INPLASY

Diagnostic Accuracy of the Passive Leg Raising test for Fluid Responsiveness in Adult Patients: A Systematic Review and Meta-analysis

INPLASY202420057

doi: 10.37766/inplasy2024.2.0057

Received: 13 February 2024

Published: 13 February 2024

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.

Likhvantsev, V[1]; Berikashvili, L[2]; Kuznetsov, I[3]; Yadgarov, M[3]; Ryzhkov, P[4]; Shemetova, M[5].

ADMINISTRATIVE INFORMATION

Support - Nil.

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

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202420057

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 13 February 2024 and was last updated on 13 February 2024.

INTRODUCTION

Review question / Objective The objective of our study is to assess the prognostic value of the PLR test for determining fluid responsiveness.
(i) population: adult patients.
(ii) intervention (index test or test method): PLR test
(iii) comparator ('gold standard' method): fluid challenge (FC) method for fluid responsiveness assessment.
(iv) outcomes: responders, non-responders, true positive results, true negative results, false positive results, false negative results, sensitivity, specificity, area under the receiver operating characteristic (AUROC), area under the summary receiver-operating characteristic (AUSROC).
(v) study design: prospective cohort studies.

Rationale Hypotension remains a considerable concern in anesthesiology and critical care. Recent clinical guidelines, updated in 2022, for the assessment and management of patients undergoing non-cardiac surgeries highlight the critical role of evaluating fluid responsiveness as an initial step in hypotension treatment. This methodology is increasingly acknowledged as a superior approach for determining the optimal therapeutic strategy.
While various methods exist to assess a patient's response to fluid therapy, many of these methods are associated with limitations. For example, precise assessment of cardiac output variability often requires invasive hemodynamic monitoring techniques. Additionally, tests that involve fluid challenges may lead to unnecessary fluid administration in non-responsive patients, given the irreversible nature of these tests.
Against this backdrop, the passive leg raising (PLR) test emerges as a valuable alternative. This non-invasive and reversible technique effectively mimics temporary autotransfusion by increasing venous return to the heart from the lower limbs through gravitational forces, offering a practical

and safer means to evaluate a patient's fluid responsiveness.
The objective of our study is to assess the prognostic value of the PLR test for determining fluid responsiveness.

Condition being studied Fluid responsiveness is defined as the ability of the left ventricle to increase stroke volume (SV) in response to fluid administration.

METHODS

Search strategy A systematic literature search of studies published from January 01, 2008, until September 28, 2023, was conducted in PubMed, Medline and the Cochrane Central Register of Controlled Trials (CENTRAL) by two independent investigators. Both backward and forward snowballing methods were also used for an exhaustive search (Litmaps service). Language restrictions were not applied.

Participant or population Adult patients (without restrictions on age, sex, race, or ethnicity).

Intervention Index test or test method: PLR test. The PLR test is a bedside assessment used to determine fluid responsiveness. The test involves raising a patient's legs (to at least 45 degrees) to induce gravitational transfer of venous blood from the patient's legs into the central circulation.

Comparator Gold standard' method: The FC method for fluid responsiveness assessment. The FC test is a hemodynamic diagnostic test consisting of the administration of a fixed volume of fluid with the purpose of identifying fluid-responsive patients.

Study designs to be included We included prospective cohort studies.

Eligibility criteria We focused on prospective cohort studies that explored the diagnostic accuracy of the PLR test for fluid responsiveness defined by the FC method. Studies were excluded if they met one of the following criteria: 1) were review articles, case reports or letters to the editors; 2) used the PLR as the 'gold standard' method; 3) used the Trendelenburg position as the 'gold standard' method; or 4) reported no relevant data.

Information sources PubMed, Medline, Cochrane CENTRAL and other databases were obtained from the Litmaps service (Crossref, Semantic Scholar, OpenAlex).

Main outcome(s) The primary outcome for this meta-analysis will be calculated area under the summary receiver-operating characteristic (AUSROC) for the PLR test.

Additional outcome(s) Number of responders and non-responders, reported area under the receiver-operating characteristic (AUROC), sensitivity, and specificity.

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 Three independent authors performed the data extraction. The following data were extracted: 1) general information and patient characteristics, including the first author, setting, sample size, mean age, sex, body mass index (BMI), APACHE II score, baseline cardiac output (CO), cardiac index (CI), stroke volume (SV), type of fluid used, baseline degree of PLR test (head of bed angle), leg elevation angle, and time frame for PLR assessment; 2) information on the index test and 'gold standard', method, parameter, and criterion (cutoff); and 3) outcome data, including the number of responders and non-responders, reported AUROC, sensitivity, and specificity.
We will convert the data to the mean ± standard deviation (SD) format if needed. We will calculate true positive, true negative, false positive, and false negative values using the number of responders and non-responders, sensitivity and specificity.
STATA 17.0 (StataCorp LLC, Texas, US) will be employed for both calculations and visualizations. We will assess interstudy heterogeneity using the I-squared (I^2) statistic and the Cochrane Q test. We will apply a random-effects model (restricted maximum likelihood [REML]). Statistical significance will be set at $p < 0.05$. Univariate meta-regression using the REML model and bubble-plots for reported AUROCs will be performed to assess whether the association between the PLR and fluid responsiveness might be affected by covariates such as age, sex, BMI, baseline CO, CI, SV, and other parameters. The diagnostic accuracy of the PLR test will be evaluated through pooled metrics, sensitivity, specificity, and reported AUROCs with 95% confidence intervals (CIs), along with calculated

AUSROCs, employing the 'midas' module in STATA 17.0.

Subgroup analysis We will conduct subgroup analyses to evaluate the AUSROC by forming the following subgroups: 1) studies utilizing 500 mL of FC; 2) studies utilizing 500 mL of FC with ΔCI and ΔCO as the 'gold standard' parameters; 3) studies utilizing 500 mL of FC with ΔSV and ΔCO as the 'gold standard' parameters; 4) studies utilizing intracardiac hemodynamic parameters (for test method: ΔCO, ΔCI, ΔSV, Δstroke volume index (ΔSVI), ΔSVV [% and absolute change]); and 5) studies utilizing pressure parameters (for test method: ΔPP, ΔMAP, ΔPPV [% and absolute change], and ΔSAP). We will also consider a subgroup of studies with a low risk of bias.

Sensitivity analysis For the sensitivity analysis, we will conduct an analysis of the reported AUROCs, specifically assessing the following subgroups: 1) colloids vs. crystalloids, 2) baseline degree of the PLR test (0° vs 30-45°), and 3) the 'gold standard' criterion (10% vs. 15%).

Language restriction No language limitations.

Country(ies) involved Russian Federation.

Keywords Passive leg raising test; fluid responsiveness; fluid challenge; cardiac output; stroke volume; hemodynamic monitoring.

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 - Levan Berikashvili - contributed data and analysis tools, performed the analysis, certainty of evidence rating, wrote the paper.
Email: levan.berikashvili@mail.ru
Author 3 - Ivan Kuznetsov - collected the data, assessed risk of bias, wrote the paper.
Email: ikuznecov@fnkcrr.ru
Author 4 - Mikhail Yadgarov - performed the analysis, certainty of evidence rating, wrote the paper.
Email: mikhail.yadgarov@mail.ru
Author 5 - Pavel Ryzhkov - collected the data, assessed risk of bias, wrote the paper.
Email: a.pavelhlw@gmail.com
Author 6 - Maria Shemetova - revised the manuscript, wrote the paper.
Email: mshemetova@mail.ru