

Sir Robert Macintosh's

Lumbar Puncture and Spinal Analgesia:

INTRADURAL AND EXTRADURAL

J. Alfred Lee

R. S. Atkinson

Margaret J. Watt

FIFTH EDITION

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Preface to the Fifth Edition

Since the last edition of this book was published in 1978, a number of changes have taken place in the theory and practice of both intradural and extradural block. Recent work has challenged many of the long-established and traditional views relating to the mode of spread of local analgesic solutions within the intradural space, while the discovery of the fact that narcotic analgesic drugs relieve pain when injected into close proximity to the spinal cord has opened up new avenues for theoretical study and clinical practice. Although the practice and technique of central neural blockade have been used for 86 years, a period longer than that of any other method commonly employed today, there is room for further study, understanding and improvement, as it must be admitted that the clinical anaesthetist cannot always explain the occasional capricious behaviour of the solutions he is using for spinal block.

In recent years the increasing interest in spinal techniques has led to a number of clinical investigations and reports, so that hardly an issue of any of the major anaesthetic journals is without some comment on these methods. This has required much reading and sifting of the literature before making alterations on almost every page. To help them with their work the authors of the fourth edition have asked a colleague, Dr Margaret Watt, to join them in the preparation of the present book. She brings to her task a wide experience of the practice of the techniques described in it, as well as the outlook of a younger anaesthetist who is also familiar with the literature of the subject.

Like the edition it replaces, this book is essentially a practical one directed at the working anaesthetist. The safety of the patient both during and after the employment of the techniques described has been our constant concern, and we believe that the advice it contains and the methods discussed, if put into practice, will not harm any patient. We would, nevertheless, continue to emphasise that the greatest care is necessary when central neural blockade is employed;

care in observation of the patient; care in sterility of equipment; and care in judgement as to the safe indications for its use.

A number of changes have taken place in the format of the present volume. The sections on physiology and pharmacology have been expanded and much of the chapter on intradural analgesia has been rewritten to take account of current work. The chapter on spinal analgesia in obstetrics has been enlarged and there is an entirely new chapter relating to narcotic analgesic drugs in the intradural and the extradural space. The authors have little practical experience of central neural blockade deliberately extended to the thorax or neck, so that these aspects of technique are not dealt with in this small book. For those who are interested in high block, and in all aspects of extradural blockade, we refer them to the definitive work *Epidural Anesthesia* by P. R. Bromage (1978), Philadelphia and London: Saunders.

The authors wish to thank the publishers for their help, but regret that, because of the cost involved, they have not found it possible to reproduce the plates again in three colours, as was done in the first edition. A number of illustrations have been added and for some of these they would like to express their thanks to Professor R. J. Last who has given them his permission to use several figures from his book *Regional Anatomy*. The authors are indebted to Mr John Wood of the Photographic Department of the Southend Hospital for his help, as well as to others who have kindly allowed reproduction of their own work. For secretarial assistance they are grateful to Mrs Betty Bradbury and Mrs Penny McLagan.

Southend-on-Sea,
1985

J.A.L.

R.S.A.

M.J.W.

Preface to the First Edition

The literature on lumbar puncture and spinal analgesia is abundant enough to make an explanation necessary for any addition to it. The reasons for another book on this subject are various. Although lumbar puncture is often entrusted to the newly-qualified house doctor, it is seldom that he has had any instruction on how to carry it out. It is difficult to find a concise exposition of the technique to which he can refer; and the result is that early attempts are frequently and unnecessarily bungled. That is why I have included in this book the things I should have liked to have readily available for myself when setting out on my first lumbar punctures and spinal anaesthetics. A road-map is often a useful thing to have when one is exploring an unfamiliar locality.

The second reason is that some surgeons, encouraged by the fact that they are expert at lumbar puncture, have been tempted to take the further step of giving their own spinal anaesthetics: in which case, not infrequently, their lack of knowledge of basic principles leads them into difficulties. 'The apparent simplicity of the manoeuvre constitutes its greatest danger in the hands of the tyro' (Editorial, 1900). 'The factor most contributory to its tragic history is the ease with which it can be performed by anyone' (Greene, 1949). Forty-nine years intervened between the writing of the last two sentences. The quip that Pentothal is fatally easy to give, still has its counterpart in spinal anaesthetics. A patient under a spinal anaesthetic should be looked after by a trained anaesthetist. But if for one reason or another, the surgeon has both to operate and to keep an eye on the general condition of the patient, he should at any rate know something about the essentials of the subject and what to do if things go wrong.

