Should all patients be placed head down for internal jugular vein catheter insertion?

Traditional teaching states that all patients undergoing internal jugular vein catheterization should be placed in the head-down position so that the site of cannulation is below the level of the right atrium. The resulting internal jugular vein distension allows easier identification of the vessel and reduces cannulation-associated complications (carotid puncture, pneumothorax or venous air embolism).

Vessel identification

The degree of internal jugular vein distension depends on the central venous pressure, which is affected by hydration status, respiratory mechanics and body position. Hypovolaemia can decrease central venous pressure. Central venous pressure decreases with spontaneous inspiration, but increases with positive pressure mechanical inspiration and application of positive end expiratory pressure. A head-up position accentuates the normal decrease in central venous pressure that occurs during spontaneous inspiration, whereas a supine or head-down position increases central venous pressure.

Techniques that increase the internal jugular vein size should help reduce the risk of carotid puncture or pneumothorax. This is particularly important when using the landmark technique for catheter insertion. Ultrasound scanning (National Institute for Clinical Excellence, 2002) allows identification and size assessment of the internal jugular vein – perhaps negating the need for head-down positioning.

Venous air embolism

Venous air embolism is a potentially life-threatening complication of internal jugular vein catheter insertion. Venous air embolism development depends upon an open communication between the atmosphere and the vein and a pressure gradient (vessel lumen:atmospheric pressure) enabling entrainment of air. Both the size of the communication and the pressure gradient determine the volume and rate of air that is entrained. Volumes as low as 100 ml can be fatal (Yeakel, 1968). Flanagan et al (1969) calculated that 100 ml could be entrained via a 14G cannula in 1 second with a pressure gradient of only 5 cmH_2O.

The pressure gradient is affected by the relative position of the needle entry point in relation to the right atrium, hydration status, mode of ventilation and central venous pressure. The head-down position ensures the needle insertion point is below the right atrium and helps maintain a positive central venous pressure and therefore a positive pressure gradient. Both hypovolaemia and spontaneous inspiration can cause decreased intravascular pressure and accentuate entry of air into the vessel. Using positive pressure ventilation significantly reduces the risk of venous air embolism. If venous air embolism occurs during spontaneous respiration a 10% obstruction to the pulmonary circulation can cause a gasp reflex which reduces right atrial pressures and causes further air entrainment. Under controlled ventilation with muscle paralysis this reflex is eliminated and so air entrainment is better tolerated (Palmon et al, 1997).

Use of ultrasound to visualize the vessel and assess degree of collapse helps minimize the risk of a negative pressure gradient and subsequent venous air embolism. However, upon cannulation, blood flow in the vessel can cause sub-atmospheric pressures to develop within the needle (Bernoulli principle) risking air entrainment.

Head-down position: disadvantages

Head-down positioning may be detrimental to patients with raised intracranial pressure, pulmonary hypertension, poor ventricular function, critical hypoxia or obesity. Brederlau et al (2004) studied 64 patients with raised intracranial pressure and found no difference in access time, puncture attempts and complications between internal jugular vein insertion using the landmark technique in the supine position and using an ultrasound-guided technique in the 30° head-up position. The risks of venous air embolism were minimized in the head-up group by only including patients with central venous pressure >12 mmHg and positive end expiratory pressure >10 cmH_2O.

Conclusions

The position used for internal jugular vein cannulation should reflect a balance between the risks of insertion and the detrimental effects of the position on the patient. The risk of venous air embolism during internal jugular vein cannulation is small and reduced even further when patients are ventilated. Ultrasound-guided needle placement eases vessel identification, assesses the vessel's filling and reduces the risk of arterial puncture – rendering the head-down position redundant in most patients.

If a supine or head-up position is chosen, then complications of cannulation can be minimized by avoiding hypovolaemia, using ultrasound, using a small calibre needle and using positive pressure ventilation or positive end expiratory pressure. **BJHM**

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