Relationship between Trendelenburg tilt and internal jugular vein diameter

S Clenaghan, R E McLaughlin, C Martyn, S McGovern, J Bowra

OBJECTIVE
To evaluate the relationship between Trendelenburg tilt and internal jugular vein (IJV) diameter, and to examine any cumulative effects of tilt on the IJV diameter.

METHOD
A statistical analysis before the study predicted that 20 healthy volunteers would be required for sufficient power, and compared favourably with other similar studies. The procedure was carried out by a single examiner (SC) using healthy volunteers selected at random. The subjects had no history of neck problems or previous IJV cannulation.

RESULTS
We recruited a total of 20 subjects (10 men, 10 women; age range 22–57 years). Clear ultrasound images were obtained and no anatomical anomalies were encountered.

DISCUSSION
In the ED, patients who require emergent central venous cannulation are those in need of rapid infusion of fluids or drugs, or monitoring of central venous pressure because of cardiovascular instability. Cannulation in such patients is often difficult (for example, due to intravascular depletion) and may have an increased risk of complications such as failed cannulation, arterial puncture, haematoma, and pneumothorax.

Abbreviations: ED, emergency department; IJV, internal jugular vein; NICE, National Institute for Clinical Excellence
reduce the rates of complication and improve the rate of cannulation success. In the absence of ultrasound guidance most clinicians would use Trendelenburg positioning, though this can be poorly tolerated and associated with increased complications (such as risk of raised intracranial pressure) in some patient populations.3–7

Our study demonstrates that 10° Trendelenburg significantly increases UV diameter in healthy adults, although this did vary greatly between individuals, with an actual distension of between 1.2 mm and 7.0 mm. There was a nonsignificant trend to further increases with greater angles of tilt, maximal at 25°; however, this increase was relatively small, with a mean of 1.2 mm. Larger studies may demonstrate significant increases at angles of tilt greater than 10°, although our subjects reported discomfort with angles greater than 10°. Furthermore, most ED trolleys tilt only to 10–15°. Hence, greater angles of tilt are not only impractical in unstable patients but may also be of little benefit.

Armstrong et al.,3 Verghese et al.,6 and others9–12 have demonstrated that various manoeuvres in increasing UV diameter in healthy adults. The Valsalva technique is particularly effective and a combination of techniques has been advocated. However, the Valsalva technique is often impractical in critically ill patients.

In the present study, the effect of respiratory cycle on UV diameter was overcome by measuring maximal diameter over three respiratory cycles for each subject at each angle of tilt. Interobserver variability was eliminated because only one researcher carried out the measurements.

CONCLUSION

Increasing the degree of Trendelenburg tilt increases the lateral diameter of the UV. Even a 10° tilt is effective. The cumulative effect of tilt (that is, the stretching effect of the previous angle) is not significant. Ultrasound guided cannulation is ideal but in its absence Trendelenburg tilt will increase UV diameter and may improve the chance of successful cannulation. While 25° may achieve optimum distension, this is impractical and may be detrimental. There was no benefit in tilting the patient to a steeper angle prior to settling at a lesser angle to carry out the procedure. There did not appear to be any “stretching” of the UV to allow greater distension at a lesser angle.

Trendelenburg tilt is used in UV cannulation to optimise conditions for successful cannulation. Our results show that UV distension shows marked inter-subject variability and that minimal increases in diameter may occur. Although this may be statistically significant, is it clinically significant? It is difficult to say. This study was not designed to assess the success of cannulation, but it highlights a significant problem with blind cannulation in that we do not know, in an individual patient, how the UVJ will respond. What we can do is provide optimum conditions to facilitate cannulation.

We recommend that practitioners use 10° of tilt when attempting central venous cannulation in the absence of real time ultrasound. However this technique assumes normal anatomy and therefore real time ultrasound is preferable.

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