

INTRASPINAL OR SPINAL ANAESTHESIA

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SPIRAL anaesthesia is a method of causing lack of sensation for operative work, particularly over the lower half of the body and is accompanied without loss of consciousness. It has been in vogue for upwards of three decades at least, but owing to untoward effects in its experimental stage the method was, to some extent, abandoned. Cocaine was the first drug used for this purpose and sometimes led to very serious results on account of its toxicity. In the early days death both at and after the operation did occur and so the method fell into disrepute, the more so because the technique though simple is rather tricky for those not accustomed to the method of administration. However, more recently and with further experience especially in using other drugs than cocaine this method is again coming to the front as a safe and very useful anaesthetic.

History and Definition

A few dates may be of interest.

1885.—Corning of New York was the first to try $\frac{1}{2}$ per cent cocaine into the *extra* dural space, and intentionally not intrathecal.

1895.—Bier tried it intrathecally with success using 2 per cent cocaine, with resulting anaesthesia up to the level of the umbilicus for 20 to 40 minutes.

1901.—Spinal Anaesthesia began to be used on the Continent.

1902.—Spinal Anaesthesia began to be used in England.

Cocaine was found dangerous and Tropocaine replaced it.

1904.—Stovaine came into use.

1905.—Alypin was tried.

1906.—Stovaine method adopted in Britain.

1907.—Barker in Britain substituted glucose dilution for saline (NaCl). This made the solution of greater specific gravity, less haemolytic and more isotonic in reference to the Cerebro-spinal fluid.

1914-1918.—During the War Spinal Anaesthesia proved disappointing for casualty work. It is excellent for preventing shock, but war cases were often in a condition of shock at operation and this method did not seem suitable. Apparently shock, if present, is not relieved by Intraspinal Anaesthesia.

1920 and onwards Intranspinal work has become more popular.

Within the bony vertebral column hangs the spinal cord or central nerve cable, which is enclosed in a sheath containing clear water like Cerebrospinal fluid. This sheath, Theca or Dura, loosely attached to the bony spine is continuous with the Dura Mater, surrounding the brain and lining the skull, where it is more adherent to the bone than in the vertebral column.

Anatomy

The spinal theca or *sheath* ends at the lower border of the 2nd Sacral Vertebra whereas the SPINAL CORD itself reaches down only as far as the spinal process of the 3rd LUMBAR Vertebra at birth. In the adult owing to the greater relative growth of the bony skeleton an apparent shortening of the cord seems to have taken place, for *the CORD at maturity reaches only to the 2nd, and not the 3rd LUMBAR vertebral spine.*

Thus there is a cavity filled with Cerebrospinal fluid beyond the end of the sheath or theca. This cavity is about 15 cms. (approx. 6 ins.) long. However, the cavity is not quite empty but also contains a bundle of nerves *en route* to their several exits lower down and a central terminal threadlike prolongation from the tip of the spinal cord. The thread and nerves hang down like a horse's tail and indeed the bundle is called the "Equine Tail."

It is into this space around these nerves and NOT into the spinal cord that the spinal injection or a lumbar puncture is made. Usually, the nerve cords slip past the point of the needle on its entrance but occasionally a nerve gets injured and may account for such post operative complications as retention of urine (bladder paralysis) and retention or incontinence of faeces (paralysis of rectum and sphincter ani). The bladder is supplied by nerves from two sources originating in the Spinal Cord at the levels of Lumbar Segments 2, 3, 4 and 5, and Sacral Segments 2, 3 and 4. The rectum and anus are similarly innervated.

Cocaine is not now used being too dangerous. Eucaine, a synthetic compound allied to cocaine, was tried for a while.

Drugs Used

Stovaine and novocaine, cocaine substitutes are less toxic drugs and are at present being used. Various modifications are preferred by different surgeons. The following is a list of drugs which have been used for Spinal Anaesthesia.

Cocaine.

Eucaine.

Tropocaine.

Alypin, a derivative of glycerine.

Tutccaine.

Zinocaine.

Apothesine (P.D. and Co.)

