Updates in Continuous Spinal Anesthesia

Essay

Submitted for the partial fulfillment of Master degree in anesthesiology

By

Eslam Ayman Mohamed Shawki Kahla

(M.B.B.CH,)

Under the supervision of

Prof. Dr. Maher Fawzy Mahmoud

Professor of Anesthesiology

Faculty of Medicine

Cairo University

Ass. Prof. Dr. Ahmed Abd ElAziz Aref

Assistant Professor of Anesthesiology

Faculty of Medicine

Cairo University

Dr. Maha Mohamed Ismail

Lecturer of Anesthesiology

Faculty of Medicine

Cairo University

Faculty of Medicine

Cairo University

2010

Abstract

Continuous Spinal anesthesia (CSA) as a technique evolved since Augustus Bier described the first Spinal anesthetic with Cocaine in 1899, and in 1906 Henry Percy Dean invented the "exploring needle" which can be left in situ during the operation so that at any moment another dose can be injected. CSA has marked advantages in certain clinical circumstances, particularly patients undergoing lower body surgery who are old and/or have co-morbidities, they can benefit from avoiding the risks of endotracheal intubation and general anesthesia and in the same time avoiding rough hemodynamic changes associated with other types of neuraxial blocks without losing their advantages. Also the intrathecal catheter can be used for post-operative analgesia and for long term intrathecal drug administration to control chronic pain or spasticity. There are many types of intrathecal catheters that can be used with different techniques of insertion, advantages and disadvanatages. Also there are possible complications to the technique which must be understood and managed, and contraindications with which the technique should be avoided or modified.

Keywords: Continuous Spinal anesthesia, neuraxial anesthesia, neuraxial blocks, high risk patients, intrathecal catheter, continuous analgesia, post-operative analgesia, chronic pain management, intrathecal pumps.

Acknowledgement

I would like to express my sincere gratitude and profound thanks to **Prof. Dr. Maher Fawzy Mahmoud** Professor of Anesthesiology, Faculty of Medicine, Cairo University, for his valuable remarks and advices, constant encouragement, and his meticulous supervision and outstanding support.

I'm also deeply indebted to **Ass. Prof. Dr. Ahmed Abd ElAziz Aref,** Assistant Professor of Anesthesiology, Faculty of Medicine, Cairo University for his sincere guidance and support to complete this work.

Also, I'm deeply grateful to **Dr. Maha Mohamed Ismail,** Lecturer of, Anesthesiology, Faculty of Medicine, Cairo University, for her generous help, valuable advices, great support and effort for this work.

I would like also to thank my parents, my wife and my brother for the continuous help and support they offered me during this work. Lastly I like to express my deepest gratitude to the oldest medical school in the Egypt, Kasr El Aini which offered me all the learning and training chances I needed to become a competent doctor who can give a hand of help to whoever needs it.

Index of Contents

Content **Page**

Index of Figures

List of Abbreviations

- aPTT: Activated Partial Thromboplastin Time
- ASA: American society of anesthesiologists
- CES: Cauda Equina syndrome
- CNS: Central nervous system
- COPD: Chronic obstructive lung disease
- CPB: Cardiopulmonary bypass
- CSA: Continuous Spinal anesthesia
- CSA/A: Continuous Spinal anesthesia/analgesia
- CSE: Combined Spinal-Epidural
- CSF: CerebroSpinal fluid
- DVT: Deep vein thrombosis
- FDA: Federal Drug Administration
- GABAB: Gamma Aminobutyric acid receptor type B
- GABA: Gamma Aminobutyric Acid
- G: Gauge
- IL: Interleukin
- IT: Intrathecal
- IONV: Intraoperative nausea and vomiting
- LMWHs: Low moelcular weight heparins
- MLAD: Minimum effective local anesthetic dose
- NMDA: N-methyl-D-aspartate
- PCA: Patient controlled analgesia
- PDPH: Post Dural Puncture Headache
- SSSA: Single-shot Spinal anesthesia
- UFH: Un-Fractionated Heparin

Introduction

Continuous Spinal anesthesia (CSA) is the technique of producing and maintaining Spinal anesthesia with small doses of local anesthetic which are injected repeatedly as required into the Subarachnoid space via an indwelling catheter.

