



Intentional Cervical Spinal Anesthesia and High Spinal Anesthesia, or Segmental Spinal Block.

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INTRODUCTION:

In the history of neuraxial anesthesia there have been a number of medical practitioners who have intentionally made subarachnoid injections with local anesthetic drugs, while inserting the needle into the high thoracic and cervical levels of the spinal canal in patients. It certainly was never a common practice, and is not currently a recognized practice within any large institutional and academic centers. This author has however, communicated via GASNET with two individuals in third world communities who had experience of such practices. Neither of those last two, reported patient death or permanent paralysis having occurred within their own practices. The prevailing popular standard of practice is to restrict anesthesia-intentioned intrathecal-injections to segmental levels below the believed termination of the spinal cord. This is to reduce the risk of an injurious injection to within the spinal cord. The cord usually terminates at the L1-2 level.

The reasons for this title-subject having any modern-time interest are;

1. Best medicine is practiced when one knows the history of how current practices evolved. To not know that, is to only be a technician with limited ability to adapt or innovate when novel challenges arise.
2. To understand what has happened, predict the outcomes, and to best manage the consequences when an *accidental cervical spinal* block is injected, during an intended epidural block.
 - This author has provided medicolegal expert opinion, in an alleged malpractice case where a test dose of local anesthetic for an epidural block was injected unintentionally intrathecal at the T4 level.
3. To consider using an intentional cervical intrathecal injection in an esoteric, rare but special case, where that would be best choice. That is a very rarely indicated technique. Such an event has not yet risen in this author's career. In that rare event, one must have full understanding of the intervention.

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HISTORY OF INTENTIONAL CERVICAL AND HIGH THORACIC SPINAL ANESTHESIA.

August Bier, from Berlin, pioneered and performed the first ever spinal (intrathecal) anesthetics in 1898¹. His concept was to inject cocaine, as local anesthetic drug, at the same point where lumbar punctures were most successfully performed to obtain cerebrospinal fluid (CSF). In 1908 an American author called DT reviewed the status of spinal anesthesia up to that time². DT reported multiple cases of successful spinal blocks injected in the 7th cervical interspace using drug mixtures modified to preserve respiration and cardiac function.

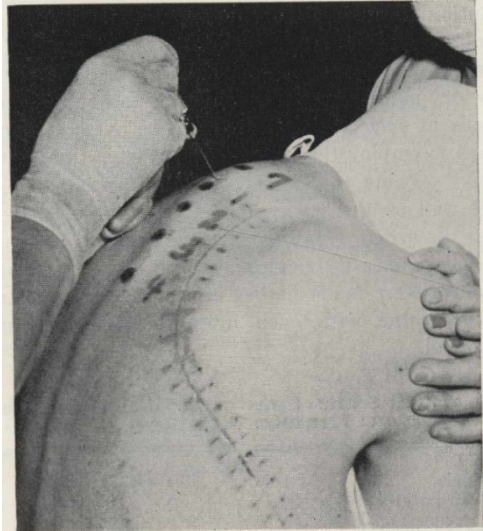


Figure no. 1. Injection of a cervical spinal block. 1950 Hubbard.

In 1950 Hubbard reviewed high segmental spinal anesthesia, and presented a personal series of 75 such cases³. See figure number 1. The block was used for lateral thoracotomy incisions for lung and pleural surgery. The extent of the block, was reported to follow the *dose* in mgs of pontocaine administered. Obviously, that could equally be matched to the *volume* of drug solution injected. The block solution consisted of 4% dextrose, 0.13% phenylephrine, 0.33% pontocaine, all in a cerebrospinal fluid volume of 1.4 ml. Only one patient needed intubation. All patients lost sensation in the arms, while retaining 50% motor strength in the arms. The block was performed in the sitting position, followed immediately by re-positioning the patient in the lateral position, surgical side UPWARDS. No thoracotomy patient died, and a few required some supplementary IV opiates for comfort. The patients were considered remarkably cardiovascular stable compared to those where either general anesthesia was used, or when

high spinal block was achieved by large drug volume lumbar spinal block. No spinal cord injuries occurred. The nerve block was segmental and was restricted to the zone immediately above, and below

the level of injection. In all patients the legs could feel and move as was normal. The spinal block needle was inserted with great slow caution whilst under constant aspiration via an attached syringe. The needle tip entry into intrathecal space was identified by the aspiration of CSF into the syringe. Needle advancement was then stopped.

