October 2015-Rapid Review Evidence Summary

McGill University Health Centre: Division of Nursing Research and MUHC Libraries

What evidence exists that describes whether the Trendelenburg and/or modified Trendelenburg positions are effective for the management of hospitalized patients with hypotension?

This report aims to summarize the best available evidence around the use of the Trendelenburg and/or modified Trendelenburg to improve hemodynamic parameters in hospitalized patients with hypotension.

Key Messages:

- The Trendelenburg position (TP) is defined as a body tilt where the head is lower than the body or legs in the supine position. The modified Trendelenburg position (mTP) is when the head is level with the body and legs are passively raised in the supine position.
- The practice claims to increase venous return to the heart and therefore cardiac output by shifting the intravascular volume from the lower extremities. It is used as an immediate intervention to improve hypotension and hypovolemic shock.
- The studies reviewed on the TP and mTP for hypotension are considered low levels of evidence, but of moderate quality. No systematic reviews were found. Specifically:
    - Since 2005, five articles reviewed the evidence on the physiological effects of the TP or mTP for hypotension and hypovolemic shock. The reviewed studies were mainly observational or quasi experimental with small sample sizes that varied from healthy volunteers to critical inpatients.
    - Three small randomized controlled trials (RCTs) were found investigating the TP on hypotension during anesthesia in healthy adult and pediatric populations.
    - In all the studies, the TP was administered in different ways and varied in degree of head tilt or degree of leg lift and duration of the intervention. In most cases, the TP and mTP were not clearly distinguished.
- The overall trend in the literature suggests that the TP and mTP are not effective for the treatment of hypotension or hypovolemic shock in hospitalized patients.
    - In some reviewed studies, participants placed in the TP had an increase in mean arterial pressure, but this effect was small and transient.
    - In some reviewed studies, the TP was shown to have deleterious effects and caused decreases in cardiac and pulmonary function, and increases in intracranial pressure and discomfort.
    - Specific patient populations are considered at increased risk of the negative effects, specifically obese patients, those with existing right ventricular or neurological dysfunction and patients with brain injuries.
    - None of the studies recommended the use of the TP in practice. One study recommended that the mTP could be an alternative, but the evidence remains unclear and may create confusion.
- Surveys demonstrate that nurses continue to use the TP to improve hypotension and shock in their daily practice and harbor beliefs about its positive effects.

Who is this summary for?
This summary is presented to Lisa Frick, NPDE and Nancy Dezeuw, RN as finalists in the Dinosaur Contest.

Information about this summary:
This report covers a broad collection of literature and evidence sources with a search emphasis on systematic reviews.

This summary includes:
Key findings from a broad collection of recently published literature and evidence sources.

This summary does not include:
Recommendations, additional information, or detailed description of the interventions in the studies.

Contents:

1. Background:

The Trendelenburg position (TP) is defined as "a position in which the head is low and the body and legs are on an inclined or raised plane" [2] and is traditionally being used to manage hypotension and hypovolemic shock. The intervention is named after a German surgeon, Dr. Friedriech Trendelenburg who placed his patients with their heads down and elevated body to shift the pelvic organs upwards for better visualization during surgery [3]. In World War I, a physiologist introduced this position as a way to treat shock by assuming that gravity would increase venous blood return to the heart, increase cardiac output and improve blood flow to the vital organs. This concept is termed "autotransfusion"[2]. TP has since been widely used in healthcare although the physiological effects, benefits and potential harm caused by the intervention were questioned as early as the 1960s. A modified TP (mTP) which consists of a passive leg raise in a supine position was previously recommended as a safer and more effective way of improving venous return most notably in CPR guidelines [4]. The updated guidelines from the American Heart Association on CPR and Emergency Cardiovascular care has since removed the recommendation stating that there is a significant knowledge gap for the mTP use in shock [5]. Despite this, even today, many nurses report using the TP as an immediate action in response to hypotension or shock and most believe that it is beneficial, despite acknowledging that it may cause deleterious effects ([6] & [7]). Adding to the confusion in practice, some evidence based reports continue to recommend the mTP for treatment of hypotension (e.g. Joanna Briggs Institute management of hypotension in patients undergoing chemotherapy [8]; UptoDate treatment of acute intradyalitic hypotension [9] but with no accompanying references for support.

This rapid review will present summaries of the best available evidence with regards to the TP and mTP for hypotension in hospitalized patients. Detailed search strategies were developed by an experienced librarian (specific search terms are available upon request). Sources included: Medline via OvidSP, Embase via OvidSP, and CINAHL Complete via EbscoHost. Search concepts included subject headings and text words and the search date was June 15th, 2015. Duplicate titles, articles that were out of scope, and studies with poor or poorly described methodology, as well as articles focusing on orthostatic hypotension were excluded by the Evidence informed Decision Making-Advisor (EIDM-A). Additionally, JBI Connect and UptoDate were also searched by the EIDM-A for background documents. The analysis of studies and the report were prepared by the EIDM-A and reviewed by the librarian. It is important to note that no systematic reviews were found on this topic.