A third reason for this book is that members of this Department have thrown light on certain obscure aspects of spinal analgesia, and I feel that the points cleared up will be of interest to others too.

My fourth reason is my desire to take advantage of the collaboration of Miss McLarty, which I have the good fortune to enjoy. Certainly I should not have embarked on this work without her help: for I believe that views on what is largely a technical subject can be conveyed more quickly and, what is more important, with greater accuracy by a few good illustrations than by pages of script. There is much to be said for Corning's observation in 1900: 'I advise those who contemplate practising spinal anaesthesia to take a look at the skeleton, especially the relations of the lumbar vertebrae. An intelligent glance of that sort is worth many words' (Corning, 1900). I have spent many unattractive but profitable hours working in the post-mortem room and, for the facilities provided, I am grateful to Dr A. H. Robb-Smith. If a dissection has been fruitful, Miss McLarty has recorded it clearly and with decision: and I am sure that these illustrations will be helpful to those who have no opportunity for dissecting this unfamiliar region. I am indebted, too, to Miss A. Arnott for other valuable illustrations. Some of the pictures may appear almost duplicates, but I include them deliberately where they are likely to help the reader to form a clear mental picture of the structures through which the needle passes on its way to the vertebral canal, and of the obstacles which are likely to be impeding it when it is off course; as well as of what happens to an anaesthetic solution deposited within the dura.

I do not intend to extol the virtues of spinal analgesia. The benefits of any method of pain relief, general or local, have to be paid for in terms of morbidity, and the price exacted to the patient in this respect depends little on the choice of method or agent, but very much on the care, skill and experience of the anaesthetist himself. From a purely selfish point of view, the consequences to the anaesthetist of carelessness or inexperience are much less serious with a general than with a spinal anaesthetic. Even in the event of death, a sympathetic pathologist has only to stress the unhealthy state of some organ; then everyone, including the anaesthetist himself, if he is complacent enough, will believe the coroner's finding that no one was to blame; and so the incident is soon forgotten. But a grave mistake with a spinal anaesthetic is quite another matter. A paralysed patient wheeled about in a bath-chair is a constant reproach, and does nothing to enhance the reputation of surgeon and anaesthetist concerned. Moreover, in some cases heavy damages have been awarded, although anomalously there would not have been the slightest prospect of this if the patient had been killed outright by a general anaesthetic badly given.

I have to thank my erstwhile Registrar, Dr A. Crampton Smith, now happily a Consultant, for his skill and care in cutting the bony vertebral sections and for his help in dissecting the specimens from which a number of the drawings were made. Even though the typescript is not extensive I am conscious of, and grateful for, the guidance extended to me by experts in allied subjects, especially Professor T. B. Johnston, Dr H. G. Epstein, Dr Grita Weiler and Mr Lionel Salt. Their help on doubtful points has been a source of considerable comfort.

I have only to add that although at first I intended to confine the scope of this book strictly to practical aspects of lumbar puncture and spinal analgesia, I have extended certain sections to include a few academic points likely to be of interest to the examination candidate.

Nuffield Department of Anaesthetics
University of Oxford, 1951

R. R. Macintosh

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Introduction

There is no doubt that spinal analgesia, having gone through a period of loss of popularity, is being employed more extensively in recent years. The reasons for loss of enthusiasm are not hard to enumerate. The phenomenal muscular relaxation central neural blockade provides has for many years been matched by the use of curare, more easily administered. There is no doubt that the shadow of litigation discourages the use of spinal analgesia even in the patient's best interests. From a purely selfish point of view, the consequences to the anaesthetist of carelessness or inexperience are much less serious with a general than with a spinal anaesthetic. Cynical in the extreme, but true, is the opinion expressed by a colleague that in anaesthetics it is less expensive to kill than to maim.

