**Clinical question.**

What is the optimal position for a person in shock? Does elevating the legs improve outcome?

**Is this question addressing an intervention/therapy, prognosis or diagnosis?** This question is addressing an Intervention.

**State if this is a proposed new topic or revision of existing worksheet.** This is a new topic.

**Conflict of interest specific to this question**

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No

**Search strategy (including electronic databases searched).**

- PubMed: “Shock” AND “Posture” as MESH (headings). 162 Hits
- PubMed: “Shock” AND “Position” as non-Mesh. 1251 Hits
- AHA EndNote Master Library: “Shock” 1741 Hits; within Shock “Legs” 25 Hits
- Cochrane database for systematic reviews, Central Register of Controlled Trials, Review of references from articles: “Shock” 35 Hits

**State inclusion and exclusion criteria**

Studies included for further review were directly related to the positioning of subjects and its relation to circulatory status and/or shock. Full articles reviewed included studies related to the elevation of the legs for shock, passive leg raising (PLR), and/or modified trendelenburg. Studies excluded were hits related the “shockwave” and “shock” as it relates to defibrillation and/or cardioversion based upon abstract and keyword review as well as studies related to MAST/PASG or leg counter pressure. Additional study abstracts and full text articles related to the trendelenburg position (head-down tilt) were reviewed for citations and possible inclusion, but were excluded from further consideration if they did not address the posed question.

**Number of articles/sources meeting criteria for further review:**

30 full abstracts were selected for review resulting in the review of 24 full text articles. 12 studies and/or review articles were considered for inclusion. These articles included studies pertaining to passive leg raising and/or the modified trendelenburg positions.

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**Summary of evidence**

**Evidence Supporting Clinical Question**

<table>
<thead>
<tr>
<th>Good</th>
<th></th>
<th>Wong 1989 E</th>
<th></th>
<th>Boulain 2002 E</th>
<th>Teboul 2008 E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair</td>
<td></td>
<td>Wong 1987 E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**Level of evidence**

A = Improved Cardiac Output  
B = Improved Mean Arterial Pressure  
C = Improved Systemic Vascular Resistance  
D = Improved Systolic Blood Pressure  
*Italics = Animal studies*
## Evidence Neutral to Clinical Question

<table>
<thead>
<tr>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Level of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Morgan 1964 E, Terai 1996 E, Delerme, 2007 E</td>
</tr>
</tbody>
</table>

### Level of evidence

- A = Improved Cardiac Output
- B = Improved Mean Arterial Pressure
- C = Improved Systemic Vascular Resistance
- D = Improved Systolic Blood Pressure
- E = Other endpoint

### Italics

- Italics = Animal studies

## Evidence Opposing Clinical Question

<table>
<thead>
<tr>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Level of evidence</th>
</tr>
</thead>
</table>

### Level of evidence

- A = Improved Cardiac Output
- B = Improved Mean Arterial Pressure
- C = Improved Systemic Vascular Resistance
- D = Improved Systolic Blood Pressure
- E = Other endpoint

### Italics

- Italics = Animal studies
**REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:**

**DISCUSSION:**

First Aid providers are taught to elevate the legs of a suspected victim of Shock in theory to return blood volume to the patient's central circulation thus raising cardiac output, systemic vascular resistance, mean arterial pressure and/or stroke volume leading to improved survival. While the evidence is mixed on the effects of leg elevation (passive leg raising or modified trendelenburg) there have been no studies that demonstrates improved patient outcome (survival of event) in the literature. By extrapolation, there is evidence that leg elevation (PLR or Modified Trendelenburg) demonstrates increases in cardiac output (Wong 1989; Wong 1987) and/or blood pressure over limited time frames and as a predictive value for fluid loading (Teboul 2008; Boulain 2002). However, other studies demonstrate that PLR and the trendelenburg position does not produce a "significant" and/or "sustained" autotransfusion effect (Gaffney 1982; Reich 1989; Terai 1996). Additionally, several studies failed to show the effect of PLR or Modified Trendelenburg on Cardiac Output, Mean Arterial Pressure and/or Systemic Vascular Resistance (Gaffney 1982; Ostrow 1994; Delerme 2007). Many studies had limitations as they were conducted using healthy volunteers or normotensive patients. The literature does highlight several concerns with the practice of the trendelenburg position and its negative effects on patients. While not evident in the literature, other concerns in the first aid environment must be discussed. The elevation of the legs for a victim suffering potential pelvic or lower extremities injuries is concerning as these injuries may not be apparent to a first aid provider in the field setting and the elevation of the legs may cause a greater harm. Additionally, the literature suggests that patients placed in the trendelenburg or modified trendelenburg may experience symptoms of nausea, increased pressure in the chest, respiratory compromise and increased intracranial pressure.