Stovaine or amylocaine.

Novocaine or procaine.

Spinocaine, a modification of novocaine.

Percaïne.

Stovaine with glucose is what was used when I was a student at the London Hospital. Percaine is one of the latest drugs for spinal anaesthesia. It belongs to a class quite different chemically from cocaine and its derivatives.

At present at Sarenga Hospital a preparation (Analytical No. 9923 Smith Stanistreet and Co., Calcutta) is in use and contains

Stovaine	...	...	0.1 gm.
Glucose	...	...	0.1 gm.
Aquam destillatam ad	...	...	2.0 ccs.

i.e., a 5 per cent solution of Stovaine in ampoule form. Needless to say, for this work none but the products of reliable firms should be used. I have found the above product satisfactory and have had no serious untoward effects.

1. 10 c.c. record syringe also marked in minims, which will fit the Instruments, etc. lumbar puncture needle and also hypodermic needles.

2. Two lumbar puncture needless with stilettes and locking shoulder piece to ensure that curved bevelled point of stilette is in apposition with curved bevelled point of canula needle.

3. A small record hypodermic needle to fit the 10 c.c. syringe for the purpose of extracting stovaine from the ampoule.

(This needle has a gold coloured haft in our case which serves to distinguish it from the hypodermic needle).

4. An ordinary hypodermic 5 c.c. syringe and needle for the purpose of giving a local anaesthetic at site of lumbar puncture. Such a local anaesthetic is perhaps hardly necessary. The skin of the back is less sensitive to pain than other places.

5. A skin pencil. Ink serves better on brown skins, for after painting over with iodine ink shows up well whereas a skin pencil mark tends to disappear.

6. A sterile towel to place across the sacral region with its upper edge stretching from one iliac crest to the other.

The patient is placed on the operating table and lying curled up on one or other side "kissing the knees" or better with

Procedure. head between his knees. This ensures a curved spine

and corresponding opening of the small spaces where the lumbar needle can enter between the spinous processes without striking the bony column. If preferred, the patient may be sitting up in the same huddled bent attitude. Some surgeons appreciate this position as it rather simplifies lumbar puncture. I have found it pays to define carefully the landmarks and so mark the tips of at least the spinous processes of the 3rd and 4th Lumbar Vertebrae with a straight line crossing the vertebral column at right angles. Note that a line passing across the loin from the

summit of one iliac crest to the other iliac crest passes across the spinous process of the 4th Lumbar Vertebra. This can be gauged by the towel edge as described. Having found the 4th Lumbar Vertebra the others are easily noted by sight or palpation. Another method is to count down from the Vertebra Prominens at the root of neck, i.e., from the 7th Cervical Spine, which is easily recognised. Having defined the landmarks the skin is again painted with iodine after the usual previous preparation, the surgeon scrubs up, takes the sterile towel whose edge is useful for laying across from one iliac crest to the other: A preliminary injection of butyn or procaine 2½ per cent may be used to raise a wheal at the site of puncture, to deaden the superficial sensory nerves; and then the hypodermic needle is further pushed in deeply and deep local anaesthesia is effected.

Next the lumbar needle with the stilette in position is entered in the mid line, mid interspace about ½ inch below the spinous process and perpendicular to the skin all around—not slanting upwards as is so often described. The lumbar spines slope very little and there is no need to incline the needle. The needle feels its way to the interspinous ligaments whose springy touch is noticed. Then the dura is penetrated and gives a characteristic impression to the surgeon's hand. Some advise the withdrawing of the stilette, before the dura is entered by the canula alone.

If success has occurred clear watery fluid appears in rapid drops sometimes tinged with blood. It is quite easy, however, to distinguish between blood alone and fluid tinged with blood. If blood alone is withdrawn as sometimes occurs by entry into the vertebral venous plexus outside the theca (or other veins inside the theca) it is useless to proceed further. The needle may be adjusted to a different position without withdrawing or may be entered in another interspace. Sometimes, the needle seems to be in the right spot and one has felt the different layers but no fluid comes. The stilette should be applied to remove any possible clot and withdrawn from the canula and then the canula slowly drawn out when fluid may run out as the end comes into right position. This has been found to be a useful tip.

