Labor epidural anesthetics comparing loss of resistance with air versus saline: Does the choice matter?

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This study examined whether air or saline, used for the loss-of-resistance (LOR) technique, resulted in a difference in pain relief or adverse events for laboring parturients. Previous studies had mixed findings regarding the onset of analgesia and subsequent pain relief.

Research questions were as follows: Is there difference in analgesic onset for patients receiving air vs saline during the LOR technique? Do women receiving the air method for LOR experience any difference in the quality of pain relief from that of women receiving saline? Is there any difference in the incidence of analgesic distribution or segmental pain relief in women receiving the air vs the saline method? Is there any difference in the incidence of adverse effects in women receiving air vs saline during the LOR technique?

This was an experimental, prospective study with 50 women. Subjects were randomized to receive air or saline. The visual analogue scale was used to measure pain. A dermatome level recorded the spread of analgesia. No significant differences were found between groups for onset or quality of analgesia. There was a significant increase in the number of subjects who experienced segmental blocks after receiving air during the LOR technique.

Key words: Air, analgesia, epidural, loss of resistance, saline.

Continuous epidural analgesia is used widely in the United States for control of pain during labor. Epidural analgesia is achieved by placement of a small plastic catheter through an epidural needle, after the needle has been identified as entering the epidural space. The most widely used method for identifying the epidural space is the loss-of-resistance (LOR) technique. Loss of resistance occurs as the anesthesia provider applies intermittent or continuous pressure to the plunger of a syringe. The syringe is attached to the epidural needle, filled with air or saline as the needle is advanced toward the epidural space. On entering the epidural space, there is sudden LOR on the plunger as the needle passes through the ligamentum flavum due to the negative pressure existing within the epidural space. Generally 3 to 5 mL of air or saline is drawn into the syringe before the LOR technique. During the LOR technique, some air or saline is injected into the tissues as the epidural needle is advanced.

• Problem statement. The choice among nurse anesthetists and anesthesiologists whether to use saline or air during the LOR technique to indicate entry into the epidural space has largely been a matter of personal preference. Because the literature is sparse regarding recommendations and only a few studies have researched this technique, anesthesia providers are without clear direction as to which substance might promote the onset and quality of analgesia and avoid adverse effects.

• Purpose of study. The purpose of this study was to determine whether there is any difference between air and saline during the LOR technique in the onset of analgesia, quality of analgesia, incidence of inadequate or segmental block, and numbers of adverse events. Specifically, 4 research questions were investigated: (1) Is there difference in analgesic onset for patients receiving air vs saline during the LOR technique? (2) Do women receiving the air method for LOR experience any difference in the quality of pain relief from that of women receiving saline? (3) Is there any difference in the incidence of analgesic distribution or segmental pain relief in women who received the air vs the saline method? (4) Is there any difference in the incidence of adverse effects in women who receive air vs saline during the LOR technique?

Review of the literature
Air and saline are widely used and accepted in syringes...
attached to epidural needles for determination of the LOR during the insertion of an epidural.\textsuperscript{1,3-6} Epidural anesthetic molecules surround the nerve roots and penetrate deeply into the spinal cord tissue,\textsuperscript{7} preventing sodium channel closing, thus blocking pain message transmission from the site of injection and below. Theoretically, air and saline may interfere with epidural anesthetic molecules binding with nerves.

Air or air bubbles may impede the onset or quality of epidural anesthetic properties. Air is composed of 78.62\% nitrogen, 20.9.9\% oxygen, and 0.04\% carbon dioxide. There are 12 other trace gases in air, but collectively, they account for only 0.09\% of gases.\textsuperscript{8} It is not known whether there is competitive interaction for receptor sites or whether air molecules affect the local anesthetic molecules before diffusion across cell membranes. One hypothesis suggests that air molecules block local anesthetics from the receptor sites at the nerve endings, delaying the onset of anesthesia. Air moves through cell membranes by diffusion among the molecules making up the membrane.\textsuperscript{9} After diffusion, receptor sites would become available for local anesthetic action. Air also may affect the normal surface tension for diffusion. It also may act competitively with local anesthetics, as suggested by the authors in case reports.\textsuperscript{10,11} Air injected into the peridural space remains as air bubbles and can persist for a relatively long period, confirmed by computed tomography scan in several case studies.\textsuperscript{10-12}