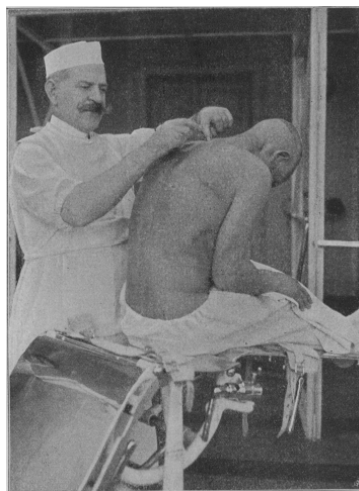


Figure #2. Jonnesco demonstrating the highest thoracic spinal injection point that he recommended.

Another pioneering anesthesiologist-surgeon in 1909, Jonnesco from Bucharest, claimed to have performed high intrathecal injections (spinal blocks)⁴. He did them at either T1-2 or T12-L1. He reported doing 103 cases with injection at the T1-2 level. There are other scientific writers who considered him to be a fraud, and a narcissist writing completely faked experiences. In probability, there is some truth in what he wrote, with possible embellishment of numbers and successes. He commented, that if in the sitting position when the needle was inserted at the T1-2 level, no CSF flowed from the needle due to low CSF pressure, the patient could be asked to cough. That would push a drop of CSF out of the needle. The drop of CSF would indicate the needle tip was in the subdural (intrathecal) space.

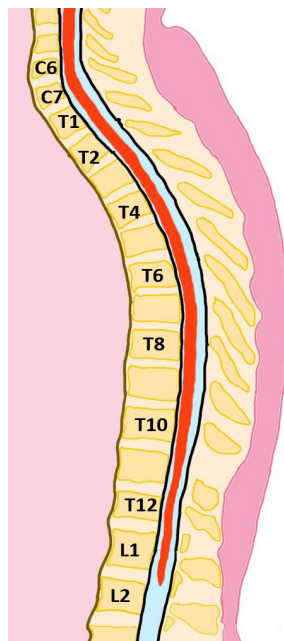


Figure no. 3. The spinal canal in longitudinal section. Note how in the thoracic zone the spinal cord lies towards anterior, thus making the CSF containing intra-theal space posterior of the cord slightly larger. This facilitates performing thoracic segmental spinal blocks.

Intentional and segmental cervical intrathecal blocks were described in 2009 in 35-patients⁵. It was used to administer bupivacaine for severe head and neck chronic pain. Non-motor blocking doses-concentrations were used. All the patients were terminal cancer patients, and the procedural risks were considered acceptable. The alternate injection site was intra-cisternal via direct suboccipital approach, but the cervical intrathecal approach was much preferred due to its relative technical ease. The authors made use of fluoroscopy and contrast injection to verify intrathecal-catheter-tip final positions, before injecting any active drugs via the needle. The authors acknowledged and referenced the procedural risks were paraplegia, subarachnoid hematoma and death.

Chronic pain therapy physicians have a documented history of performing intrathecal

subarachnoid blocks for the purpose of doing neurolysis, even though it is uncommon practice⁶.

