HOW SAFE IS SPINAL ANESTHESIA IN PRESENT DAY PRACTICE?*

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FROM time to time reassessment of accepted techniques of anesthetic practice are necessary, in order to place the methods in proper perspective in relation to recent developments. Spinal analgesia falls into such a category. In recent years sharp criticism has been directed towards this technique, one author (1) going so far as to state, "From a neurological point of view, we give the opinion that spinal anesthesia should be rigidly reserved for those patients unable to accept a local or general anesthetic." The advent of the muscle relaxant drugs has obviated to some degree the argument that subarachnoid block is the only method of obtaining profound relaxation unless deep planes of general anesthesia be initiated. In the light of this change, some anesthetists see fewer indications for intraspinal nerve block.

In any consideration of the relative safety of one technique over another, it should be emphasized that a definite calculated risk is inherent in any attempt to produce pain relief. Even local anesthesia contributes its share of undesirable complications (2). Too often this overall hazard is forgotten, particularly in articles prepared for lay consumption.

One of the unfortunate facts concerning spinal anesthesia is that the neurological complications occasionally associated with it are usually not only permanent but also incapacitating. The persistence of these complications and the doubt as to their exact etiology, has focussed an undue amount of attention on them (1) (3) (4). Details as to the incidence of morbidity following spinal anesthesia are difficult to gather, although in a recent review of 10,000 patients (5) the occurrence of permanent local neurological damage was nil. With regard to mortality incurred, a survey of 857,000 cases indicates that the death rate associated with spinal anesthesia is less than that accompanying general anesthesia (6).

It is the purpose of this discussion to review some of the known hazards which may accompany subarachnoid analgesia, with the hope that the prophylactic or therapeutic measures mentioned may help to improve the status of this technique in the professional and public mind.

Technical Administration

The axiom that a technique of anesthesia is as safe as the experience and ability of the physician applying it holds true in spinal anesthesia. The injection of a local anesthetic drug into the subarachnoid space is a procedure which, if carried out adequately, requires skill and care. The preparation of the anesthetist and the back of the patient should be just as thorough and painstaking as the preparation of the surgeon and the front of the patient for an aseptic incision.

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The results of carelessness or short cuts by the anesthetist could be more devastating to the patient than any lapse on the part of the surgeon.

1. *Assessment of Patient.* Prior to administration, a knowledge of the medical background of the patient is important. A history of previous or existing neurological disease is probably a contraindication to spinal anesthesia. A recrudescence of previous symptoms following operation will be associated with the subarachnoid injection, and it will be difficult to disprove a cause and effect relationship. Medicolegal proceedings have been initiated linking paraesthesias following spinal anesthesia to poliomyelitis which occurred 20 years previously (3).

Fear or objection on the part of the patient to a spinal block must not be brushed away lightly. Sufficient and well planned premedication may help to obviate the overall apprehension associated with anesthesia and operation. But if the patient is adamant in his refusal of spinal injection, even after a thorough explanation in the preoperative visit, then other methods of pain relief should be used. The present day anesthetist is sufficiently versatile that the desires of the patient usually can be heeded.

2. *Preparation of Equipment.* It is acknowledged universally today that spinal trays should be autoclaved before their use. However, care should also be taken to ensure that syringes and needles are properly prepared prior to autoclaving. A recent report (7) describes neurologic sequelae developing from a detergent in which syringes were washed before being sterilized.

3. *Positioning of Patient.* A single, direct insertion of the needle into the subarachnoid space is much more to be desired than repeated, frustrating attempts to find the canal. The latter undermines the confidence of the patient in the administrator and the associated trauma may be the cause of postoperative low back pain. A true lateral position with the patient curled up "like a kitten" will widen the spaces between the lumbar spines maximally and allow easy access to the cerebrospinal fluid. In the prone position an exaggerated jacknife position will accomplish the same effect.

4. *Aseptic technique.* Ideally the lumbar area of the back should be shaved. An antiseptic solution should be applied at least twice, working outward from the proposed site of injection. Prior to insertion of the spinal needle, the site of injection should be allowed to dry or be wiped off. Chemical arachnoiditis can occur from the inadvertent introduction into the spinal canal of cleansing solutions (8). Aseptic technique will be enhanced if the anesthetist ensures that his gloved hands do not touch any part of the needles to be inserted into the patient's back.