Saline also can interfere with the onset and quality of pain relief provided by epidural anesthetics and analgesics. Normal saline or injectable 0.9\% saline is accepted as a physiologic solution for parenteral administration within the human body.\textsuperscript{1} Saline with local anesthetic molecules is accepted widely to dilute the strength of local anesthetic drugs but not alter or degrade them.\textsuperscript{5} The volume used for dilution directly parallels the reduction in potency.\textsuperscript{13}

Two studies compared the effects of air and saline injected during LOR.\textsuperscript{2,14} The results of these studies do not yield the same conclusion. The first study\textsuperscript{14} found no difference in the onset and quality of epidural analgesia obtained in the saline and air groups. The second study\textsuperscript{2} found that the use of saline for LOR resulted in onset and spread of epidural analgesia superior to that in the air group. Differences in the LOR technique, method of measuring pain, and the frequency of measures may have contributed to the mixed results.\textsuperscript{15}

Additional studies have tested the differences in inadequate or segmental blocks. One study\textsuperscript{16} examined the use of air vs saline for the LOR technique to determine the incidence of paresthesias or segmental blocks during the epidural catheter insertion. There were no significant difference in segmental blocks between groups. The onset of analgesia between groups was not analyzed. Another study\textsuperscript{17} examined complications from the insertion of an epidural catheter in women with obstetric and surgical procedures. This study used the intentional injection of 10 mL of air on entry into the epidural space to “open up” the space. The catheter was then inserted.\textsuperscript{17} There was a significant reduction of paresthesias and blood vessel puncture in the group receiving the 10 mL of air; no complications occurred during this investigation. This study indicates that injecting up to 10 mL of air into the epidural space may be safe. Yet other data suggest that air as the injected substance may be harmful.

During the past 15 years, a number of case reports have appeared in the literature suggesting that air injected into the epidural space may be associated with the delay in the onset of epidural analgesia and may interfere with the spread and quality of relief obtained.\textsuperscript{10,11,16-22} A review article examining the use of air during LOR detailed additional potential complications from published case reports: spinal cord and nerve root compression, pneumocephalus, subcutaneous emphysema, and venous air embolism.\textsuperscript{18}

Methods
This study was a prospective, experimental design. Subjects were randomized to have a syringe filled with 3 mL of air or 3 mL of saline during LOR.

- Procedure. The institutional review boards at 2 institutions (academic and hospital setting) approved the protocol; no additional risk than normally occurs with placement of an epidural catheter was anticipated. All clinicians who participated in data collection completed training in human subjects’ protection. At this clinical facility, use of air and saline with LOR was common practice.

Data collection tools were assembled into packets numbered 1 through 50; each packet then was associated with a single subject. The data collection packets were placed in a box with consenting subjects assigned to the packages at the front of the box. A computerized table of random numbers was used to assign each subject to air or saline instillation and included in the packet (consent, statistical tools, etc). The anesthesia provider learned which approach would be used after informed consent was obtained; this information was not shared with the subject unless the subject requested the information.

After admission to the labor and delivery unit for active labor, potential participants received an expla-
nation of the study. Once informed consent was obtained, demographic data were obtained and the use of the visual analogue scale (VAS) was explained.

Epidural catheters were inserted after the women were assessed to be at 2 to 9 cm of cervical dilation and approved by the obstetric provider for an epidural. The epidural insertion procedures were conducted by staff and trainee anesthesia providers briefed on the protocol; all providers were comfortable with air and saline use during LOR. Nurse anesthesia students and anesthesiology residents who had inserted at least 50 epidural catheters and had completed their obstetric anesthesia rotation participated under the direct supervision of a CRNA familiar with the protocol and trained in the use of the dermatome procedure.

All epidural anesthetics used an 18-gauge Tuohy needle at L2-3, L3-4, or L4-5. Air or saline, 3 mL, was in the syringe attached to the epidural needle during advancement to the epidural space. For purposes of this study, the syringe contained only 3 mL of air or 3 mL of saline (no air bubble). Once the LOR occurred, a test dose of 3 mL of lidocaine 1.5% with 1:200,000 epinephrine was administered, to check proper position and to open up the epidural space. The test dose of 3 mL also served to help minimize the variable of encountering difficult catheter insertion. The epidural catheter was inserted 4 to 5 cm. The needle then was removed and the catheter taped in place. A second test dose through the catheter of 2 mL of lidocaine 1.5% with 1:200,000 epinephrine was administered. The anesthesia provider then administered 5 to 10 mL of 0.25% bupivacaine, depending on the size of the subject, and noted the time.5