When fluid has been obtained no more is allowed to run to waste, than can be helped. The full 2 ccs. Stovaine solution is sucked up into the 10 c. c. syringe by the small separate hypodermic needle. When air bubbles have been carefully driven out of the syringe the small needle is detached and the syringe applied to the lumbar needle in situ after withdrawing the stilette. 1 to 7 ccs. of Cerebrospinal fluid are withdrawn very slowly into the syringe and allowed to mix with the Stovaine solution. This can be watched in progress through the glass barrel of the syringe. Then after a pause the whole syringe contents are very slowly reinjected. The lumbar needle is gently pulled out. There is no need to add a

collodion or other dressing. The lumbar puncture wound, however, may be closed with a rotary pressure of the thumb on the spot.

The patient is now quickly turned into the supine position with head raised on pillow and the head end of the table is depressed 5 per cent (five degrees). There is no necessity to raise the shoulders. In fact, as long as the Foramen Magnum of the skull is above the level of the lumbar puncture, little fear need occur of cessation of breathing due to the Stovaine flowing up to the cerebral centres of respiration. Even if breathing were to stop the patient may be kept going by artificial respiration, until the anaesthesia passes off and normal respiration again occurs. I have not experienced this complication. Breathing is sometimes very quiet.

Anaesthesia sometimes comes on very quickly as can be watched by the rapid inability of the patient to lift his legs within 5 or 10 minutes of the spinal injection. Perhaps, an average time for the onset of anaesthesia is 20 minutes. It extends from below upwards and may reach even to the head. One case did not object to being pricked with a needle over his malar or cheek bones. There was no anxiety about respiration.

Loss of muscular power as in the legs does not always apparently run parallel with loss of sensation. A case who was insensible to pricks over chest, neck and face could move his legs.

The anaesthesia lasts about one hour usually and passes off in the same reverse order as the onset, i. e., passes off from above down. The period, however, varies very considerably. Therefore, if time presses when anaesthesia is passing off, an abdominal wound is closed from above down. Insensibility may last only half an hour and it is this uncertainty which detracts from the usefulness of intraspinal anaesthesia.

One case of a tremendous ovarian tumour weight about 80 lbs. in a woman of 38 years was removed successfully by an operation that took 3½ hours on account of the difficulty of adhesions, etc. Only one intraspinal injection of 2 ccs. Stovaine with glucose was given. But towards the end anaesthesia passed off rapidly while closing the abdominal wound and chloroform and ether had to be administered for about half an hour.

Extent may, to some degree, be regulated by position of the patient immediately after injection, i. e., for 5 to 10 minutes after which time the intraspinal drug becomes fixed in the tissues and any position even Trendelenburg's may be allowed.

For operations on the pelvis, e. g., external gynaecological operations, the patients may be permitted to assume a more upright position to allow of the injected fluid gravitating to the lower thecal limits. It is usual, however, to let the patient lie down after injection; a marked fall of blood pressure might lead to syncope of fainting. In case of high anaesthesia required he should lie down immediately with *pelvis up and head raised*.

For operations on one limb, say right leg tilt the body over on to that side. In this way localised anaesthesia can be caused, one leg being affected and the other free. This refers to solutions such as stovaine and glucose which are of greater specific gravity than the cerebrospinal fluid. The converse would hold for those lighter.

1. *To the Patient.*

There is no dread of losing consciousness which weighs so much in the mind of some patients, more particularly women, Mortality due to reflex failure in which chloroform has been such a bogey does not occur. Respiration may fail with spinal injection and then the heart in consequence; but this can be obviated by artificial respiration until anaesthesia passes off and normal respiration returns.

