals (CIs). We will follow the Cochrane Handbook guidelines to interpret SMD using rules of thumb for effect size (0.70 = large effect) [https://training.cochrane.org/handbook/archive/v6/chapter-15]. Statistical significance for hypothesis testing will be set at the 0.05 level. Meta-regression using REML model will be performed to assess whether the association between Trendelenburg position and studied outcomes might be affected by covariates such as age, sex, tilt angle, and time interval between the onset of Trendelenburg position and hemodynamic parameters assessment. All covariates will be first tested in a univariate model, all covariates that will be available for most studies will also be considered for a multivariable model.

Subgroup analysis A sensitivity analysis will be performed with additional subgroup analyses comparing conscious patients (awake), those under anesthesia or sedation, and hypovolemic patients in the ICU. We will also consider various tilt angles of Trendelenburg position (≤10°; >10°).

Sensitivity analysis The effect sizes for the quantitative data will be also expressed in standardized mean difference (SMD, Hedges' g) format with 95% CIs. We will use the Cochrane Handbook guidelines to interpret SMDs using rules of thumb for effect size (0.70 = large effect).

Language restriction No language limitations.

Country(ies) involved Russian Federation.

Keywords Trendelenburg position; hemodynamics; systematic review; meta-analysis.

Contributions of each author
Author 1 - Valery Likhvantsev - conceived and designed the analysis, revised the manuscript, wrote the paper.
Email: lik0704@gmail.com

Author 2 - Giovanni Landoni - conceived and designed the analysis, revised the manuscript.
Email: landoni.giovanni@hsr.it
Author 3 - Levan Berikashvili - contributed data and analysis tools, performed the analysis, assessed risk of bias, certainty of evidence rating, wrote the paper.
Email: levan.berikashvili@mail.ru
Author 4 - Petr Polyakov - wrote the paper, performed the analysis.
Email: petrpoljakov01@gmail.com
Author 5 - Mikhail Yadgarov - assessed risk of bias, certainty of evidence rating, wrote the paper.
Email: mikhail.yadgarov@mail.ru
Author 6 - Pavel Ryzhkov - collected the data, assessed risk of bias, wrote the paper.
Email: a.pavelhlw@gmail.com
Author 7 - Georgii Plotnikov - wrote the paper, revised the manuscript.
Email: georgpp@mail.ru
Author 8 - Roman Kornelyuk - collected the data, wrote the paper.
Email: rkornelyuk@mail.ru
Author 9 - Valeriia Komkova - collected the data, wrote the paper.
Email: komkova9654130282@gmail.com
Author 10 - Ivan Kuznetsov - assessed risk of bias, wrote the paper.
Email: rkornelyuk@mail.ru
Author 11 - Anastasiya Smirnova - wrote the paper.
Email: a.smirnova.msmu@gmail.com
Author 12 - Kristina Kadantseva - wrote the paper.
Email: kristina161093@gmail.com
Author 13 - Maria Shemetova - revised the manuscript, wrote the paper.
Email: mshemetova@mail.ru