The anesthesia provider asked the participant to mark the second, third, fourth, fifth, sixth, and seventh VAS scores at 5, 10, 15, 20, 25, and 30 minutes after bupivacaine injection. The provider marked the dermatome level concurrently by stroking the dermatome with an alcohol pad. The total amount of saline or air injected during the LOR technique was recorded. Any adverse events associated with the LOR such as headache, backache, or neurological sequelae were recorded in the log during the 30-minute observation period after epidural placement. The need for further administration of epidural analgesic medications during the 30-minute observation period was noted in the log; these data also were used to indicate inadequate analgesia. After the 30-minute VAS measurement, any analgesic management was conducted in whatever manner was deemed appropriate. Additional data specific to epidural-related adverse events were collected on removal of the epidural catheters, several hours postpartum, and again the following day.

Setting and sample. This study was conducted at a US military medical center in the mid-Atlantic region. It was conducted in the labor and delivery area of the obstetric department.

The target population included English speaking, pregnant women at term who were planning a vaginal delivery and wanted an epidural anesthetic for management of labor pain. Inclusion criteria were all term parturients admitted for active labor, of any age, planning to have a vaginal birth and wanting epidural analgesia. Exclusion criteria included conditions that contraindicate epidural analgesia or make it a poor choice for pain relief. Women were excluded from the sample for the following conditions or therapies: (1) coagulopathies associated with severe preeclampsia, (2) previous lumbar spine surgery, (3) severe scoliosis because this deformity has a frequent incidence of segmental blocks resulting from an uneven spread of local anesthetics, (4) receiving magnesium sulfate, or (5) any condition likely to require rapid preparation for a cesarean section because of the time-sensitive measurement criteria of the study. Additional exclusion criteria included the following situations during insertion of the epidural catheter: (1) insertion attempts at more than 3 lumbar interspace levels, (2) more than 2 staff anesthesia providers required to insert the epidural catheter, (3) a toxic reaction to the local anesthetic requiring a pharmacologic intervention, and (4) more than 10 mL of air or saline injected into the peridural space during the LOR insertion technique. These situations were not encountered with any subject.

Demographics. Fifty-four women were approached for possible participation in this study during the initial preanesthesia interview. One parturient declined; no reason was given. After consent was given, 3 parturients had epidural catheters placed by anesthesia providers before randomization to air or saline. These 3 women were not enrolled, and no data were collected. Thus, 50 parturients were enrolled, 25 subjects in each experimental group. Only one participant was unable to complete the study due to a precipitous delivery; missing data were not included in analysis after the 10-minute VAS and dermatome assessments.

All subjects underwent epidural catheter placement for bupivacaine analgesia during labor and delivery of a full-term infant. The typical enrollee was 25 years old and of average height and weight for US women for term pregnancy given a recommended weight gain of about 25 to 35 lbs. A typical participant experienced her second pregnancy but first delivery.
Table 1 summarizes characteristics of participants overall and those in each group (ie, recipients of air and recipients of saline during LOR).

To ensure that participants in each group had similar characteristics, differences between means in each group were examined. There were no significant differences between groups in age, height, weight, education, gravida and para status, or weeks of gestation. There were no significant differences between the groups related to ethnicity or the numbers of women receiving oxytocin in each group.

- **Instruments.** Two instruments were used to measure the onset and quality of pain relief. The first was the Visual Analogue Sensation and Distress of Pain Scale. The VAS is a 100-mm solid line on which the subject is asked to place a mark representing her level of pain or discomfort. One end represents no pain or discomfort and the other end the worst pain imaginable. This instrument originally was presented to participants as a vertical 100-mm line but today is used by many as a horizontal line. Later, a superimposed transparency marked in 100-mm increments is placed over the marked scale, and pain is reported on a scale of 1 to 100 mm. The validity and reliability of the scale is supported in the published literature. Intrarater reliability for the VAS measurement in this study was evaluated by randomly selecting 20 VAS records and measuring their values a second time several weeks after the original measurement. A variation of 2 mm was considered acceptable; intrarater agreement was maintained at 90% agreement.

