SHOULD WE ABANDON THE "LOSS OF RESISTANCE TO AIR" TECHNIQUE DURING EPIDURAL ANAESTHESIA?

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INTRODUCTION

In 1933 Gogliotti performed epidural anaesthesia using the loss of resistance (LOR) technique with saline. However, during the subsequent years this was replaced by air, due to problems with the plunger within the glass syringes as this might be blocked easier with saline than air ("sticky syringe").

Both media had their defenders and refuters, but mainly since 1990 on average two cases per year have been reported describing complications following the use of air. Also the present review will start with a case presentation. The higher complication rate with air has also resulted in a gradual switch to saline, although any switch, also from air to saline, may result in an initial higher failure and/or complication rate. Several overviews focused on the disadvantages of air.1-4 The most complete and actual review was published by Shenouda in 2003.5

CASE REPORT

A 34 year old nulliparous parturient received an epidural for relief of her labour pain. The resident performing the analgesic procedure used air to detect the epidural space. The dura was punctured inadvertently and approximately 5 mL of air were injected intrathecally. The epidural was successfully repeated at another interspace. Within the first hour after delivery the patient complained of a terrible neck- and headache, which did not become worse in the supine position. Treatment was initiated with paracetamol.

The next day, as complaints persisted, a CT scan was performed showing large air bubbles. (Fig. 1) The headache became progressively position dependent. As the attending anaesthetist assumed that the headache...
evolved towards a classical post dural puncture headache, an epidural blood patch was performed using 15 mL of blood. This partly alleviated her symptoms, but she reported persisting headache even in the recumbent position, visual disturbances and lightheadedness. These complaints were not thought to be the result of CSF leakage, but could not be evidenced by technical examinations.

She stayed in the hospital for 8 days (twice the average stay after an uncomplicated delivery) receiving conservative treatment with paracetamol and NSAID’s. When leaving the hospital she claimed at least an 80% improvement of her symptoms. She was called one week after discharge which revealed complete disappearance of her complaints.

**Figure 1.** CT-scan of the patient receiving 5 mL of air inadvertently during a loss of resistance to air technique. The recording was 24 hours after the epidural and no second evaluation was suggested. Collections of air are clearly observed bilaterally.

**DISCUSSION**

It can be imagined that several problems may arise when selecting air to detect the epidural space especially when some conditions (unexpected, obvious or to be anticipated) are obstructing an uneventful course. Possible complications, whether or not in a clear causal relationship with the use of air, are listed in Table 1.

**Pneumocephalus**

Headache due to pneumocephalus following a dural tap is the most frequently reported complication with air as the medium to detect the epidural space. This headache is experienced quite immediately and is mostly not related to position. Most of the time it lasts less than 24 hours although some cases may only resolve after days. The use of 100% oxygen, even hyperbaric oxygen therapy may be helpful. The final outcome is good and sequelae are rare, as shown in Figure 1.

CT-scanning may evidence the presence of air in the ventricles, Silvian fissura, basilar cisterns and subarachnoid spaces. Patients at risk for pneumocephalus are those where there is difficulty to find the epidural space at the first attempt, but those requiring an epidural blood patch may theoretically also have a greater risk because a dural hole is already present. However in a large series of blood patches for which the epidural space was detected with air, Vercauteren et al, did not find any symptom compatible with pneumocephalus.

Differential diagnosis may be difficult if the headache lasts longer than 24 hours because patients will also experience the classical postdural puncture headache (PDPH). It is also remarkable that in many cases rather large amounts of air have been used although as little as 3 mL should be sufficient.

**Are there more taps with air?**

In my opinion, one of the most important reasons why air may be injected in the subarachnoid space is lack of experience or a wrong technique. Doing a loss of resistance technique is quite different with saline than with air. With saline the finger pushing constantly on the plunger will belong to the hand advancing the epidural needle while the other hand

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**Table 1.** Complications described possibly related to a loss of resistance to air when detecting the epidural space in anesthetic practice.

1. Pneumocephalus
2. Higher incidence of technical problems
   a. More dural taps
   b. More blood in catheter
   c. More paresthesias
3. More unblocked segments, less complete analgesia
4. Venous air embolism
5. Subcutaneous emphysema
6. Nerve root compression
7. Single cases: convulsions, transverse myelitis, loss of consciousness, pupillary dilatation
8. Not reported up to now: central nervous infection (is air sterile?), pneumocephalus during epidural blood patch

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will rest on the patient’s back taking the hub of the needle between thumb and index to prevent sudden inward movement. When using air the finger on the plunger will serve as the control while the plunger will be pushed intermittently and the other hand will be the driving one advancing the needle towards the epidural space.

One crucial question is: are there more taps when using air than saline. For this purpose comparative studies have been performed such as the study by Aida et al. They compared the two techniques in more than 3700 patients and found no difference with respect to the incidence of accidental taps but a higher incidence of headache with air, which was evidenced by the finding of air on CT in 30 out of 32 patients.

Two even larger but retrospective reviews found an incidence of dural puncture of 1-1.1% with air which appeared to be significantly more than saline (0.6-0.7%). The most recent prospective study of Evron et al in 2004 found a dural puncture rate of 1.7% (3 patients out of 180) in the air group versus none with saline.

