Air Embolism Arising from Burr Holes

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Venous air embolism is a well-recognized complication of posterior fossa exploration of a patient in the sitting position.1-5 The usual sources of air entry are the open venous channels from the suboccipital craniotomy. The following two cases demonstrate that burr holes should also be considered possible sources of air.

**Report of Two Cases**

Patient 1. A 6-year-old boy was scheduled for a posterior fossa craniotomy in the sitting position for a cerebellar astrocytoma. Catheters were inserted into the right atrium and dorsalis pedis artery and heart sounds monitored with the ultrasonic doppler. A right parietal burr hole was made to facilitate cannulation of the lateral ventricle. The burr hole was sealed with bone wax and a wet cotton plug. Approximately 45 min later, a suboccipital incision was made. As the tumor was being excised, we heard changes in the sounds of the doppler; small amounts of air were then aspirated from the right atrial catheter. The wound was flooded with saline solution, positive airway pressure applied, and the nitrous oxide turned off. Because no further sign of air entrament occurred and no source of air entrament was found, the operation was continued. Shortly after this, air was again detected by changes in the sounds of the doppler and confirmed by right atrial aspiration. Arterial blood pressure was unobtainable and heart sounds disappeared. Cardiopulmonary resuscitation was instituted and the patient was returned to the supine position. Phenylephrine, 0.1 mg, was given twice intravenous, 1 min apart, resulting in an arterial blood pressure of 100 torr. The vital signs stabilized without further impairment of cardiovascular function. The patient was again placed in the sitting position and the operation was continued. Again no venous bleeding could be identified by the surgeon. Thirty minutes later, air was detected by changes in the sounds of the doppler and confirmed by right atrial aspiration. The wound was flooded with saline solution, and no venous bleeding could be identified when the venous pressure was increased. At this point the burr hole was considered as a possible site of air entrament. The ventriculostomy catheter was removed and the skin over the burr hole closed. No further episode of air entrament occurred, and the rest of the operation and recovery were uneventful.

Patient 2. A 57-year-old man had a posterior fossa exploration in the sitting position for excision of a right acoustic neuroma. Catheters were inserted into the right atrium and right radial artery and heart sounds were monitored with the ultrasonic doppler. A parietal burr hole was placed for a lateral ventriculostomy catheter. The bone edges were not sealed with bone wax but the hole was plugged with wet cotton. Approximately 45 min later, the suboccipital craniotomy was performed. The tumor was being excised when changes in the doppler were heard; 5-10 ml air were aspirated from the right atrium. The arterial systolic pressure dropped from 120 to 75 torr, but quickly returned to baseline after positive airway and jugular pressures were applied and the nitrous oxide turned off. No venous bleeding site was identified. Changes in the doppler sounds occurred repeatedly over the next 3 hours, and a total of 150 ml air was aspirated from the right atrial catheter. Each time air was aspirated from the right atrial catheter, positive pressure was applied and the source of air sought, but none was found. The arterial pressure was maintained, so the operation was continued. After considerable discussion that the burr hole might be the source of the air because there was no temporal relationship between the doppler sound changes and the manipulation of the tumor, the ventriculostomy tube was removed and the skin over the burr hole was closed. About 15 min after the burr hole was closed, a small amount of air was aspirated from the right atrial catheter following doppler sound changes during manipulation of the tumor. After that, no more air was detected. The rest of the procedure progressed without difficulty, and recovery was uneventful.

**Discussion**

The potential for venous air1-5 or paradoxical arterial embolization8 exists any time the surgical wound is above the level of the heart, producing a subatmospheric pressure in the open veins. The usual sources of air are the suboccipital plexus of veins with branches held open by fascial attachments to the cervical muscles, occipital emissary veins, dural sinuses, diploic veins, and veins in the tumor itself.7,8 In both of our patients, air was assumed to be entrained in the area of the suboccipital incision. The burr hole was not considered...
Fentanyl-associated Delirium in Man

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Berryhill et al.,† recently reported a case in which a patient experienced a dramatic stimulatory effect after the intravenous administration of morphine sulfate. We recently observed a patient who showed hyperexcitability after intravenous administration of fentanyl.

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REFERENCES

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