The second instrument, marked by the anesthesia provider, was the skin dermatome chart. This chart was used as the reference to determine the cephalad movement of the epidural analgesic spread. Dermatome scores were obtained by brushing an alcohol wipe along dermatome levels and comparing the change in sensory perception with a standard spinal dermatome chart. The dermatome chart was scored as 0 to 17 to include analgesic spread to thoracic vertebrae (1-12) and lumbar vertebrae (13-17). A score of 0 would reflect no analgesia before the administration of a local anesthetic, and a score of 13 represented no sensation to stroking the dermatome at L1. All investigators were trained in the use of the dermatome chart before beginning the study.

A log of adverse events was used to record the occurrence of any such events. A demographic sheet was used to obtain information about the sample.

- **Data analysis.** Differences in the characteristics of women who received air during LOR vs those who received saline were examined using $\chi^2$ for nominal and categorical data. Alpha was a priori selected as .05 for all analyses.

A 2-tailed $t$ test was used to determine whether there was a difference in the onset of pain relief after receiving air vs saline during LOR as measured by mean VAS scores at the point of maximal pain relief. Repeated measures multivariate analysis of variance (MANOVA) was used to determine whether there was a difference in the quality of analgesia measured by differences in VAS over time. The $\chi^2$ was used to test the third hypothesis, that there would be no difference in segmental blocks between groups as measured by nominal data (segmental or incomplete analgesia present or absent). The $\chi^2$ also was used to test the

| Table 1. Subject characteristics (overall) and in each experimental group* |
|-----------------------------|-----------------------------|-----------------------------|
| Demographic                | Overall (N = 50)             | Group 1† (air; n = 25)       | Group 2† (saline; n = 25)   |
|                            | Mean   | SD   | Range | Mean   | SD   | Range | Mean   | SD   | Range |
| Age (y)                    | 25.6   | 4.8  | 17-40 | 24.9   | 4.6  | 20-37 | 24.2   | 5.1  | 17-40 |
| Height (in)                | 64.8   | 3.1  | 59-71 | 65.2   | 3.3  | 59-71 | 64.5   | 3.0  | 59-71 |
| Weight (lb)                | 182.3  | 34.5 | 113-302 | 182.6  | 31.9 | 130-265 | 182.0  | 37.6 | 113-302 |
| Education (y)              | 13.2   | 1.9  | 10-18 | 13.5   | 1.9  | 11-18 | 12.8   | 1.7  | 10-18 |
| Gestation (wk)             | 38.9   | 1.5  | 35-41 | 38.8   | 1.6  | 36-41 | 38.9   | 1.5  | 35-41 |
| Cervical dilation (cm)     | 4.5    | 1.3  | 2-7   | 5.0    | 1.3  | 2-7   | 3.9    | 0.9  | 3-6   |
| Gravida                    | 2      |      |       | 2      |      |       | 2      |      |       |
| Para                       | 1      |      |       | 1      |      |       | 1      |      |       |

* Frequency data were as follows: Ethnicity, overall, 70% white; 20% African American, 10% other; group 1; 68% white; group 2, 72% white. Oxytocin used, overall, 80%, 40 with and 10 without.

† Women in group 1 received air during loss of resistance, and women in group 2 received saline during loss of resistance.
fourth research question about a difference in adverse events between groups as measured by the presence or absence of recorded complications related to LOR in the log.

Results

The average VAS and dermatome scores at each time point are described in Figures 1 and 2, respectively. Effect sizes were calculated for the VAS and dermatome scores. The range of effect sizes for the VAS scores at each data collection point was 0.11 to 0.23. The range for the effect sizes for the dermatome score at each data point was 0.02 to 0.03. Power for analyses with the VAS scores was calculated at 0.85 for this study.

Research question 1: Is there difference in analgesic onset for patients receiving air vs saline during the LOR technique? A higher VAS score indicates greater perceived pain. The average VAS score at baseline was 72 for both groups. At 5 minutes, the average VAS score was 34, indicating a reduction in pain almost immediately after bupivacaine administration. There were no significant differences in the baseline VAS scores between groups ($t = 1.49, P = .143$).

Figure 1 illustrates that participants marked the greatest reductions in pain during the first 15 minutes following administration of bupivacaine. Table 2 lists the results of $t$ tests with Bonferroni corrections at each time point. There were no significant differences between VAS scores in women receiving air during LOR and women receiving saline during LOR at any data point. Hypothesis 1 was supported; there was no difference in the onset of pain relief between women receiving air and those receiving saline during the LOR technique.