Cogent arguments against the use of intradural spinal analgesia have appeared in medical journals from 1906 onwards: (Kennedy et al, 1950; Cope, 1954; Koenig, recorded by Greene, 1961). While in no way belittling the calamity of a post-spinal neurological lesion, the probability of faulty technique must be borne in mind. Seldom are details given of the training, skill and experience of the anaesthetist concerned. To get these tragedies into perspective, consideration must be given to the large number of less publicised silent witnesses, in the graveyards, of general anaesthesia incompetently administered. Moreover, major neurological lesions are not confined to intradural and extradural spinal analgesia (Pisetsky, 1945; Ciliberti, 1948; Zweighaft, 1949; Thomas and Dwyer, 1950; Sinclair, 1954; Norman, 1955; Lett, 1964); and paraplegia has been reported after spinal analgesia, but otherwise unrelated to it (Leatherdale, 1959).

We concur in the view that postoperative complications are no more common after both forms of spinal analgesia than after general anaesthesia (King, 1933; Dripps and Deming, 1946; Urbach et al, 1964) and we believe the safety of well-conducted spinal analgesia is attested by the reports of thousands of carefully followed-up

cases by recognised authorities (Dripps and Vandam, 1954; Vandam and Dripps, 1955, 1956; Lake, 1958; Wilkinson, 1963; Moore and Bridenbaugh, 1966; Phillips et al, 1969). The results bear comparison with those of any other similar series given general anaesthetics. Our belief is reinforced by a publication (Gordh, 1969) which states that in the 24 years up to 1969, 50 000 intradural spinal anaesthetics had been administered in the Department of Anaesthetics of the Karolinska Hospital in Stockholm without any serious neurological sequelae, while from Canada comes a review of over 78 000 cases from teaching hospitals with no serious sequelae (Noble and Murray, 1971).

Although the first three editions of this small book dealt primarily with spinal or intradural analgesia, much of what we have written can be applied to the slightly more difficult technique of extradural block, which was incorporated in the fourth edition. The widespread interest in narcotic analgesic drugs injected into the extradural or intradural space has necessitated an additional chapter in this fifth edition. We hope that the increasing number of anaesthetists who employ these techniques will find the new edition useful.

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History

Intradural analgesia

The introduction of the hollow needle and a conveniently sized glass syringe by Alexander Wood (1817–1884) (Wood, 1855) in 1853 and the clinical demonstration of the local analgesic properties of cocaine by Koller (1858–1944) (Koller, 1884a) in 1884 were direct steps leading to spinal analgesia. Corning (1855–1923), a neurologist, who wrote the first textbook on local anaesthesia, *Local Anesthesia in General Medicine and Surgery* (New York, 1886) was the first to inject cocaine into the region of the spinal cord (whether intra- or extra-durally, is not quite certain), but it is not surprising that this work passed unacclaimed by contemporary workers. It was in 1885 that he injected cocaine into the subarachnoid space, but he did so unintentionally and without recognising what he had done. The result was indeed dramatic, but it is certain that it could not be reproduced at will, either by Corning himself or by anyone else carrying out the technique he described. Corning's experiment was based on faulty physiological and anatomical premises: for he believed that cocaine injected into the region between two spinous processes would be absorbed by veins and 'transferred to the substance of the cord, and give rise to anaesthesia of the sensory and perhaps motor tracts of the same' (Corning, 1885a). The fact that morphine and other narcotic analgesics can act at sites distal to the brain, is one of the most interesting discoveries of recent years (Snyder, 1977; Behar et al, 1979).

At this time the aim of any injection was to deposit the drug as near as possible to the site on which it was desired to act. Thus Wood (Wood, 1855; Howard-Jones, 1947) believed that the main virtue of the hollow needle was that it deposited morphine in close contact with painful nerves, and for many years physicians continued to consider morphine effective only if injected actually into the painful lesion. Corning was in a dilemma. He wished to deposit the cocaine

reasonably close to the cord, and yet avoid the risk of injuring it by puncture. He performed a preliminary experiment on a dog, injecting, at an unstated depth, 20 minims of 2 per cent cocaine 'into the space situated between the spinous processes of two of the inferior dorsal vertebrae'. This was followed by loss of sensation, and incoordination of the hind legs. The fact that the effect had not spread to the forelegs was attributed to 'the lethargy of the circulation at this point'.

