Myth: The Trendelenburg position improves circulation in cases of shock

Sonia Johnson, BA; Sean O. Henderson, MD

Introduction

In World War I, Walter Cannon, an American physiologist, popularized the use of the Trendelenburg position as a treatment for shock. The Trendelenburg position involves the patient being placed with their head down and feet elevated. This position was promoted as a way to increase venous return to the heart, increase cardiac output and improve vital organ perfusion. A decade later, Cannon reversed his opinion regarding the use of the Trendelenburg position,[1] but this did not deter its widespread use. The Trendelenburg position is still a pervasive treatment for shock despite numerous studies failing to show effectiveness.

The evidence

A MEDLINE search was done using the key words "Trendelenburg" and "Trendelenberg," and the abstract of each article was reviewed. Papers that described clinical trials using the Trendelenburg position in the treatment of hypotension or shock were included in the following review.

There is little information describing use of the Trendelenburg position in the emergency department setting but in a survey of critical care nurses Ostrow[2] found that 99% of respondents had used the Trendelenburg or modified Trendelenburg (only legs elevated) position to treat hypotension. These nurses reported learning about the head-down position through nursing education or from colleagues and physicians. Most believed that it almost always (28%) or sometimes (61%) proved beneficial to patients in shock by increasing blood pressure and cardiac output. Many were aware of its potential adverse effects, including respiratory compromise, increased intracranial pressure and vasodilation.

Prospective studies

In a 1967 prospective study, Taylor and Weil tested the effectiveness of the Trendelenburg position in 6 hypotensive patients in clinical shock and 5 normotensive controls.[3] In 9 of the 11 of patients, Trendelenburg positioning was ineffective, causing reductions in systolic, diastolic and mean arterial pressures. These authors noted that, in the head-down position, the viscera weigh down the diaphragm and compromise lung volumes. They also suggested that patients were at higher risk of cerebral edema, retinal detachment and brachial nerve paralysis.[3]

In 1994, Sing and colleagues[4] assessed the impact of the Trendelenburg position on oxygen transport in 8 hypovolemic postoperative patients and found that it was associated with higher mean arterial blood pressure but not with improved cardiac output. Therefore, despite increases in blood pressure and left ventricle filling, there do not appear to be changes in tissue oxygenation during body tilting.[4,5]

In 1985, Bivins and coworkers[6] studied the effect of the Trendelenburg position on blood distribution, finding that only 1.8% (99% confidence interval, –1.3% to 4.7%) of the total blood volume was displaced centrally when normovolemic patients were placed in the head-down posi-

From the Department of Emergency Medicine, Keck School of Medicine of the University of Southern California, Los Angeles, Calif.

Received: July 23, 2003 ; final submission: Aug. 22, 2003; accepted: Aug. 22, 2003

This article has been peer reviewed.

Can J Emerg Med 2004;6(1):48-9

tion. They concluded that the autotransfusion effect produced by Trendelenburg positioning was small and unlikely to have an important clinical effect.[6]

Sibbald and cohorts investigated the effect of the Trendelenburg position on systemic and pulmonary hemodynamics in 76 critically ill patients (61 normotensive and 15 hypotensive) with acute cardiac illness or sepsis.[7] In the normotensive group there was no change in pre-load or mean arterial pressure, but cardiac output increased slightly. In hypotensive patients there was no increase in preload or mean arterial pressure, but cardiac output decreased, suggesting that Trendelenburg positioning may be detrimental. These authors, like others, concluded that there were no demonstrable beneficial hemodynamic effects in hypotensive patients.[1,3,7]

Trendelenburg position versus passive leg raising

Reich and coworkers compared the Trendelenburg position to passive leg raising in 18 hypotensive patients with coronary artery disease. Trendelenburg positioning was associated with higher mean arterial pressure (82 mm Hg v. 77 mm Hg; $p < 0.05$) and cardiac output (4.53 L/min v. 4.24 L/min; $p < 0.05$); however, the adverse effects outweighed the benefits because both interventions stressed the right ventricle and led to deterioration of pulmonary function.[8]

Terai and colleagues performed a similar study comparing the autotransfusion effect of the Trendelenburg position and passive leg raising in 8 healthy adult males. In this study both positions increased left ventricular filling, stroke volume and cardiac output, but the effects were transient and returned to baseline within 10 minutes. These authors suggested that both positions might be beneficial; however, given the small sample size and the use of healthy volunteers rather than hypovolemic patients, these conclusions are questionable.[9]

Conclusion

The Trendelenburg position is taught in schools and on the wards as an initial treatment for hypotension. Its use has been linked to adverse effects on pulmonary function and intracranial pressure. Recognizing that the quality of the research is poor, that failure to prove benefit does not prove absence of benefit, and that the definitive study examining the role of the Trendelenburg position has yet to be done, evidence to date does not support the use of this time-honoured technique in cases of clinical shock, and limited data suggest it may be harmful. Despite this, the ritual use of the Trendelenburg position by prehospital and hospital staff is difficult to reverse, qualifying this as one of the many literature resistant myths in medicine.

Competing interests: None declared.

References

1. Martin JT. The Trendelenburg position: a review of current slants about head down tilt. AANA J 1995;63:29-36.
2. Ostrow CL. Use of the Trendelenburg position by critical care nurses: Trendelenburg survey. Am J Crit Care 1997;6:172-6.
3. Taylor J, Weil MH. Failure of the Trendelenburg position to improve circulation during clinical shock. Surg Gynecol Obstet 1967;124:1005-10.
4. Sing RF, O'Hara D, Sawyer MA, Marino PL. Trendelenburg position and oxygen transport in hypovolemic adults. Ann Emerg Med 1994;23:564-7.
5. Terai C, Anada H, Matsushima S, Shimizu S, Okada Y. Effects of mild Trendelenburg on central hemodynamics and internal jugular vein velocity, cross-sectional area, and flow. Am J Emerg Med 1995;13:255-8.
6. Bivins HG, Knopp R, dos Santos PA. Blood volume distribution in the Trendelenburg position. Ann Emerg Med 1985;14:641-3.
7. Sibbald WJ, Paterson NA, Holliday RL, Baskerville J. The Trendelenburg position: hemodynamic effects in hypotensive and normotensive patients. Crit Care Med 1979;7:218-24.
8. Reich DL, Konstadt SN, Hubbard M, Thys DM. Do Trendelenburg and passive leg raising improve cardiac performance? Anesth Analg 1988;67:S184.
9. Terai C, Anada H, Matsushima S, Kawakami M, Okada Y. Effects of Trendelenburg versus passive leg raising: autotransfusion in humans. Intensive Care Med 1996;22:613-4.

Correspondence to: Dr. Sean O. Henderson, Department of Emergency Medicine, Keck School of Medicine, LAC+USC Medical Center, Unit #1, Rm. 1011, 1200 N State St., Los Angeles CA 90033; 323 226-6667, fax 323 226-8044, sohender@usc.edu