The studies reviewed were mainly literature reviews or research briefs and are considered low levels of evidence, but of moderate quality from 2005-2015, (with 2 articles from 1997). Some RCTs were reviewed here but are specific to investigating the TP during induction of anesthesia in surgical patients. A list of all the articles found and reviewed is available upon request (sonia.castiglione@muhc.mcgill.ca).

Levels of Evidence (adapted from OHRI KTA Evidence Summary document)

Each piece of evidence presented in this summary is assigned a level.

This assignment is based on the evidence being presented and not on the claim made by the authors.

- **Platinum:** Systematic reviews and meta-analysis
- **Gold:** Randomized-controlled trials
- **Silver:** Observational studies (non-randomized trials, case-control, time-series, cohort studies, case series, literature reviews, qualitative studies.)
- **Bronze:** Expert committee guidelines, reports or opinions, commentary or editorials.
- **Level of evidence** cannot be determined.

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2. Summary of Findings:

a. Sources that are directly relevant to question

A 2012 literature review reported on the physiological effects of the Trendelenburg position and/or the modified Trendelenburg specifically on hypotension and cardiac performance. 25 mostly small observational studies were included in the review that spanned human as well as animal subjects, with varied populations from healthy volunteers to acute or critical care in-patients. In addition, the Trendelenburg position was administered differently in each study, where the head-down tilt ranged from 10^{o}-30^{o} and the modified Trendelenburg passive leg raise from 45^{o}-60^{o}, and was maintained from 1-30 minutes. Overall, the physiological effects described by the studies demonstrated that there was no benefit of the Trendelenburg positioning in improving hypotension, cardiac output or index. The effects were often transient, and in some small studies, a negative impact on oxygenation was identified, especially in patients with specific conditions such as coronary artery disease, obesity and neurological impairments. The Trendelenburg position is also reported to be poorly tolerated by patients due to discomfort. The authors claim that the evidence is not robust but leads us to question the tradition in practice. [10]

In 2011 the evidence around several common nursing practices were discussed in an effort to dispel traditional care beliefs and encourage practice changes. A table was provided to consolidate the physiological effects of the Trendelenburg position that included references to the supporting evidence (see Table 1). It reports that the use of the Trendelenburg position for hypotension and shock dates back to the 1960s where the head-down tilt position was least favorable and in some instances can worsen the condition in humans. A number of limitations of the literature were described, including the heterogeneity between sample populations, small sample sizes, range in degree of head-down positioning and length of time in the position, as well as the differing end point measurement. The authors conclude that despite the limitations in the research, the evidence "does not show a demonstrated benefit of the Trendelenburg position for patients with hypotension and/or hypovolemic shock" and can be associated with deleterious effects. [1]

Table 1 from Flynn Makic et al, 2011 [1]
Physiological Effects of Trendelenburg positioning in hypotensive patients.

Cardiovascular[21-27]
Slight increase in mean arterial pressure
No increased preload
Dilated right ventricle
Decreased right ventricular ejection fraction
Decreased cardiac output
Increase in systemic vascular resistance
Pulmonary[21,26,28,29]
Reduced vital capacity
Increased work of breathing
Decreases in Pao_2
Increases in mechanical impedance of lung and chest wall
Decreased tidal volume
Decreased lung compliance
Increases in $Paco_2$
Tissue perfusion[27]
No change in oxygen delivery
No change in oxygen extraction
No change in oxygen consumption
Gastrointestinal[26,28,29]
Cephalad shift of abdominal contents
Increased abdominal pressure
Impaired diaphragmatic function
Impeded lung expansion
Neurological[17,24,30-32]
Possible increase in intracranial pressure associated with increase in central venous pressure
Distention of internal jugular vein

- *A 2010 review briefly reviewed the evidence on the use of the Trendelenburg position for adult patients with hypotension. Five studies were found to be relevant and summarized. The studies were a mix of observational and non-randomized controlled trials, all with small sample sizes and a variety of aetiologies. The author did not provide any information on how the Trendelenburg was administered and therefore may have also been performed differently in these studies. Although they were varied significantly, they all concluded that the Trendelenburg did not show any benefit on cardiac output. The author concludes that the Trendelenburg is not recommended for practice with these patients. [11]*

- *A 2007 literature review summarized five quasi-experimental studies that described the effect of the Trendelenburg position or the modified Trendelenburg position on a number of outcomes including hemodynamic parameters, and lung function and mechanics. The studies differed greatly in sample characteristics (healthy vs surgical populations), Trendelenburg position degree of tilt, passive leg lift only) and all had small sample sizes. The authors concluded that there was no overwhelming support for the use of these positions for improvement of hypotension. In some studies, when cardiac parameters improved with the Trendelenburg position, it was brief and lead to hemodynamic deterioration if continued. In addition, they identified populations at higher risk of negative consequences when in the Trendelenburg position, including obese, those with compromised right ejection fraction, pulmonary disorders or head injuries. The authors caution against the use of the Trendelenburg position as a treatment for hypotension or acute shock until future large sample studies are conducted for efficacy. [2]*