Research question 2: Do women receiving the air method for LOR experience any difference in the quality of pain relief from that of women receiving saline? One method to reduce pain is to reduce all sensation. A dermatome chart was used to record sensation. Dermatome scores were obtained every 5 minutes after bupivacaine administration; maximal scores (least sensation) were obtained 5 minutes after bupivacaine administration with an average score of 10 (SD =

Table 2. $t$ test results for VAS scores from baseline to 30 minutes*

<table>
<thead>
<tr>
<th>VAS</th>
<th>$t$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (baseline)</td>
<td>1.496</td>
<td>.143</td>
</tr>
<tr>
<td>5 (5 min after LOR)</td>
<td>1.633</td>
<td>.109</td>
</tr>
<tr>
<td>10 (10 min after LOR)</td>
<td>0.30</td>
<td>.976</td>
</tr>
<tr>
<td>15 (15 min after LOR)</td>
<td>−1.495</td>
<td>.142</td>
</tr>
<tr>
<td>20 (20 min after LOR)</td>
<td>−0.984</td>
<td>.330</td>
</tr>
<tr>
<td>25 (25 min after LOR)</td>
<td>−0.930</td>
<td>.357</td>
</tr>
<tr>
<td>30 (30 min after LOR)</td>
<td>−0.930</td>
<td>.357</td>
</tr>
</tbody>
</table>

* VAS indicates visual analogue scale, and LOR, loss of resistance. Bonferroni correction yields a significant $P$ value at .008.
3.75). A dermatome score of 10 indicates that reduced sensation occurs below the tenth thoracic dermatome, approximately at the umbilical level. Stable levels of reduced sensation were achieved at 15 through 30 minutes, averaging 6.9 (SD = 2.8), indicating a reduced sensation below the xiphoid process. Figure 2 illustrates the cephalad dermatome level spread of the analgesic block. All subjects started with a value of zero (indicating full sensation, data not shown).

The first correlation between VAS and dermatome scores was examined because MANOVA is used for interrelated measures. The Pearson analysis showed a moderate degree of correlation between the VAS and the dermatome level of analgesia, with the r values ranging from 0.35 to 0.62 (P = .05) during the first 20 minutes of measurement. Repeated measures MANOVA then was used to answer the second research question. The results of repeated measures MANOVA demonstrated there were no differences in VAS and dermatome scores between women receiving air during the LOR technique and those receiving saline. However, this analysis was associated with a low power of 0.36. There were too few subjects to determine whether there were differences in the quality of pain relief (a combined measure of VAS and thoracic level of analgesia) in women who receive 3 mL or less of air during the LOR technique. These analyses indicate there are not enough data to support or reject the second hypothesis, that there is no difference in the quality of pain relief when using air vs saline during LOR.

A secondary analysis of VAS scores was done to gain some insight related to the second research question. After administration of analgesia, the mean VAS scores during 30 minutes were 12.1 (SD = 15.4) for women who received air and 12.5 (SD = 17.2) for women who received saline during LOR. There was no difference in these scores (t = −1.495; P = .142), giving support to the hypothesis that there is no difference in the quality of pain relief between using air vs saline during LOR.

Research question 3: Is there any difference in the incidence of adverse effects in women who received air vs saline during the LOR technique? Participants were evaluated for adverse effects during the LOR technique, on removal of the epidural catheter, several hours postpartum, and again the following day. One parturient who received saline during the LOR technique reported a headache during her first day postpartum. This was evaluated and thought to be a post-dural puncture headache despite the fact that a dural puncture was not encountered during insertion and her epidural analgesia and delivery were without incident. She elected conservative treatment, fluids and Fioricet (a combination drug consisting of butalbital, acetaminophen, and caffeine) at that time. Her headache persisted, and she elected for an epidural blood patch the second day postpartum that immediately alleviated her headache. No other adverse events with any study participants occurred. With only 1 adverse event, data were insufficient for analysis.

Discussion

There are limitations to this study. The small effect size associated with the dermatome scores indicates a small variability in sensation after analgesia is administered through the epidural catheter. To examine whether this reduced sensation has an effect on the quality of pain relief, a much larger sample is needed. It may be that reduced sensation is not linked to quality of pain relief with only a moderate correlation between VAS and dermatome scores. Future studies could explore other measures of the quality of pain relief, including patient satisfaction or provider estimate.