5. *Care in Puncture.* The use of small bore 24 to 26 gauge needles is felt to lessen the possibility of postspinal headache. The exact cause of this vexing complication is unknown, but majority opinion adheres to the so-called leakage theory. This supposes that escape of cerebrospinal fluid from the hole in the dura made by the needle is sufficient to cause stretching of the cerebral vessels and associated headache. The use of thin needles, however, increases the technical difficulty of lumbar puncture. If the bevel of the needle employed is facing either caudad or cephalad, there will be less potential trauma to the dura.

Occasionally, as the dura is entered, the patient will complain of sharp pain radiating down one of the extremities. This discomfort is due usually to the needle impinging on a nerve root. The position of the needle in the canal should be altered before injection of the anesthetic solution, as permanent neurologic sequelae have been reported to follow injection into a nerve root within the subarachnoid space (9).

From time to time blood is obtained mixed with cerebrospinal fluid when the stilette is withdrawn from the needle. This "bloody tap" is due most frequently to perforation by the needle of the venous plexus which lies between the anterior aspect of the subarachnoid space and the bodies of the vertebrae. If the needle is withdrawn one or two millimeters, it will be more properly within the subarachnoid space, the blood will disappear rapidly, and the procedure may continue If in spite of all efforts the blood continues to appear, a new interspace should be selected for the tap.

6 *Anesthetic Drugs.* Most of the drugs prepared for spinal anesthetic use on this continent are of such a high standard that their purity is seldom questioned. However, considerable discussion has appeared in recent years regarding the safest way of sterilizing the drug ampoules prior to use. Soaking in antiseptic solutions may lead to contamination of the drug by penetration through cracked or imperfect ampoules. Coloring the sterilizing solution with a dye such as methylene blue will aid in detecting such contamination (10), but even with this help the naked eye may not recognize the seepage (8). "Niphinoid" compounds are an aid in this regard, as such preparations dissolve with one or two drops of liquid. The best way of circumventing this hazard entirely is to have all ampoules autoclaved with the tray or as a separate package. Epinephrine is the only drug commonly employed for spinal injection which cannot be autoclaved at least once.

At times the inherent toxicity of spinal anesthetic drugs to nerve tissue has been incriminated in patients suffering neurological sequelae. None of the compounds employed commonly in practice today are believed to exert such effects, unless they be injected in too high concentrations. For example, procaine hydrochloride in concentrations up to 5 per cent is considered safe, but a ten per cent solution is capable of producing permanent nerve damage. All other factors considered equal, the more dilute the injected solution, the less likelihood of direct nerve involvement (11).

In the last ten years it has become a common practice to extend the duration of spinal anesthesia by the direct injection of vasoconstrictor drugs into the subarachnoid space. Recent evidence (12) suggests that in the total doses employed clinically, these drugs exert no deleterious effects on spinal cord or meninges.

It is difficult to conceive of generalized toxic manifestations occurring from overdosage of the anesthetic drug used for spinal analgesia. However, true sensitivity can occur (13), although the incidence of this complication has been estimated to be as low as 1 in 200,000 (14). Such reactions appear usually as generalized convulsive movements beginning within 20 minutes of the time of injection. They can be controlled by the inhalation of oxygen and the intravenous administration of a barbiturate.

Early Complications

1. Fear in a patient may become uncontrollable after subarachnoid block. One should do his best to allay dread by psychological comfort, but at the same time should not hesitate to employ narcotic or sedative drugs as indicated. In order to produce the most beneficial and predictable results, such compounds are best given intravenously (Table I). Before administration one should

TABLE I

SEDATION

Drug	Dose (Intravenous)*
Morphine	5 mg
Demerol	25 mg.
Seconal	50 mg
Nembutal	50 mg

*Administer every 3 to 5 minutes until drowsy

establish that the restlessness shown by the patient is not due to anoxia. This point in differential diagnosis may be difficult to make, and if one is in doubt, the sedative drugs should be withheld. Finally, the anesthetist should not be too proud to begin light general anesthesia to complement his conduction block, should the individual situation warrant it.