- *A 2005 article reviewed the evidence on the use of the Trendelenburg or modified Trendelenburg position for resuscitation of hypovolemic shock or hypotension. They summarized eight peer review articles, two medical textbooks and the American Heart Association's 2002 published Guidelines for Cardioplumonary Resuscitation. Though a systematic review was not completed, they found that overall there was an absence of strong evidence to support the practice of Trendelenburg or modified Trendelenburg for hypovolemia or hypotension. Overall, the studies represented a low level of evidence, with large variations in the population of study and the interpretation of the Trendelenburg position.*

The article reported that the reviewed studies did not report any deleterious effects in using the Trendelenburg. The authors recommend the "judicious use of the Trendelenburg position" in practice until further evidence can demonstrate its benefits." [3]

b. Use of Trendelenburg for improvement of hypotension during general anesthesia

✳ *A 2011 controlled trial randomized 40 elective adult cardiac surgery patients to head-down tilt at 15^{o} until skin incision versus supine position for management of hypotension during general anesthesia. An improvement in systolic blood pressure was seen in the first two minutes, but the effects were minimal and transient. Otherwise a similar improvement was seen in both groups throughout the rest of the 10 minute period. However, a significantly less number of vasopressor administrations and total dosages were used in the head-down tilt group. The authors concluded that the head-down tilt position "is effective in the management of hypotension after the induction of general anaesthesia in patients" undergoing cardiac procedures. Adverse effects were neither measured nor noted, specifically with regards to respiratory function. [12]*

✳ *A 2006 randomized controlled trial investigated whether the 20^{o} head-down tilt Trendelenburg position used for five minutes following the induction of healthy children undergoing surgery affected hemodynamic parameters compared to the supine position. Two similar groups of 15 children were compared using impedance cardiography to measure changes in hemodynamic parameters. Heart rate and end-tidal carbon dioxide (to provide information on respiratory function) were both significantly lower in the Trendelenburg group but the effects were not lasting. The authors concluded that during "IV induction using propofol and fentanyl, there was no clinical significant attenuate of hemodynamic changes with the Trendelenburg position." [13]*

✳ *A 1997 randomized controlled trial measured the effect of a 10^{o} head-down tilt on the incidence of hypotension during spinal anesthesia in healthy women undergoing elective caesarean. Although the sample size was small (17 women randomized to each group, Trendelenburg or supine), the results showed no effect on the "incidence or magnitude of hypotension." The study did not report any adverse events. [14]*

Additional sources:

✸ *A 1997 study surveyed 494 members from the American Association of Critical Care Nurses on the use of the Trendelenburg positions and the beliefs about their efficacy in practice. 99% responded positively to having used the Trendelenburg position and 80 % of these believed that it always or sometimes improved hypotension. The authors point out that the results of the survey provided evidence that "tradition-based therapy still underlies some interventions used in the care of critically ill patients" despite the lack of support in current research. [6]*
(Note: the full text article was not available; therefore the description is based on the published abstract. The article was cited by others reviewed in this document).

✪ *A 2015 Research brief on current Nursing Practices informally surveyed 2, 356 nurses on whether the Trendelenburg position improved blood flow to the heart and brain for patients experiencing*

hypotension or shock. Half of the responds believed that the rational was indeed accurate. In addition, they state that most studies do not show lasting benefits of the practice and in fact can cause harm in certain populations, including obese and traumatic patients. The authors conclude, based on the evidence of other research briefs, to "stop using [the] Trendelenburg position to manage hypotension and shock." They instead recommend a modified Trendelenburg. [7]

✪ *A 2013 practice brief generally described the evidence of the use of Trendelenburg position to treat hypotensive episodes. The article describes research dating back to 1960 that indicates the risk of harm when using the position. Specifically, they refer to the engorgement of the right ventricle, complications with lung function, potential for retinal detachment and cerebral edema. Although no specific studies were mentioned in this article the authors conclude that there is no evidence to support the Trendelenburg, but do advocate for the modified Trendelenburg as a method to improve blood pressure without the added negative consequences. [15]*

✳ *A 2011 randomized trial compared 2 acceptable protocols for treating exercise-associated postural hypotension in adult athletes at high endurance race events. 28 athletes were randomized after receiving the diagnosis to either the OT group that involved raised buttocks and legs to 30^{o} and oral fluids, or the IV group where patients were placed in the supine position and were administered IV fluids. The results demonstrated no hemodynamic differences between groups and within groups at admission and discharge. As well, there was no difference in time to discharge with either group. The authors also report that that total volume of fluid received was significantly less in the OT group during the stay. The authors conclude that "the results of the study show that time to discharge following EAPH is the same whether an athlete is given a large volume of IV fluid or is treated in the Trendelenburg position with smaller amounts of oral fluids." The small sample size and major differences in the protocols make it difficult to conclude whether the Trendelenburg was the major factor in influencing the time to discharge. [16]*

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3. **References:**

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