**Acknowledgements:**

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**Citation List**


Use of the Trendelenburg position as the resuscitation position: to T or not to T?

Bridges N, Jarquin-Valdivia AA.

The Neurointensive Care Unit, Vanderbilt University Medical Center, Nashville, TN, USA.

Publication Types:
Review
PMID: 16120887 [PubMed - indexed for MEDLINE]


Changes in BP induced by passive leg raising predict response to fluid loading in critically ill patients.

Boulain T, Achard JM, Teboul JL, Richard C, Perrotin D, Ginies G.

Service de Réanimation Médicale, Hôpital de Bicêtre, Faculté de Médecine Paris-Sud, Paris, France. boulain@hotmail.com

PMID: 11948060 [PubMed - indexed for MEDLINE]

Use of the Trendelenburg position by critical care nurses: Trendelenburg survey.

Ostrow CL.

Department of Health Restoration, School of Nursing, West Virginia University, Morgantown, USA.

PMID: 9131195 [PubMed - indexed for MEDLINE]


Effects of Trendelenburg versus passive leg raising: autotransfusion in humans.

Terai C, Anada H, Matsushima S, Kawakami M, Okada Y.

Publication Types:
Comparative Study
Letter

PMID: 8814487 [PubMed - indexed for MEDLINE]


Trendelenburg position and oxygen transport in hypovolemic adults.

Sing RF, O'Hara D, Sawyer MA, Marino PL.

Department of Surgery, Graduate Hospital, Philadelphia.

PMID: 8135435 [PubMed - indexed for MEDLINE]


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Rollheiser EE.

PMID: 3639692 [PubMed - indexed for MEDLINE]


Passive leg raising does not produce a significant or sustained autotransfusion effect.

Gaffney FA, Bastian BC, Thal ER, Atkins JM, Blomqvist CG.

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Research Support, U.S. Gov't, Non-P.H.S.
Research Support, U.S. Gov't, P.H.S.

PMID: 7069801 [PubMed - indexed for MEDLINE]


[Trendelenburg position in hypovolemic shock]

[Article in Chinese]
Sun RL.

PMID: 4492275 [PubMed - indexed for MEDLINE]


Trendelenburg position in hypovolemic shock.

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[Influence of the Trendelenburg position on peripheral and carotid hemodynamics in hemorrhagic shock state]

[Article in Italian]

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PMID: 5741257 [PubMed - indexed for MEDLINE]


Failure of the Trendelenburg position to improve circulation during clinical shock.

Taylor J, Weil MH.

PMID: 6022475 [PubMed - indexed for MEDLINE]


THE EFFECT OF TRENDELENBURG'S POSITION ON BLOOD PRESSURE AND CAROTID FLOW.

GUNTEROTH WG, ABEL FL, MULLINS GL.

PMID: 14200967 [PubMed - indexed for MEDLINE]


EFFECT OF POSITION ON LEG VOLUME. CASE AGAINST THE TRENDELENBURG POSITION.

MORGAN BC, GUNTEROTH WG, MCGOUGH GA.

PMID: 14102941 [PubMed - indexed for MEDLINE]

PLR


Prediction of volume responsiveness in critically ill patients with spontaneous breathing activity.

Teboul JL, Monnet X.

Research Unit EA 4046, Bicêtre Teaching Hospital, Paris-11 University, Le Kremlin-Bicêtre, France. jean-louis.teboul@bct.aphp.fr

Hemodynamic effects of passive leg raising: an echocardiographic study in patients with shock.

Caille V, Jabot J, Belliard G, Charron C, Jardin F, Vieillard-Baron A.

Medical Intensive Care Unit, Centre Hospitalier Universitaire Ambroise Paré, 9, Avenue Charles-de-Gaulle, 92104, Boulogne Cedex, France.

PMID: 18351322 [PubMed - as supplied by publisher]


Ability of pleth variability index to detect hemodynamic changes induced by passive leg raising in spontaneously breathing volunteers.

Keller G, Cassar E, Desebbe O, Lehot JJ, Cannesson M.

Hospices Civils de Lyon, Groupement Hospitalier Est, Department of Anesthesiology and Intensive Care, Louis Pradel Hospital and Claude Bernard Lyon 1 University, INSERM ERI 22, 28 avenue du doyen Lépine, 69500 Bron-Lyon, France.
maxime_cannesson@hotmail.com.

PMID: 18325089 [PubMed - as supplied by publisher]


Fluid and volume monitoring.

Pinsky MR, Brophy P, Padilla J, Paganini E, Pannu N.

Critical Care Medicine, Bioengineering, Cardiovascular Diseases and Anesthesiology, University of Pittsburgh Medical Center, Pittsburgh, PA 15261, USA. pinskymr@upmc.edu

PMID: 18311728 [PubMed - in process]


Passive leg raising.