After this he carried out his now well-known experiment on man. He had noted that in the lower thoracic region the transverse processes of the vertebrae lie at the same depth as the laminae which form the posterior boundary of the vertebral canal. He therefore first inserted the needle lateral to the mid-line until the point touched the transverse process, and adjusted the marker on the shaft of the needle to skin level (Fig. 1.1). The needle was then reinserted, this time in the mid-line between two spines, but as a guarantee against injury to the cord, not quite up to the marker (Fig. 1.2). He now injected — with what object it is not clear — 60 minims of 3 per cent cocaine 'into the space situated between the spinous process of the 11th and 12th dorsal vertebrae' of a man who suffered from

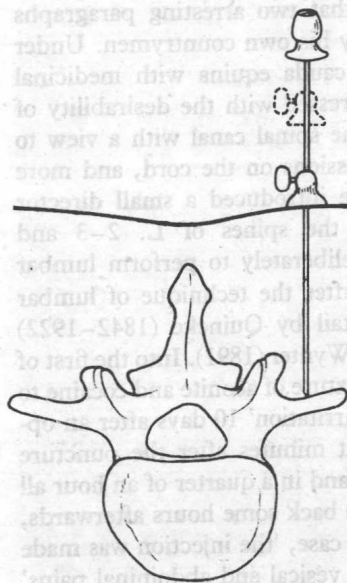


Fig. 1.1

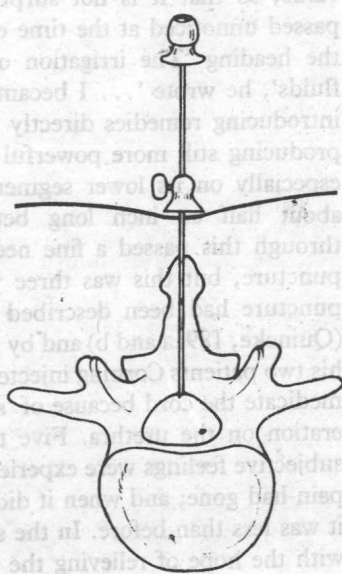


Fig. 1.2

'spinal weakness and seminal incontinence'. Ten minutes later the legs felt sleepy, and later still there was complete analgesia of legs and perineum. If these directions are followed, the tip of the needle will lie roughly at the depth of the ligamentum flavum, and in the hands of a cautious contemporary investigator trying to corroborate Corning's findings, well proximal to it. Corning does not mention the ligamentum flavum nor the dura mater: yet such anatomical boundaries are of the greatest significance when considering the spread of injected fluid. If the tip of the needle lies superficial to the ligamentum flavum, the effect of the injection is nil. Even if the tip penetrates the ligament and lies within the extradural space, the effect of 3 to 4 ml of 3 per cent cocaine is negligible. If, inadvertently, the needle happens to have been inserted a fraction of an inch further on, the dura is pierced and the wide spread of the injected fluid in the cerebrospinal fluid gives striking results. The dripping of cerebrospinal fluid through the needle, the sure sign that the dura has been entered, was denied to Corning because, as his article makes clear, he introduced his needle with a charged syringe already attached.

In 1894 this prolific writer published another book of essays (Corning, 1894), some rehashes of previous articles, others of mixed value, so that it is not surprising that two arresting paragraphs passed unnoticed at the time even by his own countrymen. Under the heading 'The irrigation of the cauda equina with medicinal fluids', he wrote '... I became impressed with the desirability of introducing remedies directly into the spinal canal with a view to producing still more powerful impressions on the cord, and more especially on its lower segment.' He introduced a small director about half an inch long between the spines of L. 2-3 and through this passed a fine needle deliberately to perform lumbar puncture, but this was three years after the technique of lumbar puncture had been described in detail by Quincke (1842-1922) (Quincke, 1891a and b) and by Essex Wynter (1891). Into the first of his two patients Corning injected a mixture of aconite and cocaine to medicate the cord because of 'spinal irritation' 10 days after an operation on the urethra. Five to eight minutes after the puncture subjective feelings were experienced, and in a quarter of an hour all pain had gone; and when it did come back some hours afterwards, it was less than before. In the second case, 'the injection was made with the hope of relieving the severe vesical and abdominal pains' which are a peculiarly distressing feature of caisson disease, then common because of the building of the tunnel under the Hudson

River. As well as in these two cases, he had 'occasionally resorted to the procedure in properly selected cases'.