There are also a series of reports of intentional intrathecal blocks done at varying thoracic levels in the form of a combined spinal-epidural (CSE) block. The popular term often used for these high level CSE blocks is "Segmental" spinal block. Zundert, in 2006, reported doing a CSE at T10 level for awake cholecystectomy in a critically ill patient⁷. After confirmatory CSF flowed out of the block needle, Zundert injected 2.5 µgm sufentanil, plus 1ml 0.5% bupivacaine. A segmental sensory nerve block was obtained from T3 to L2, at 10-minutes after injection. No supplementary analgesia was needed during surgery. It is of note that the spinal cord tends to lie more to anterior with the thoracic intrathecal space leaving a few extra millimeters of CSF containing space into which a thoracic intrathecal needle can be inserted from posterior. Zundert emphasized that the thoracic spinal cord lies slightly towards anterior within the fluid filled intrathecal sack. See figure no. 3, which derived from an MRI view in Zundert's article.

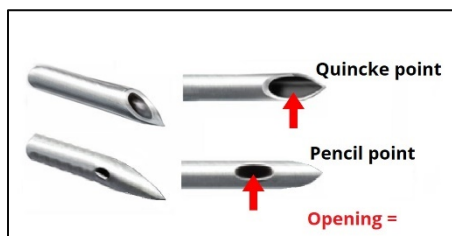


Image #4. Note how a pencil-point spinal needle-tip, would require a deeper insertion of the needle before the *side-orifice* entered the intra-theal space to let CFS leak out via the needle, compared to the *tip-orifice* sharp point Quincke tip needle.

In 2009 Imbelloni made an argument for segmental thoracic spinal anesthesia in an editorial commemorating a century from Jonnesco's report⁸. He also recommended using a Quincke-point type spinal needle rather than pencil-point needles, for segmental thoracic spinal blocks. The reason is that the pencil-tip type needle has a side orifice, as opposed to the Quincke type needle's end-orifice. Consequently, a pencil point spinal needle would need to be advanced 2 to 5 mm deeper into the intrathecal space before the side-orifice entered the intrathecal space to allow CSF to wash back through the needle as a "safety" marker of correct needle insertion depth. This would increase the risk of the needle tip puncturing the spinal cord.



This author must also add that a pencil point needle penetrates fascia layers more difficultly than sharp-point needles. This would make the dura tent inwards towards the spinal cord, before the needle could puncture the dura. That is an additional factor increasing the risk of cord puncture by needle tip. Therefore. For this block type, a Quincke needle should be used.

A 2011 editorial-style letter by Armando Fortuna, who had experience in this field argued strongly that there is only one justifiable indication for segmental spinal anesthesia (e.g. cervical spinal). That indication is, when a lytic injection of spinal nerve roots is needed for analgesia for severe unresolvable pain, in definitively bed-ridden and terminal-cancer patients⁹. Fortuna, also made strong argument that the 1909 reports of multiple level application of segmental spinal blocks with success, by Jonnesco were fraudulent. He said Jonnesco was a fraud who additionally used the lay press for self-promotion. Fortuna's letter was, in fact, a response to the above mentioned Imbelloni 2009 editorial where Fortuna made strong arguments disagreeing with Imbelloni's support of segmental thoracic spinal blocks.

In a 2003 GASNET letter exchange Raw and Fortuna agreed that cervical spinal anesthesia was "lunatic"¹⁰.

UNINTENTIONAL HIGH INTRATHECAL BLOCKS.

The concept of "high" here refers to the segmental level of block needle insertion well above the termination of the spinal cord. It does not refer to the height of the achieved nerve block. A total-spinal high-block is achievable from any level of drug injection, if sufficient volume of drug is injected.

Fukushige reported in 2009, of an epidural catheter, being inserted at T7-8 for analgesia after awake gastrectomy, that ended intrathecal¹¹. Fluoroscopy, using injected contrast, confirmed the epidural catheter was in the subarachnoid space. It was then decided to use it as an intrathecal catheter. Ten ml. of 0.5% bupivacaine was injected. A block from C5 to S1 was obtained. Five ml. 0.5% bupivacaine injection was repeated, after 2 hours of surgery. The catheter was infused with 0.25% bupivacaine at 2ml / hour for 7-postoperative days. The catheter was effective and no complications arose. Unfortunately, there is no English text available describing whether the high spinal block was 100% effective for awake upper abdominal surgery, or whether substantial supplementary IV analgesia was needed. The author believes that because Vagus was not blocked, the discomfort of parasympathetic transmitted pain would have required some supplementary analgesia during the surgery.