2. *Cardiovascular Reactions.* Hypotension and bradycardia are the principal complicating factors seen, and result more or less directly from the ascending paralysis of the sympathetic nervous system. Uncompensated vasodilatation of arterioles and unopposed action of the parasympathetic system are involved in the pathogenesis of the alterations. The anesthetic level may be controlled most adequately by employing either hypobaric or hyperbaric solutions, and thus enlisting the aid of gravity. Extreme caution should be exercised in patients with large abdominal tumors, as in such individuals the anesthetic solution may rise most rapidly in the subarachnoid space. Prophylactic measures against hypotension include the administration of a vasopressor subcutaneously before the conduction block. This is indicated particularly in the older age group with pre-existing hypertension. In such patients sudden falls in blood pressure are more dangerous than occasional elevations. The bradycardia may be controlled by small intravenous doses of a parasympatholytic drug such as atropine. Under all circumstances the safety of the patient is enhanced if an intravenous drip is begun prior to beginning the block. With an open vein sudden falls in blood pressure, neurogenic in origin, may be reversed rapidly and effectively by one of several vasopressor drugs (Table II).

3. *Respiratory System.* A conduction block which ascends higher than the 9th thoracic dermatome is likely to cause some degree of intercostal paralysis. Careful observation of respiratory movements should be maintained and attention paid to subjective complaints of difficulty in breathing. Oxygen administration by nasopharyngeal catheter is indicated if any doubt exists in the mind of the anesthetist regarding adequacy of tidal volume. The application of a face-mask with the administration of high oxygen concentrations, along with

TABLE II

VASOPRESSORS

Drug	Dose (mg)	
	I V	I M or S C
Ephedrine	10–25	50
Methedrine	3–5	10–20
Vasoxyl	3–5	10–20
Neosynephrine	1–3	3–5

Levophed—continuous drip only—4 mg to 1000 cc
Vasoxyl—continuous drip—20 mg to 1000 cc

assisted respirations, may be necessary at times The immediate availability of positive pressure oxygen during spinal anesthesia should not require emphasis in modern anesthetic practice.

4. *Nausea and Vomiting* When these complications occur within thirty minutes of the anesthetic administration, they are due usually to hypotension or anoxia, and the condition can be corrected as outlined above. When retching occurs later in the procedure, it is associated usually with traction on the mesentery by the surgeon or by an unusual position, e.g. prone, in which the patient may be lying If anoxia can be ruled out, the cautious administration of sedative drugs along with oxygen will often alleviate the condition At times light general anesthesia may be necessary.

5 *Inadequate Analgesia* Failure to obtain satisfactory pain relief after spinal injection is believed due in nearly every instance to technical errors Perhaps the most common mistake is the placement of the bevel so that it lies partially inside and partially outside the subarachnoid space. If one can obtain a free flow of cerebrospinal fluid by aspiration with a syringe both before and after the anesthetic injection, then the possibility of failure is remote Rachi-resistant patients will be seen perhaps only once or twice in the lifetime of the anesthetist

Late Complications

After general anesthesia both surgeons and patients expect to some extent metabolic upsets which lead to such symptoms as nausea, retching, headache, tinnitus, and so on. When such disturbances appear after spinal block, great furor is created and immediate remedies sought. Some of these symptoms may be associated with the surgical condition itself.

1. *Headache.* The commonest theory called upon to explain postspinal headache is that of abnormal leakage of cerebrospinal fluid through the hole in the dura made by the spinal needle. Actually the true and undeniable cause of this distressing symptom is unknown. Until the pathogenesis has been determined unequivocally, numerous and varied methods of treatment will persist. The best treatment for any one anesthetist is the one with which he has had the largest number of good results.

2 *Nausea and Vomiting.* This complication is not common, and may be associated with rough handling of the patient while the nerve block is still effective. Too early ingestion of food may also precipitate nausea.

