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A Technical Report

The BIP Test: A Modified Loss Of Resistance Technique For Confirming Epidural Needle Placement

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Background: Correct identification of the epidural space minimizes complications and ensures successful epidural blockade. The loss of resistance technique is the most common technique used for identification of the epidural space. However, sometimes loss of resistance occurs when the needle is not actually in the epidural space. The injection in this instance will result in the medication not being deposited in the epidural space. At other times, loss of resistance is not definitive. Further advancement of the needle may predispose to a wet tap.

Methods: A simple manual technique was devised using pressure applied with two fingers (bi-digital pressure test; BiP Test).

Results: The technique helps distinguish true loss of resistance from a false loss of resistance.

Conclusion: This technique adds a useful confirmatory test to the already well-known loss of resistance technique used to verify the position of the epidural needle.

Key words: epidural injection, epidural block, loss of resistance technique, epidural, spinal-epidural

Correct identification of the epidural space minimizes complications and ensures successful epidural blockade. The loss of resistance (LOR) technique for identifying the epidural space was originally described by Dogliotti in 1933, using fluid as a medium and was based on the different densities of tissues encountered as the needle tip passed through the thick, fibrous ligamentum flavum into the epidural space (1).

There have been various modifications to the LOR technique that serve the purpose of confirming correct epidural needle placement. A recent modification of the LOR approach uses a combination of saline and air. In this technique, the epidural needle is connected to a three-way stop cock and a short length of extension tubing forming a vertical loop, which is connected to another three-way stop cock connected to the LOR syringe (2). Normal saline is drawn up via the needle into the descending limb of the loop, while the ascending limb and syringe contain only air. As the needle is advanced, loss of resistance to the column of air in the syringe and ascending limb of the loop is felt, but it is the saline from the descending limb that is injected. Apart from being tedious, other shortcomings of this technique are the possibility of air leaks in the assembly, as well as the complex assembly of equipment that has to be arranged and tested prior to performance of the epidural injection. Another recent technique uses a combination of saline and air and involves a "membrane in a syringe" (3). Other methods involve using a drip in various ways to detect entry into the epidural space (4-6). Techniques using acoustic devices to identify the epidural space have also been described (7).

Techniques other than the LOR method have also been used to identify the epidural space. Some are based on the principle of negative pressure (8). These methods – the "hanging-drop" and Macintosh balloon techniques – have been felt to be unreliable by some as negative pressure cannot always be demonstrated.

The "Whoosh" test first described in 1992 involves injecting air through the needle while an assistant simultaneously listen with a stethoscope over the thoracolumbar spine in the midline (9). If injection of air is heard with the stethoscope (a positive whoosh test) then the needle was deemed to be correctly located in the epidural space. This method, however, appears to present the problems of breaching the sterile environment when listening for the "whoosh", as well as requiring the presence of an assistant to auscultate for the "whoosh."

The loss of resistance technique appears to be the most commonly used technique for identification of the epidural space. A survey of obstetric anesthesiologists performed in 1998 revealed that 53% of the respondents used LOR with saline, 37% LOR to air, 6% LOR to both air and saline, while 3 % used a different technique with or without one of the above LOR approaches (10). However, the LOR method of ensuring correct positioning of the needle is not completely reliable. In order to

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improve the reliability of the LOR technique, we developed a technique of applying pressure with two fingers adjacent to the needle (bi-digital pressure test; the BiP Test), to aid in identifying the epidural space.

Methods

When performing an epidural injection, the following structures are sequentially pierced: the skin, superficial fascia (composed of fibrous connective tissue and a varying amount of adipose tissue), the supraspinous and interspinous ligaments, and then the thick fibrous ligamentum flavum. Loss of resistance is detected by applying gentle pressure to the plunger of the syringe as the needle is slowly advanced. When the needle is superficial to the epidural space, any attempt to inject air will usually meet with resistance. When the needle is in the dense ligamentum flavum, increased resistance is transmitted to the plunger. However once the dense, fibrous ligamentum flavum is pierced, a distinctive loss of resistance occurs. Entry into the epidural space is thus confirmed.