RADIOLOGY AND INTENTIONAL CERVICAL AND HIGH INTRATHECAL INJECTION, AND THE DANGER OF INTRA-CORD INJECTION.

In the medical era before the discovery of MRI scanning and CT scanning, radiological myelography was the standard method of assessing the vertebral canal^{12, 13, 14, 15}. There are abundant case reports from radiologists of accidental needle placement to within the spinal cord^{16, 17, 18}. The resultant injuries ranged from death and paraplegia or quadriplegia, to nothing discernable.

Robertson was able to report on 25 cases from a survey, and review the literature on other case reports¹⁹. Five of the survey group, had documented needle punctures of the cord without substance injection. The patient outcomes were largely fine except for one who died associated with an artery injury. Those sixteen others with documented cord needle puncture, had had an additional injection of



substances, like radiological contrast agents. Of those sixteen, all had immediate large neurological deficits with only 50% of them ever achieving any recovery. It can reasonably be concluded that when the only insult to the cord was needle penetration followed by its removal without substance injection, then the extent of patient injury was not death, nor severe life-style-limiting severe injury. It also seems that severe cord injury was most strongly associated with the *injection* of substance into the cord tissue. It also depended on the amount of substance injected, and the nature of substance injected with respect to its inherent neurotoxicity in full concentration. Finally, it seems deep cord injections into the gray matter was much more serious than superficial cord injection into the white matter.

Therefore, it can be concluded that great emphasis must be placed upon determining when possible, if the needle-tip is within the cord or not, before any substance is injected. Lateral radiological scanning of the needle tip during advancement of the needle was highly encouraged in order to minimize the risk of advancing too far (into the cord). There was not clarity about the occasional observation of pain during injections. The mention of pain upon injection seen with some patients in the Robertson report ⁽¹⁸⁾, was largely considered a bad sign and a reason to cease injecting and to remove the needle. That pain also had a high correlation with neurological fallout only in the distribution of the lateral nerve roots on the side from where the lateral approach was being used. Such pain on injection has only been reported with lateral approaches, thus far. It thus must be believed that such pain came from *nerve roots* associated with hyperalgesic pain, and that pain did not indicate specific cord penetration.

It seemed also that using larger more blunt needles, like typical epidural-needles did usually produce a fine “popping” feel upon dural puncture, that was useful to the operator. However, it was also shown that with a larger blunt needle, the dura could be tented inwards up to one centimeter before it was penetrated. That could result in the needle indenting the spinal cord, if not actually penetrating it as well. Accordingly, some respected experts recommended using smaller sharp-tip needles for cervical myelography to *reduce* the risk of cord penetration. Another recommendation was to also limit the very first contrast injection to less than 0.5 ml as that corresponded with least severe cord injuries, when cord puncture was diagnosed.

THE DANGER OF AN INTRA-CORD INJECTION:

The first risk factor is that the spinal cord, being part of the central nervous system (CNS) with the brain, is insensate like the brain is. Patients who are entirely unsedated report no pain from spinal cord and brain incisions. This author verifies that fact, via personal experience observing this during awake spinal cord surgery. A patient can sometimes describe very unusual, and hard to describe, very subtle sensations in a specific distal anatomical region matching the CNS part which an inserted needle is touching. The patient will only however offer that information if the correct very specific questions are asked about the targeted body part. Neuro-surgeons sometimes utilize this patient feedback when needing to insert cyst drainage-needles or stimulating wires into very specific targeted CNS parts. An example surgery, would be insertion of a CSF drainage catheter into a section of the cervical cord with syringomyelia. Sometimes, with awake brain surgery, a small electric-current needs to be passed through the needle, to elicit the vague sensation for a patient to report upon. Of note, the patients will not object to the needle or wire insertion as it is painless, and will not volunteer the subtle minor novel



sensations experienced unless asked. Also, if the patients are sedated in any degree, they are unable to report those minor CNS sensations even if asked about them.

