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FAILED SPINAL ANESTHESIA

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INTRODUCTION

Spinal anaesthesia has evolved greatly since its introduction in 1899 to clinical use by August Bier. It is currently the most common technique for non emergency obstetric, urologic and orthopaedic anaesthesia. Furthermore, most infra umbilical procedures can be done under spinal anaesthesia. There is a demonstrable reduction in mortality and morbidity with regional techniques ⁽¹⁾.

The level of competency in administering spinal anaesthesia is attained relatively quickly, with a >90% success rate after 40 to 70 supervised attempts ⁽²⁾. As the use becomes common and frequent, so too will the complications. And not all spinal intrathecal injections culminate into successful spinal anaesthesia, consequently general anaesthesia is readily and hastily advanced. This occurs commonly at the expense of patient choice and the benefits of regional anaesthesia.

DEFINITION

Failed spinal anaesthesia is loosely defined in various texts. It is further not addressed fully in the general literature. Onset of action differs between various intrathecally injected anaesthetic agents. Bupivacaine is one of the most extensively studied and well understood of these agents. A bupivacaine spinal anaesthesia is considered to have failed if anaesthesia and analgesia have not effected within 10 minutes of successful intrathecal deposition of heavy bupivacaine and 25 minutes for plain bupivacaine ^(4,6). Ropivacaine is 50 to 60% as potent as spinal bupivacaine, however, equipotent doses of ropivacaine will have similar recovery times as bupivacaine ⁽⁷⁾. Thus ropivacaine in equipotent doses (2:1) is virtually indistinguishable from bupivacaine for clinical anaesthesia.

INCIDENCE

In the training environment the incidence of failed spinal anaesthesia can be as high as 25% or 1 in 6. Current literature, however, quotes this incidence to be in the region of 5% ⁽³⁾. The combined spinal/epidural technique

appears to be associated with a higher incidence of failed spinal anaesthesia ⁽³⁾.

MECHANISM OF ACTION

Upon successful intrathecal injection, the injectate undergoes three important phases ⁽⁴⁾:

1. Dilution

Once injected into the intrathecal space, the injectate mixes with CSF and there is a drop in its concentration. This occurs within the first 1-2 minutes. There are individual variations in lumbosacral CSF volumes with a range of 28-81 ml.

2. Diffusion

In the next 2 to 6 minutes, the injectate then diffuses by virtue of molecular motion and is absorbed into the nervous tissue. Concentration is thus reduced further.

3. Distribution

The injectate is then distributed and attaches to receptors on neural tissues particularly the nerve roots and in this manner clinical effect is obtained. Unidirectional transport of material from CSF to epidural space occurs and may contribute to clearance of the injectate.

Finally, vascular absorption and elimination through capillary bed, parenchyma and arachnoid villi takes place.

Latency of block

Latency of block varies from 10 to 60 minutes and is shorter when hyperbaric solution is used. Spread of analgesia continues for more than 30 minutes after plain bupivacaine ⁽⁵⁾. This process is completed in approximately 90 to 120 minutes. During this time the risk of higher spread is not eliminated. Furthermore, the volume and concentration of the injectate appear to have little influence on the elimination time ⁽⁷⁾.

About 10% of the drug deposited in the peridural tissues reach the subarachnoid space and produce sensory nerve block.

The minimum dose required for a spinal anaesthetic varies depending on surgical area:

Saddle block - 1 ml hyperbaric bupivacaine, 2 ml plain, 1 ml hyperbaric lidocaine

Lumbar block - 2-3 ml hyperbaric bupivacaine, 2-3 ml plain, 1,5 -2 ml lidocaine

Mid-thoracic block - 2-4 ml hyperbaric bupivacaine, 2-4 ml plain, 2ml lidocaine ⁽⁶⁾

Within these commonly used dosage ranges, a 50% increase in the dose injected will result in an increase of mean spread of only a dermatome, with an increase in duration of action.

ASSESSING FUNCTION

"...sensational perception of needle pricks to the thigh, tickling of the soles of the feet, a small incision in the thigh, pushing a large helved needle down the femur, strong pinching with dental forceps, application of a burning cigar, pulling out pubic hairs, a strong blow with an iron hammer against the tibia, vigorous blows with the knuckles against the tibia, and strong pressure on a testicle" (Bier, 1899). An apparently adequate block may fail because of the differences in stimuli used to assess the block. Temporal and spatial summation may contribute to this. It is unnecessary to inflict harm to the patient in order to assess function of the block.