We changed in 1996 to the BD-Adjustable equipment containing epidural needles unfamiliar to our staff. As opposed to the findings of Evron et al, we found that although the dural click feeling required some experience, no dural tap was noticed in any of the 150 initially studied cases. Although it is known that the epidural space discovered by a loss of resistance technique to air offers a significantly larger margin of safety between the epidural needle tip and the dura as compared to the hanging drop technique, it is unclear whether there is any difference between saline and air.

**Technical problems**

Evron et al reported more problems with catheter placement in the air group but this was not confirmed in other studies. Also the hypothesis that patients might experience more paraesthesias or that in more patients blood may be aspirated through the catheter when air is used, could not be evidenced. Gadalla et al when performing a CSE technique with air but injecting saline 10 mL or nothing just before placement of the catheter, found that in the dry group 10 out of 50 placed catheters showed intravenous placement which seems to be an extremely high incidence, not consistent with common experience. Technical problems were not encountered in any of our studies in which only air was used.

**Quality of the block: more unblocked segments?**

The first case of unblocked segments when using air was already reported in 1987. Several subsequent studies confirmed either twice as many unblocked segments or less complete analgesia at 15 minutes. Okutomi and Hoka demonstrated that this problem may equally occur with saline but that the volume used plays an important role as 10ml causes more unblocked dermatomes than 1 mL.

**Venous air embolism.**

Naulty et al showed in 1982 that out of 17 parturients, 7 had venous air embolism without haemodynamic consequences. They used the hanging drop technique while the position of the epidural needle tip was confirmed by the injection of air (5mL). In one additional patient air embolism was found before the injection of air. In paediatrics two other reports demonstrated venous air embolism with haemodynamic instability. This however, may be explained by a higher risk of a bloody tap in paediatric caudals while an amount of 3 mL may be a relative overdose in children.

It may also be wise to avoid performing a Woosh test to confirm correct caudal needle placement. This is done by injecting 5ml of air through the caudal needle which may be heard as a woosh sound when placing a stethoscope at the thoraco-lumbar vertebral region.

**Subcutaneous emphysema**

The few cases reported confirm that this does not cause any harm. Its occurrence depends on the volume of air injected. Nitrous oxide may aggravate the emphysema while differential diagnosis with an anaerobic infection may seem to be difficult.

**Nerve root compression**

Following the use of air, 5 cases have been described up to date versus only one with saline. This complication is also volume dependent as two cases were reported after the injection of 10 mL and 40 mL, respectively. Symptoms are muscle weakness, paraesthesias and in two cases pain was also present. Nevertheless the reported outcomes were good.

**Other neurological symptoms**

A few isolated cases also reported pupillary dilatation, loss of consciousness, convulsions and transverse myelitis although the relationship with the injection of air was rather unclear. In addition
convulsions also occur with classical PDPH caused by a parieto-temporal shift of the brain resulting in minor subarachnoid bleeding.

**Are there no advantages with the use of air?**

Although apparently less important on an individual basis, air is cheaper than saline. More importantly, with air no mistakes are possible. Many reports exist on the inadvertent injection of other fluids than saline and the real incidence is surely much higher than based on the number of actual reports. Also in our hospital at least 5 patients received potassium chloride, distilled water or hypertonic saline, all fortunately with an uneventful outcome. The breaking of the reservoir containing saline may also increase the risk of the injection of glass or PVC particles.

Using air also results in a dry technique which may be important with the CSE technique. The fluid appearing in the hub of the spinal needle is undoubtedly CSF which might be less clear when using saline. Although the fluid returning may be tested upon the presence of glucose or proteins, this is rather time consuming. Protagonists of saline will wave this argument. Although many studies mention the LOR technique to air when reporting on CSE anaesthesia, I found no comment in the literature on the possible benefit of air for the performance of CSE anaesthesia. Also, in our hospital we used air for this technique since the early nineties when we started our experience with combined techniques.

We make our residents familiar with CSE anaesthesia from the early beginning of their training period and with the use of air for LOR. The equipment used is also important. We use glass syringes for CSE and perform LOR with air, while our regular epidurals are performed with PVC syringes, for which we prefer saline. It is my experience that when exerting some lateral pressure on the plunger of PVC syringes, saline may be lost backwards, which would not be observed in the case of air while a false loss of resistance would be felt. When realizing that CSE may result in a 60% lowering of the incidence of accidental dural taps, the difference between air or saline may become felt. When realizing that CSE may result in a 60% lowering of the incidence of accidental dural taps, the difference between air or saline may become felt.

**CONCLUSIONS**

It can not be ignored that there is a trend towards a switch from air to saline. This may be explained by a negative atmosphere created by different reviews condemning the use of air. Nevertheless, complications of air are overstated while those for saline are largely ignored. Numbers and incidences need to be interpreted in a correct way. It should be realised that a LOR technique to air or saline are two different techniques which should be made familiar in training centres as early as possible. The choice of equipment may be important as well. Performing a LOR with air may offer additional advantages in CSE anaesthesia. Any switch will signify a learning curve. A volume of 3 mL for air as well as saline should be sufficient. When the epidural space needs to be entered more than once, the use of saline may be recommended.

REFERENCES