This phenomenon, of the spinal cord having no pain sensations, makes it easy to unintentionally insert needles into the cord, even in awake patients. It was strongly, infamously argued in the past by Bromage, that all neuraxial nerve blocks must be done on awake patients only in order that they can alert the operator, via pain response, that a needle has touched or entered the spinal cord^{20, 21}. Sixty regional anesthesia experts replied to Bromage by published letter, where they disputed Bromage's recommendations. Bromage did not know that the spinal cord is essentially, insensate. It is now widely acknowledged that that Bromage had made an erroneous argument. The cord lacks normal sensation. It is also impossible to absolute differentiate any report of sensation whether it came from cord penetration or a needle touch of a nerve rootlet outside of the cord. The normal healthy peripheral nerve does not produce pain when touched or penetrated by a needle. A peripheral nerve however involved in a hyperalgesia syndrome, is very sensitive to touch by a nerve block needle and that nerve does produce pain. Learned opinion is now that performing neuraxial blocks on sedated or asleep patients is no riskier than doing the same on block on awake patients.

CONCLUSION:

Clearly, intentional high thoracic and cervical spinal anesthesia is technically feasible, and has been practiced effectively and safely by a good number of people. The major concern remains, and that is the potential for spinal cord injury, either from needle penetration of the cord, or from intra-cord injection from an unrecognized intra-cord needle tip-placement.

If ever any person considers performing such a cervical intrathecal block, they should meet with fulfilling all the following requirements;

1. Be a physician.
2. Be certified and skilled in advanced life support techniques.
3. Be a trained, practicing, and very experienced person in the general techniques of epidural and spinal anesthesia.
4. They strongly *consider* also using lateral view radiological confirmation of final needle tip position, for which they must additionally be experienced in the use thereof.
5. The indication for the procedure must have strong indications relative to alternative techniques that could be used.
6. The patient is appropriately informed of the pertinent risks, and then consents to the procedure.
7. Use a thin shallow-cut, sharp-point end-orifice needle, with a Quincke design. Then aspirate gently and continuously if performing the high spinal in an upright (sitting) patient.

True high spinal blocks are not elective procedures for the common working anesthesiologist with modest or less regional anesthesia knowledge and experience, and this author highly recommends against it.

Conversely, it is useful having this knowledge about high intrathecal local anesthetics blocks. Epidural injections in the low cervical and high thoracic regions, can accidentally be injected intrathecal. That should not be catastrophe with any long-term consequence provided the patient is given cardio-



respiratory support as needed, if even needed. One must know that the drug will act only in a segmental fashion and only for the segmental extent and block effect proportional to the injection volume and concentration of the local anesthetic.

The technique for cervical and any thoracic epidural must also be modified to have extra methods by which intra-cord needle placement can be detected before drugs are injected. This author has unpublished informal research where 10 needles were placed into the epidural space in sleeping pigs. Half were into the lumbar region and half were into the mid-upper thoracic region all via midline approaches. The needles were situated in the epidural space using loss of resistance techniques to air.

Then the needles were advanced until a very subtle “pop” was felt followed by flow of CSF. Next the needles were advanced another centimeter upon which CSF flow stopped. Then attempts were made to advance an epidural catheter. With the thoracic epidurals, simultaneous transesophageal sonography was done imaging toward posterior. With correct needle insertion point adjustments, while “looking” via an intervertebral disc window, with the ultrasound, it was possible to position the epidural needle at a level where it could enter the portion of the spinal canal that the ultrasound machine could see. In summary, all the epidural needle tips were placed within the porcine spinal cord. In the thoracic region there was sonographic verification of the fact, and in the lumbar region it was presumed that the needle tips were within the spinal cord. Attempts were made to pass an epidural catheter out of the needle into the spinal cord. It was impossible when an Arrow brand Flex-tip^R catheter was used, with the stiffening stylet withdrawn 1 cm. Using other brands of traditional more stiff catheters, it was possible with some force to advance the catheter 1 to 2 centimeters into the spinal cord. An Arrow brand Flex-tip^R catheter, with the stylet withdrawn 1cm, can be easily advanced into normal epidural spaces. Based on this limited and yet, unvalidated by others study, this author strongly

There was no communication or contact made with any trade company relating to this informal study. The study was done with institutional animal research ethical approval.