3. *Backache.* This symptom perhaps is more common than anesthetists realize. It may not begin until the patient is ambulatory, and the anesthetist may not learn of it until the patient is hospitalized at some future time. Like headache, the etiology of spinal backache certainly is obscure. However, it is known that muscles tend to protect joints from undue strain or stretching. If the muscles of the back become completely paralysed and lose all tone, the lumbosacral and vertebral joints will be subjected to most unusual direct stresses. Stretching or actual alteration in alignments may occur, and these give rise to pain in the post-operative period. A certain amount of protection against this disturbance can be obtained by placing a small pillow under the back in the lumbar area in order to preserve the normal lordosis. Undue stretch may be alleviated by placing a second pillow behind the knees.

4. *Cranial Nerve Palsies* The exact cause of this usually self-limiting complication is unknown, but majority opinion believes that its inception is related to the leakage of fluid from the subarachnoid space, with consequent stretching of a cranial nerve, usually the sixth. The stretching is believed to cause a temporary interference with function (15) (16). However, one cannot rule out the possible involvement of "toxic" factors introduced from without.

5. *Cauda Equina Syndromes.* Damage to the nerve trunks lying within the subarachnoid space is referred to commonly as a cauda equina syndrome. The alteration which occurs within the nerve tissue usually is irreversible. Most commonly this syndrome follows the injection of a local anesthetic solution intrathecally. However, its occurrence is rare and follows no special pattern, nor is it associated with any particular sequence of events. Once again the etiology of this most serious complication is unknown. There seems general agreement that it is due to the insertion of some substance, chemical or bacterial, into the subarachnoid space, which under certain circumstances can cause loss of function in certain nerves. The possibility of its occurrence can be reduced by adhering to basic principles such as outlined above.

Summary

Spinal analgesia may be considered as safe as any method of pain relief, provided meticulous care is observed, common sense is exercised, and the technique is reserved for patients who want it, surgeons who desire it, and anesthetists who can perform it intelligently.

Résumé

De temps en temps une réévaluation des techniques courantes dans la pratique de l'anesthésie est nécessaire, afin de situer les méthodes à leur juste place en vue des développements récents. Le but de cette discussion est de passer en revue certains des hasards connus qui peuvent accompagner l'analgésie arachnoide, avec l'espoir que les mesures prophylactiques et médicamenteuses indiquées, pourront aider à améliorer l'état de cette technique dans l'esprit des professionnels et du public.

Dans toute considération de la sécurité relative d'une technique comparée à une autre il faut reconnaître que tout effort pour amener un soulagement de la

souffrance comporte un risque précis et déterminé. Il est difficile de rassembler des détails sur l'incidence de la morbidité suivant l'anesthésie lombaire, quoique dans une revue récente de 10,000 patients (5) la présence de détériorations neurologiques locales a été zéro. Un examen de 857,000 cas indique que le taux de la mortalité relatif à l'anesthésie lombaire est moins élevé que celui qui est calculé pour l'anesthésie générale (6).

Il ne faut pas imposer l'anesthésie lombaire aux patients qui la refusent et toute histoire de désordre neurologique antérieur ou plainte est une contre-indication. Les complications seront évitées en nettoyant scrupuleusement l'équipement avant de le mettre dans l'autoclave, en observant strictement les principes d'une aseptie, en suivant une technique soigneuse et précise dans l'exécution de la ponction lombaire. Des solutions diluées des drogues anesthésiques locales devraient être employées pour l'injection, et l'injection ne devrait pas être faite en présence de paresthésie produite par la canule, ou d'un écoulement continu de sang (bloody tap). Dans chacun des ces derniers cas on devra choisir un autre espace intermédiaire.

Les premiers complications de l'anesthésie lombaire se rattachent à la peur, à l'hypotension provenant de la paralysie sympathétique, et à l'anoxie due à la paralysie des muscles respiratoires. Ces complications seront traitées par l'emploi approprié de sédatifs ou anesthésie générale, de vaso-presseurs et d'oxygène. Les dernières complications sont maux de tête, nausées, vomissements, douleurs de reins et complications neurologiques Chaque anesthésiste a sa propre méthode préféré de traitement des maux de tête. La nausée et le vomissement proviennent généralement d'un traitement dur du patient ou d'une ingestion prématurée de nourriture. On évitera les maux de reins en plaçant un petit oreiller sous la partie lombaire de l'épine dorsale et un autre sous les genoux pendant que le patient repose sur la table d'opération. On évitera les séquelles neurologiques par le choix approprié du patient et une technique soignée.

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