Permission can be obtained from the patient during operation for decisions of importance according to findings. It is wiser, however, to prepare for this in advance by previous permission. In cases of urgency a patient can go straight to the theatre without the preparation required for a general anaesthetic. Also he is still conscious when he comes out, which may be of prime importance in cases of urgency as far as legal matters, seeing relatives, making wills, etc., are concerned. There should be no unpleasant after-effects in contradistinction to the wretchedness of a patient for 24 hours or more after an anaesthetic of any considerable length of time by the inhalation method. But the chief benefit from the patient's point of view is its safety. Spinal anaesthesia is the best of all anaesthetics in this regard in selected cases suitable for this method.

What disadvantages there are for the patient such as the unpleasantness of administration by needle stab, consciousness during operation and often a headache afterwards are small compared with its merits. It has, however, to be remembered that cases of meningitis ascending to the brain have occurred as a complication following lumbar puncture. This is rare.

To avoid the sounds in a surgical theatre the patient's ears should be plugged with a wad of damp cotton wool. Head phones for wireless reception of a concert in progress are in the nature of a luxury but are said to have been provided.

2. *To the Nursing Staff.*

The advantages are really very welcome indeed. There is no need to prepare the patient as in the case of a general anaesthetic in reference to food, purgatives and enemas. He comes out from the theatre conscious and does not need the special care of an attendant for post-anaesthetic vomiting following chloroform and ether. Nor is there worry of asphyxia occurring while coming round. His relatives can sit with him and even spare the nurse for other pressing work. He can be fed immediately before, during and immediately after the operation, a considerable relief to

the nursing staff in a patient already on the border line as regards nutrition.

There is less likelihood of post-anaesthetic lung complications though bronchopneumonia is said to be one of the sequelae or after-effects of Intraspinal Anaesthesia, it is more likely to be due to the debilitated condition of the patient on admission. For Intraspinal Anaesthesia is an anaesthetic for extreme urgency cases which would by no means stand a general anaesthetic. Herein it is of great benefit to the nursing staff in that post-anaesthetic lung complications directly due to the Intraspinal injection are not the general rule.

When pressed for time the nursing staff have in this method a great boon, for a patient is very soon able to fend for himself in bed after the operation. Vomiting, stomach washes, distention, all of which can be nightmares for the nurses are conspicuous by their absence.

Sometimes, certain complications occur which are a disadvantage. Retention of urine may be troublesome with the necessity for catheterisation. It is said to be due to slight injury of the cauda equina or "horse's tail" during penetration of the needle among the nerve bundles inside the theca. Vomiting may occur on the table and nausea be tiresome. We have had very little such trouble.

The outfit is simple and quickly ready for use and only needs the care necessary for preparation of a hypodermic outfit. In only one case have I had trouble with retention of urine following spinal anaesthesia but this passed off in a little over a week, and I am not sure in my mind whether this retention was not wholly or partly due to other causes as the operation was a severe one in a case of longstanding Inguinal Hernia.

3. *To the Surgeon.*

To the surgeon Intraspinal Anaesthesia offers very considerable advantages. It is an anaesthetic that can be used at once without delay in preparation of the patients. The surgeon's mind is relieved of anxiety about the anaesthetic which is a safe one even if respiration fails. This is of no little relief to those mission hospitals or dispensaries which for shortage of staff, etc., have to depend on such as are not skilled in the administration of a general anaesthetic. And even if they are fortunate to have two doctors what a help it is to have the 2nd doctor assisting at operation instead of for the anaesthetic. From personal experience I have found this one of the greatest advantages of the use of Intraspinal Anaesthesia. It relieves anxiety and sets free a pair of valuable hands for further assistance.

Relaxation of the abdominal musculature under a spinal anaesthetic is as complete as with any other method, a great asset in abdominal work and also in manipulating for setting fractures particularly of the lower limbs.

There is also a reduction of post-operative shock as compared with a general anaesthetic. Reflex shock does not occur as in cases of heart failure due to *under* dosage of chloroform. There is less post-operative distention

of gut. In fact, it is said that one of the actions of intraspinal stovaine is a stimulation of the involuntary musculature of the gut.

The cost of spinal anaesthesia is far less than chloroform and ether, another weighty advantage to mission hospitals where the surgeon is also very often the medical superintendent and has to think of ways and means.