Subjects did not typically receive the full 3 mL of saline or air during LOR; the provider allowed as
much of the substance as necessary to enter the epidural space to confirm placement. Variable amounts of air or saline may have led to differences in outcomes such as the occurrence of segmental blocks. However, no subject received more than 3 mL or less than 1 mL, and earlier data suggest that more than 10 mL is needed to cause changes in analgesia.\(^{26,27}\)

Subjects had a wide range of cervical dilation that may have had a variable impact on the VAS scores. Mean scores were used in analyses to avoid intraindividual responses to cervical pain, and this range of cervical dilation reflects the range encountered in practice by anesthesia providers in labor and delivery, supporting the clinical relevance of findings from this study.

A final limitation is that 5 providers were involved in performing LOR and collecting data. Interpersonal interactions may have influenced pain perception reports. The advantage of using multiple providers is that no averaged score was the result of a single provider's presence or communication skills, increasing the generalizability of results to settings with multiple anesthesia providers.

Similar to the findings of Valentine and colleagues,\(^ {14}\) subjects in the present study experienced no difference in the onset of pain relief. These findings may be similar because each study had a similar protocol. Beilin and colleagues\(^ {2}\) found reduced pain relief after air was used during LOR, but they removed the epidural catheter 15 minutes after the full dose of bupivacaine was administered. Perhaps removal of the catheter interfered with distribution of the medication (such as leaking out through the epidural track), leading to different results.

Like Valentine and colleagues,\(^ {14}\) we found an increased incidence of segmental or incomplete pain relief after using air during LOR in this study. This contradicts findings from Philip and colleagues.\(^ {17}\) Their study was reported in 1985, and there may have been different equipment used, leading to different outcomes. For example, disposable syringes are common in practice today; in 1985, glass syringes were still used in many settings.

There was only 1 adverse event, persistent headache, in this study, and it followed the use of saline during LOR. However, it occurred more than 18 hours after the LOR. The lack of adverse effects suggests that a small amount of air or saline injected during LOR is safe during epidural catheter placement.

The use of the dermatome chart was planned to confirm pain reduction. Low scores correlated moderately with high VAS values, confirming the usefulness of the VAS as a measure of pain. However, the small effect size of the dermatome scores, indicating only a small clinical effect, was surprising. Perhaps the absence of sensation is not a precise or accurate measure of the quality of pain relief. The most dramatic decrement in dermatome scores occurred within 5 minutes of bupivacaine administration, but the greatest reduction in pain scores occurred less precipitously during the first 15 minutes. This may be related to anxiety (which is moderately correlated with pain), or perhaps the initial loss of sensation contributes to discomfort for a limited period in laboring women. That these 2 measures were correlated only moderately suggests that each captures unique information about analgesia in epidural pain management among paruturient women. Alternatively, because multiple anesthesia providers collected dermatome data, perhaps there was variation in scoring that accounts for these findings. One variable to examine further is the influence of the anesthesia provider. Future investigations might use only a single provider or only trainees to sort out the influence of the provider on outcomes.

Of the women receiving saline during LOR, only 2 experienced segmental blocks, but they had higher VAS scores and were more uncomfortable than the 4 women who experienced segmental blocks after receiving air during the LOR technique. It is unclear as to how this information about segmental blocks might be applied to current practice because there are mixed results: air results in more segmental blocks but saline-associated segmental blocks were associated with greater discomfort. Segmental blocks are not uncommon with epidural analgesia. However, a segmental block poor enough to diminish patient comfort or requiring the epidural to be repeated is clinically important. No participant requested new placement of the epidural in this study. Although air resulted in more segmental blocks, all patients with segmental blocks experienced safe and effective pain relief within 15 minutes of the LOR technique. Further study is needed to determine whether the increased incidence of segmental blocks is clinically important; additional investigation is needed to determine whether the quality of pain relief varies between LOR techniques.

**Conclusion**

This study examined whether air or saline used for the LOR technique in placing an epidural catheter in laboring women resulted in differences in pain relief or adverse events. No differences were found in the onset of pain relief or incidence of adverse events. However, there were differences in the incidence of segmental
blocks with air resulting in more segmental blocks and saline resulting in more discomfort during a segmental block. There is a larger effect size related to pain relief compared with loss of sensation in both techniques, indicating that neither substance interferes with overall pain relief during the first 30 minutes after epidural catheter placement and analgesia administration. Based on our results, air and saline were equally safe during the LOR technique. Until new data are presented, practitioners can select saline or air for LOR, and either can be recommended to anesthesia students as long as the volume is 3 mL or less.

REFERENCES


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