In 1885, Corning finished his article describing the patient to whom he had introduced cocaine unwittingly and unknowingly into the subarachnoid space with the following dramatic passage: 'Whether the method will ever find an application as a substitution for etherisation in genito-urinary or other branches of surgery, further experience alone can show. Be the destiny of the observation what it may, it has seemed to me, on the whole, worth recording.' These two sentences have often been taken incorrectly from their context to give Corning credit for the introduction of spinal analgesia. It is strange that in 1894, when he purposefully introduced mixtures containing cocaine into the subarachnoid space, he did not realise that the case he reported in 1885 was one of inadvertent spinal analgesia, and that there was now a more dependable method of achieving this which would allow certain surgical operations to be performed without general anaesthesia.

There was, however, a defect in Corning's technique which made it not nearly as reliable as it would at first appear. The needle, before it was introduced through the skin, was screwed on to the nozzle of the syringe already charged with solution. It was then a matter of hit or miss, with the latter a strong probability. The needle was inserted and the solution injected; and such a procedure would necessarily lead to a percentage of failures high enough to be discouraging. Present-day spinal analgesia would soon be abandoned if, before injection, the anaesthetist did not confirm that the point of the needle lay within the dural sac. Even after spinal analgesia for surgery had been generally accepted, such blind shots appear to have been commonplace, for many writers found it necessary to stress that the solution should not be injected until cerebrospinal fluid was seen to issue from the needle (Lusk, 1911). On one occasion the anaesthetist, having introduced his needle, accepted a shooting pain down the leg as his clue to inject (Trantenroth, 1906). A glance at Figure 7.18 suffices to explain why the resultant analgesia was restricted.

Corning appears to have regarded his intentional intradural injection only as a means of alleviating existing pain. He overlooked its possibilities in surgery. One is reminded of the part played by Humphry Davy (1778-1829) (Davy, 1800) in the discovery of general anaesthetics. He recorded when inhaling nitrous oxide experimentally that the pain caused by an erupting wisdom tooth was relieved; but he did nothing further about the matter and his

observation had no direct bearing on the introduction of general anaesthetics some 46 years afterwards. Similarly, Corning's writings attracted no attention at the time, and it is certain that they had no influence upon the ultimate adoption of spinal analgesia in surgery (see also Little, 1979).

In 1891, Essex Wynter (1860–1945) (Wynter, 1891), physician to the Middlesex Hospital in London, briefly described four cases in which he had performed lumbar puncture with Southey's tubes (used in the treatment of dropsy and ascites) to allow continuous drainage of cerebrospinal fluid, in an attempt to relieve increased intracranial pressure associated with tuberculous meningitis. A few months later, Quincke (1842–1922) (Quincke, 1891a), acknowledging Wynter's work, described the technique of lumbar puncture, essentially the same as that practised today, and showed how the cerebrospinal fluid pressure could be relieved by simple puncture. The practice of present-day spinal analgesia is a direct consequence of this admirable article. The withdrawal of fluid proved disappointing as a therapeutic procedure: but soon hope was transferred from simple withdrawal to replacement of the fluid by a solution which would come into contact with the region which it was desired to treat. Ziemssen (von Ziemssen, 1893) suggested this after injecting methylene blue intrathecally into corpses, and Sicard (1872–1929) (Sicard, 1898, 1899), after preliminary work on animals, injected antitetanus serum by the same route into a patient with tetanus.

The first two publications on spinal analgesia for surgical operations were made in 1899. At the time of their investigations neither author knew of the work of the other, but both acknowledged their indebtedness to Quincke. The article by Bier (1861–1949) (Bier, 1899) (who worked at the same hospital as Quincke at Kiel) preceded that of Tuffier (1857–1929) (Tuffier, 1899) by a few months, and in it he described six patients to whom he had given 10 to 20 mg cocaine intradurally for operations on the lower limb, the first receiving his injection on 16th August 1898. The question of sterility is not mentioned, and since he used tap water to dissolve the cocaine crystals (Sebrechts, personal communication) and placed his finger over the hub of the needle to lose as little cerebrospinal fluid as possible, it is not surprising that headache and vomiting were marked features of convalescence. These unpleasant after-effects were described as being as bad as those after chloroform and ether, with the added disadvantage that they sometimes lasted longer. In order to investigate their causation,