The afferent (sensory) and efferent (motor and autonomic) functions are assessed.

1. Afferent

- Vibration and proprioception
- Pinprick and cold sensation allow discrimination between 'sharp' and 'dull' pain.

2. Efferent functions

Motor response is assessed by the modified Bromage scale as follows:

- 0 no motor block
- 1 Inability to raise extended leg; able to move knees and feet.
- 2 Inability to raise extended leg and move knee; able to move feet
- 3 Complete motor block of limb

WHY SPINALS FAIL

Technical errors are common causes of failed spinal. Chemical interactions also contribute to the problem.

A) Technical errors

1. Entering intrathecal space at a lower spinal level than surgical level
2. Improper rates of injection (smaller gauge, longer needles are associated with slow return of CSF and higher injection resistance) may lead to injection into tissue planes
3. Failure to recognize dural puncture
4. Needle point partly inside/outside dural sac
5. Patient cooperation
6. Needle in the ventral epidural region
7. Injection in the lateral horizontal position (plain bupivacaine) 25% failure rate.

B. Chemical interactions

- Bloody tap - blood pseudo-cholinesterase will readily hydrolyze ester type anaesthetics.
- Concentration errors - marginal local anaesthetics concentrations due to improper mixing and/or excessive dilution.
- Loss of potency due to prolonged exposure to light.
- High CSF alkalinity may precipitate local anaesthetics.
- Glucose - intrathecal 10% dextrose alone produces hyperalgesia
- Spotty anaesthesia - "salt bridges" around the nerve (4).

TOWARDS A SUCCESSFUL SPINAL - 6 POINT PLAN

1. Attain patient comfort and optimal position

Sitting, curled position is best. Lateral position for elderly and uncooperative patients.

2. Use correct equipment

24-26 G needle preferred. Be prepared to wait for 30 seconds for CSF to flow back.

3. Use correct drugs at correct concentrations**4. Test functioning correctly**

Cold sensation is best.

5. Allow adequate time for the drugs to act**6. Above all, achieve technical and mental competence.**

Perform more spinal blocks and recognise potential complications. Practise makes perfect!

IF A SPINAL FAILS REGARDLESS

It is unlikely that a spinal will work if it has not done so within 10 minutes of deposition (hyperbaric bupivacaine). Having discussed how spinals work, the fate of the injectate and the causes of failed spinal anaesthesia, it follows that it is feasible to repeat the injection without increased risk of a higher dermatomal spread. It is common practice in the United Kingdom to use higher volumes for spinal anaesthesia and this has happened without higher incidence of complications.

Immediate conversion to general anaesthesia (GA) after a single failed spinal anaesthesia can be safely avoided. Some patients express their preference for regional anaesthesia and such a choice must be protected. Often the choice of regional may have been motivated by a potentially difficult airway and sudden conversion to GA can be disastrous.

Draping for surgical sterility has to be done only when the anaesthetist is satisfied about adequacy of the block since repositioning may be necessary. If the block was initially not technically difficult and the surgical procedure allows for extra time to redo the intrathecal injection, it should, by all means, be repeated.

In some patients, however, there is general resistance to local anaesthetics and a repeat successful intrathecal injection of local anaesthetic agent produces no analgesia/anaesthesia. In the current literature only two attempts are recommended since multiple punctures can inflict nerve injury and predispose to haematoma formation.

CONCLUSION

The importance of regional anaesthesia over general anaesthesia cannot be over-emphasized. An attempt to make regional anaesthesia work is a worthwhile endeavour. It is not necessary to immediately convert to general anaesthesia if a single shot spinal anaesthetic injection failed to produce analgesia/anaesthesia. A repeat intrathecal injection is safe to perform and general anaesthesia can be avoided.

ACKNOWLEDGEMENTS

Many thanks to Dr. CM Lephoto, for her selfless help in the type setting and proof reading of this article. I am forever grateful.

Dr. JR (Oom Koos) Reyneke, and the department of anaesthetics of the University of the Free State for having been supportive and a source of guidance during my post graduate training.

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