This author strongly recommends always using an **Arrow brand Flex-tip^R** epidural catheter, when performing any epidural block or single shot injection above the L2 level. Make all injections be via the catheter, and never through the needle. For a single shot injection, advancing the catheter only 1cm beyond the tip is sufficient. Then inject, and afterwards the needle and catheter can be removed together. For patients needing repeat injections or infusions, the catheter can be advanced deeper and managed in routine fashion, as for regular epidural anesthesia. **The absence of resistance to soft catheter advancement beyond the needle tip, is the test that strongly verifies that the needle tip is not within the spinal cord.** This routine might save one person from accidental paraplegia from a high epidural injection.

recommends to never place an epidural block above the L2 level, if it is not a true ultra-flexible tip catheter. At time of writing The Arrow product is the only one brand with a true ultra-flexible catheter soft tip, known to the author.

This author also believes the high thoracic epidural and cervical epidural TEST DOSES should be of a lesser volume than the commonly recommended universal 3ml of 2% lidocaine with adrenaline (epinephrine) as that is a full spinal dose. Those test doses although they may still contain 15 units of adrenaline (epinephrine), should not be in a volume exceeding 1 ml of 2% lidocaine. That will ensure that the block from the unexpected intrathecal block, will have a short segmental spread, be of short duration, and near certain be of trivial consequence.



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Reference no. 10; Full text.

To: The Anesthesiology Discussion Group
Subject: RE: Segmental spinal anaesthesia

Date: Tue, 11 Mar 2003 09:33:11 -0300
From: "Dr. Armando Fortuna" <armando.fortuna@UOL.COM.BR>
Subject: Re: ANESTHESIOLOGY Digest - 9 Mar 2003 to 10 Mar 2003 - Special issue (#2003-190)
Date: Sun, 9 Mar 2003 20:50:09 +0200
From: Robert Raw <robraw@IAFRICA.COM>
Subject: Re: Midthoracic spinal puncture.

It's physiologically impossible to get a segmental subarachnoid block. Nitin Bhorkar.

Vince Collins .. would thread SA catheters up to the thoracic region ..and inject very dilute LA solutions to achieve what you say is physiologically impossible. Theo von Hoheim

REPLY; I have been thinking about this and I believe segmental spinal anesthesia is possible above the L2 level. Below L2 one achieves a total block downwards. That is fact because every nerve passing on its way down though the local anaesthetic cloud in the Cauda equina gets blocked. The nerves at this point are also loosely filamentous and are presumably easily penetrated by drug. However, above this level of L2 in order to block the most distal nervous system outflow, one has to block the spinal cord. I think it is impossible for local anesthetic to soak across the entire large dense chord swiftly. I cannot see it soaking through more than a few mm of spinal cord white matter before the drug disperses. Accordingly, the drug should only block the exiting nerve roots within the segmental subarachnoid zone, where the local anesthetic sits. The spinal cord sensory and motor fibres to very distal, I truly believe, will escape blockade. Mid-thoracic spinal is however not formally reported and I cannot find a single peer reviewed reference. I do believe it is technically feasible generally.

The bigger issue is however the likely common pricking of the chord while performing midthoracic spinal anesthetics. One can't evaluate such techniques as the occasional authors of anecdotal reports decline to provide their technique details. A pencil-point needle tip will probably be in the chord when the side orifice is in the CSF. With a Quincke end-orifice tip needle, the very > sharp cutting end will be on the chord. Does anybody know the depth of the subarachnoid space in the midthoracic zone? I asked many technical questions on this list recently about > midthoracic spinals and practitioners thereof, only answered one trivial question. I remain open-minded out of natural curiosity, but where is a full technical report? Until a convincing person offers comprehensive precise technical details and some sort of honest series report in peer reviewed literature or even this informal site, I think such practice must be regarded as lunatic.