Monnet X, Teboul JL.

Service de réanimation médicale, Hôpital de Bicêtre, AP-HP, 78 rue du Général Leclerc, 94270, Le Kremlin-Bicêtre, France, xavier.monnet@bct.aphp.fr.

PMID: 18214429 [PubMed - in process]


Functional hemodynamic monitoring and dynamic indices of fluid responsiveness.

Cavallaro F, Sandroni C, Antonelli M.

Department of Emergency Medicine, Unit of Anesthesia and Intensive Care, Cattolica del Sacro Cuore University, Policlinico Universitario 'Agostino Gemelli', Rome, Italy. fabio_cavallaro@yahoo.it
PMID: 18212731 [PubMed - in process]


Volume responsiveness.

Monnet X, Teboul JL.

Medical Intensive Care Unit, Bicêtre University Hospital, Paris-11 University, Le Kremlin-Bicêtre, France.

Publication Types:
  Review

PMID: 17762234 [PubMed - indexed for MEDLINE]


Variations in pulse oximetry plethysmographic waveform amplitude induced by passive leg raising in spontaneously breathing volunteers.


Publication Types:
  Clinical Trial

PMID: 17606088 [PubMed - indexed for MEDLINE]


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Maizel J, Airapetian N, Lorne E, Tribouilloy C, Massy Z, Slama M.

Unite de Reanimation Medicale, Service de Nephrologie, CHU Sud, 80054 cedex 1, Amiens, France.

Publication Types:
  Research Support, Non-U.S. Gov't

PMID: 17508202 [PubMed - indexed for MEDLINE]


Comment in:

Changes in aortic blood flow induced by passive leg raising predict fluid responsiveness in critically ill patients.


Medical Intensive Care Unit, Cochin Hospital, APHP, Université Paris Descartes, 27, rue du Faubourg Saint Jacques, 75679 Paris Cedex 14, France.
aurelie.l@club-internet.fr
Can passive leg raising be used to guide fluid administration?

De Backer D.

Department of Intensive Care, Erasme University Hospital, Route de Lennik 808, B-1070 Brussels, Belgium. ddebacke@ulb.ac.be

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Passive leg raising predicts fluid responsiveness in the critically ill.

Monnet X, Rienzo M, Osman D, Anguel N, Richard C, Pinsky MR, Teboul JL.

Service de réanimation médicale, Centre Hospitalier Universitaire de Bicêtre, Assistance Publique-Hôpitaux de Paris, Université Paris 11, Le Kremlin-Bicêtre, France.

Passive leg raising predicts fluid responsiveness in the critically ill.

Cannesson M, Slieker J, Desebbe O, Farhat F, Bastien O, Lehot JJ.

Department of Anaesthesiology and Intensive Care, Louis Pradel Hospital, Claude Bernard Lyon 1 university, Hospices Civils de Lyon, Lyon, France. maxime_cannesson@hotmail.com

Changes in BP induced by passive leg raising predict response to fluid loading in
critically ill patients.

Boulain T, Achard JM, Teboul JL, Richard C, Perrotin D, Ginies G.

Service de Réanimation Médicale, Hôpital de Bicêtre, Faculté de Médecine Paris-Sud, Paris, France. boulain@hotmail.com

PMID: 11948060 [PubMed - indexed for MEDLINE]


Effects of Trendelenburg versus passive leg raising: autotransfusion in humans.

Terai C, Anada H, Matsushima S, Kawakami M, Okada Y.

Publication Types:
- Comparative Study
- Letter

PMID: 8814487 [PubMed - indexed for MEDLINE]


Does passive leg raising increase cardiac performance? A study using Doppler echocardiography.

Kyriakides ZS, Koukoulas A, Paraskevaidis IA, Chrysos D, Tsiapras D, Galiotos C, Kremastinos DT.

Athens General Hospital, Greece.

PMID: 8077076 [PubMed - indexed for MEDLINE]


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Wong DH, O'Connor D, Tremper KK, Zaccari J, Thompson P, Hill D.

Department of Anesthesiology, University of California, Irvine.

PMID: 2791582 [PubMed - indexed for MEDLINE]


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Trendelenburg position and passive leg raising do not significantly improve cardiopulmonary performance in the anesthetized patient with coronary artery disease.

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Randomized Controlled Trial

PMID: 2702840 [PubMed - indexed for MEDLINE]

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Department of Anesthesiology, University of California, Irvine Medical Center,
Orange.

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Passive leg raising does not produce a significant or sustained autotransfusion
effect.

Gaffney FA, Bastian BC, Thal ER, Atkins JM, Blomqvist CG.

Publication Types:
Research Support, U.S. Gov't, Non-P.H.S.
Research Support, U.S. Gov't, P.H.S.

PMID: 7069801 [PubMed - indexed for MEDLINE]