The surgeon has a relief too in no anxiety for post-operative chest complications which are always present to a greater or less extent after inhalation anaesthesia.

There are one or two disadvantages to the surgeon, chief of which is the limitation of spinal anaesthesia. This is not suitable for operations on the upper part of the body. To get full anaesthesia in this region a dangerous degree of involvement of the respiratory and possibly cardiac centres might generally have to be obtained. Also anaesthesia in the upper regions passes off earlier than below and so perforce lasts a shorter time. It is sometimes disconcerting to the surgeon to find how quickly the anaesthesia passes off from above downwards when he is, say, sewing up an abdominal wound and the upper part of the wound may feel while the lower end may be insensitive.

The short duration and its disappointing effects in regard to reliability in any case is often another drawback. Thus I have had experience of one case of insensibility lasting about 3 hours and another barely $\frac{1}{2}$ hour. Generally speaking, gynaecological cases and operations in or around the pelvis are particularly suitable.

Another disadvantage is the technique of lumbar puncture. By no means does the needle enter with confidence of success every time at the first instance. With experience it becomes simple, but cases of exceptional difficulty do occur, as for example, in the aged with calcareous interspinous ligaments.

Complications. These may be tabulated :

- Nerve paralysis
- Meningitis
- Bladder and rectum paralysis
- Fall of blood pressure
- Nausea
- Vomiting
- Backache
- Headache.

Temporary paralysis of the 6th cranial nerve supplying the External Rectus muscle of the eye has been reported.

Meningitis is a rare complication and is unlikely to occur with rigid attention to aseptic technique.

Bladder paralysis seems to be fairly common with some but apparently is not permanent. I have had no experience of it except in one case where it appeared doubtful as to whether it were due to the lumbar

puncture or to reflex disturbance as a result of the operation (already mentioned.)

Nausea and vomiting are not common.

Backache and headache especially the latter are more likely than other complications.

There is usually a fall of Blood Pressure at operation due to splanchnic paralysis, the patient, as it were, bleeding into his own dilating visceral veins, supplying gut, etc. This is said entirely to be combated by the injection of Ephedrine. We use $\frac{3}{4}$ grain Ephedrine hypodermically 5 minutes after the lumbar puncture and repeat, if necessary.

Spinal Anaesthesia is not a suitable anaesthesia for children beyond babyhood. Nor is it suitable for the very nervous or mentally unstable. For infants with intussusception, however it is the anaesthetic of choice and gives a better chance of recovery than any other anaesthetic. Those with low blood pressure are thought not to be suitable subjects. The aged with calcareous interspinous ligaments and any with spinal ankylosis who cannot arch the spine sufficiently to expose the spaces between the vertebrae are not suitable.

For those with chest complications, e. g. Pulmonary Phthisis, spinal anaesthesia obviates the danger of accentuating the lung complication already present which would be worse after inhalation anaesthesia.

The dangers of a general anaesthetic can be a great anxiety in the mind of patient, friends and doctor or surgeon. Chloroform is distinctly an anaesthetic not without special risks no matter how skilled the anaesthetist. In spinal anaesthesia despite drawbacks we have an anaesthetic which is primarily safe, inexpensive and in selected cases of peculiar advantage. It has advantages that are remarkable. Its present chief obstacles are in regard to time and extent of anaesthesia and dependability. These will be overcome as further knowledge and experience are gained.

We have gone a long way since chloroform was first used, nor are yet able to dispense with chloroform but the days of a safe anaesthetic are brought nearer by the introduction of Spinal Anaesthesia.

In regard to chloroform for the use of Anaesthesia a story of its discoverer is worth repeating in conclusion. Sir James Y. Simpson among the many things he found out had to his credit that he was the first physician who discovered and brought into use chloroform as an anaesthetic. He was once asked at a social function what was his greatest discovery. To the questioner he replied simply "My greatest discovery was when I found Jesus Christ as my Saviour."

"The strong man and the waterfall channel their own path".--*Carlyle*.