Dr. Robert Raw, Johannesburg, South Africa.

Dear Robert:

There is no doubt that one can do SEGMENTAL METAMERICAL EPIDURAL analgesia, from the cervical to the thoracic and lumbar regions. On old times, I did many cervical epidurals for neck procedures, breasts, chests and for cordotomies at the higher segments, so the surgeons could stimulate and check the pain pathways from below. The analgesia was enough for the surgery area but the patient felt his original pain, so the surgeon would be guided by him on which fibers to cut. I have never seen neurological complications from those cervical and thoracic epidural blocks. However, those are becoming very common and I would use these techniques much less frequently now, considering

them to be exceptions, to be done only with good justification for its application... Today, I would do them, for incoercible pain treatments or for a few cases of post op pain, after giving deep consideration of the risk/benefits of this technique and the hospital facilities available for watching those patients. For clinical anesthesia I would think two or three times before doing any thoracic or cervical epidural blocks.

Now, for HIGH SPINALS, INTRADURAL OR SUBARACHNOID, their use should be limited for the introduction of neurolytic agents 5% phenol in glycerin (Maher's) or pure alcohol (Dogliotti's), mainly indicated for the terminal cancer patients suffering from intolerable pain. After all, today we are not in the same position we were when the only general anesthetics we had were ether, cyclopropane, thiopental and nitrous oxide. I am very familiar with them all as I used those agents for more than 20 years. The awakening and post op were quite different than what it now a days with the newer drugs and techniques. Now we have simpler and safer general anesthesia. In Brazil, where the "fashion" method for cosmetic breast surgery is becoming thoracic epidural, with hundreds of published cases, I have been fighting it at every meeting I go. Paraplegia and arachnoiditis are a very heavy price to pay for something so simple, for ASA 1 patients, than what can be easily done with an LMA mask, spontaneous or assisted ventilation and sevoflurane or any other non-explosive agent.

There have been rumors of adverse events resulting in paraplegia and deaths. So far, I have not seen these complications published in our journals, as sequels of cosmetic surgery...Sooner or later they will appear. Segmental spinal analgesia was described by Tait and Caglieri in the year of 1900 but it was Jonnesco, of Bucharest who presented, in 1909 and 1910 around 400 cases of it, making punctures from the cervical to the thoracic and lumbar region. I had those papers, courtesy of the Royal Society of Medicine of the UK. Unfortunately, I made the mistake of making them available to my residents without the precaution of making copies. So, they were lost and I have been unable to get new ones. Good descriptions are found on "Lund PC- Principles and Practice of Spinal Anesthesia, Charles C Thomas, Springfield 1971, pag.1-39" and also with Maxson, LH, Spinal Anesthesia, J.B. Lippincott Co, Philadelphia 1938 page 1-10.

Prof. Macintosh, in his -to me his best book, Lumbar Puncture and Spinal Anesthesia, Edinburgh 1951, page 107, states, about thoracic spinal punctures, the following: "it is true that spinal punctures can be made at these high levels, This direct and heroic approach to the thoracic roots had its supporters many years ago, but it never achieved wide popularity and now happily has fallen out of favor altogether". If it was absurd to do them for routine anesthesia as commented on a book written in 1951, imagine now. I like this book because it is so practical and concise. Besides, Sir Robert gave it to me with a beautiful dedicatory. A great teacher and a friend for all seasons who created simpler and safer methods of anesthesia adapted everywhere.

I think that you, Robert Raw, closed the subject, of thoracic spinal punctures, when you said "I think such practice must be regarded as lunatic". As an anesthetist and also as a lawyer I agree with you one hundred per cent. Safety first must always be all motto and primo non noscere our goal. Spinal anesthesia at the thoracic level for clinical anesthesia should be discarded once for all and be quoted only as a curiosity from the past.

Armando.