However, in some instances a loss of resistance may occur before the needle enters the ligamentum flavum. In this case the needle is located somewhere between the dermis and the epidural space, possibly in a fat layer. The principle behind the BiP Test is that when pressure is applied to the tissues this compresses them, increasing their density and thus increasing resistance to the needle. Digital pressure is applied with the index and forefinger of the hand that is stabilizing the needle, with one finger on either side of the needle pressing downward firmly on the skin in the direction of travel of the needle. This will compress the tissues around the tip of the needle between the skin and the spine. This compression of the tissues will increase their density and an increased resistance to fluid injection will be felt, indicating that the needle tip has not yet entered the epidural space. The needle may then be slowly advanced until a more distinctive loss of resistance is felt, indicating that the needle tip has traversed the ligamentum flavum and entered the epidural space.

Fig.1. *Bi-digital pressure applied firmly on either side of needle when performing the "BiP" test during cervical epidural injection*

In a different situation, loss of resistance may be equivocal, and one may be in doubt as to whether the needle has actually entered the epidural space. This may occur if epidural scarring is present – the needle has entered the epidural space, but a distinct loss of resistance is not felt. Advancing the needle in this case is not safe as unintentional dural puncture may occur, resulting in a wet tap. If the BiP test were now performed, the result would be no change in the loss of resistance, as the needle is deep to the ligamentum flavum. Hence, compression of the tissues will have no effect on the loss of resistance. The same suboptimal loss of resistance that occurred before the BiP test was performed is felt again, confirming that the needle may be in the epidural space and not in superficial tissues.

Discussion

This test may be used where single-shot epidurals are being given without the use of fluoroscopy, such as in the OB suite or operating room. Even in an operating room with the use of fluoroscopy, it is still of value. It is also of use in upper thoracic epidural injections when a quick BiP test can verify the position of the tip of the needle and obviate the need for trying to pass a catheter to confirm epidural placement. In the case of upper thoracic epidural injections, although a lateral X-ray can be done to confirm the position of the needle and injection of contrast, one cannot easily visualize the needle because the scapulae may obscure the image. In this case, the BiP test may provide a rapid, simple means to confirm the position of the needle, without the need for additional equipment.

Conclusion

The BiP test is a modification of the loss of resistance technique and can provide rapid confirmation of epidural needle position. The method can be used in all situations where the LOR technique is used for epidural injections.

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References

1. Dogliotti AM. Segmental peridural spinal anesthesia. *Am J Surg* 1933; 20:107-118
2. Kale SS, Oosthuysen SA. Identification of the epidural space using air with normal saline. *Anaesthesia* 2000; 55:615-616
3. Lin BC, Chen KB, Chang CS, Wu KC, Liu YC, Chen CC, Wu RS. A 'membrane in syringe' technique that allows identification of the epidural space with saline while avoids injection of air into the epidural space. *Acta Anaesthesiol Sin.* 2002; 40:55-60.
4. Michel MZ, Lawes EG. Identification of epidural space by drip method *Reg Anesth* 1991; 16:236-239.
5. Bhate H. Identification of the peridural space with the infusion method in relation to the incidence of inadvertent puncture of the dura. *Reg Anaesth* 1984; 7:44-47.
6. Kumagai M, Yamashita M. Sacral intervertebral approach for epidural anaesthesia in infants and children:application of "drip and tube" method. A*naesth Intensive Care* 1995; 23:469-471.
7. Lechner TJ, van Wijk MG, Maas AJ, van Dorsten FR, Drost RA, Langenberg CJ, Teunissen LJ, Cornelissen PH, van Niekerk J. Clinical results with the acoustic puncture assist device, a new acoustic device to identify the epidural space. *Anesth Analg* 2003; 96:1183-1187
8. Moore D:*Regional Block*. Springfield, Illinois, Charles C Thomas; 1975: pp 413-415
9. Lewis MP, Thomas P, Wilson LF, Mulholland RC. The "Whoosh" test. A clinical test to confirm correct needle placement in caudal epidural injection. *Anaesthesia* 1992; 47:57-58
10. Howell TK, Prosser DP, Harmer M. A change in resistance? A survey of epidural practice among obstetric anaesthetists. *Anaesthesia* 1998; 53:238-243.