Continuous Spinal anesthesia (CSA) as an alternative to general anesthesia for many surgical procedures is a method almost as old as the technique of Spinal anesthesia itself. Augustus Bier described the first Spinal anesthetic with Cocaine in 1899 and in 1906, Henry Percy Dean described a technique in which Spinal anesthesia could be extended. Dean was aware that Ester local anesthetic agents did not usually last long, that the dose requirement of local anesthetic agent varied in each patient and that the duration of surgery could be different. To overcome this, he considered giving another injection during the surgical procedure and he invented the "exploring needle" which can be left in situ during the operation so that at any moment another dose can be injected without moving the patient beyond a slight degree. However, the technique did not become accepted into practice and his efforts to promote it were probably limited due to his ill health and his retirement in 1933. [1]

CSA was rediscovered in 1940 and went through a "stuttering evolution" through the 20th century by Tobias et al. who gave a fascinating account of this technique. The CSA technique evolved further in the 1990s when Spinal micro-catheters were introduced, but the technique was surrounded by controversy due to assumed occurrence of Cauda-Equina syndrome leading to the banning of Spinal micro-catheters by the Federal Drug Administration (FDA) in the USA. But Denny questioned the etiology of Cauda-Equina syndrome and stated that "For a number of years and on several occasions CSA has prevented patients from needing postoperative ventilation and it would be unfortunate if this extremely useful technique was abandoned due to its inappropriate application". While in the same time, CSA continued to be used in clinical practice outside of the USA. [2]

CSA has been used in medically complicated patients (as in patients with respiratory failure) undergoing cardiac, vascular, orthopedic, and general surgeries. Many authors advocate general anesthesia with or without Epidural analgesia as first choice in fit patients undergoing abdominal procedures. While in selected patients undergoing surgeries on the lower extremities, perineum, groin and lower abdomen, who are living at the edge of their cardiovascular and respiratory physiological reserves and in whom general anesthesia is likely to increase morbidity and mortality, many authors advocate CSA as an alternative to general anesthesia. [2]

CSA allows conduction anesthesia to be tailored to individual patient needs and also for surgical operations of long durations. The Spinal anesthesia is not more dangerous than Epidural anesthesia, but when we combine the potential lack of knowledge with the unforgiving Subarachnoid space and with the narrow "therapeutic window" for Spinal local anesthetics, a background for significant iatrogenic injury is set. It is with this in mind, as well as from the historical perspective that the technique and its current applications are discussed. [3]

The best way to examine the clinical applications for CSA is by comparing it to other available major conduction anesthetics: single-shot Spinal anesthesia, continuous Epidural anesthesia and combined single-shot Spinal & continuous Epidural anesthesia and also to general anesthesia. Catheters used for performing CSA differ in sizes (gauge) and in technique of insertion:

1- <u>Epidural catheter (macro-catheter):</u>

A standard Epidural catheter can be used for continuous Spinal anesthesia (standard Epidural catheters range from 18 to 20G). The catheter is inserted into the subarachnoid space after a deliberate Dural puncture with an Epidural needle. These sets are widely available and little additional training is required for those familiar with inserting a normal Epidural catheter. However, performing a deliberate Dural puncture with an Epidural needle may be psychologically difficult for some experienced clinicians, also Post Dural Puncture Headache (PDPH) is a risk as we will see later. It should be put in mind that if this catheter type is left in situ for post operative pain relief then there is potential for error, as an Epidural dose of drug could be administered intrathecally. [3]

2- Catheter over-needle type:

Represented by the B Braun SPINOCATH®. Perceived advantages of this kit is that CSF does not leak because the hole made in the Dura by the Spinal needle is sealed by the wider bore catheter resulting in less incidence of PDPH, also there is an unequivocal endpoint of catheter placement in the subarachnoid space because CSF can be aspirated through the catheter. [4]

3- Catheter through-needle type:

These catheters are available in varying sizes ranging from 25G (macro-catheter) to 32G (micro-catheter). Pajunk Intralong® manufactures 27G and 25G catheters which are introduced through 22 or 21G Sprotte needles. Smith Medical® produces the PORTEX® kit, a 28G micro-catheter with a 23G Crawford needle. Kendal® produces a 28G micro-catheter with a 22G Sprotte needle. [4]

In this study we will try to discuss the commercially available CSA kits and related devices, the advantages and indications of the CSA technique itself, its limitations and complications.

1- <u>The Lumbar Vertebrae:</u>

The bodies of the Lumbar vertebrae are large and kidney-shaped (Fig.1), the vertebral foramen is roughly triangular, larger than in the thoracic but smaller than in the cervical region. The transverse processes are slender, they increase in length from L_1 to L_3, then become shorter again so that the third transverse process is longest. The Lumbar spines are horizontal and oblong. If the articulated vertebral column is inspected from behind, it will be noted that the laminae and spines so overlap and interdigitate with each other that the Spinal canal is completely hidden, except in the lower Lumbar region. This interlaminar gap (Fig.2) is increased by forward flexion of the spine: a combination of circumstances that makes Lumbar puncture possible. [5]

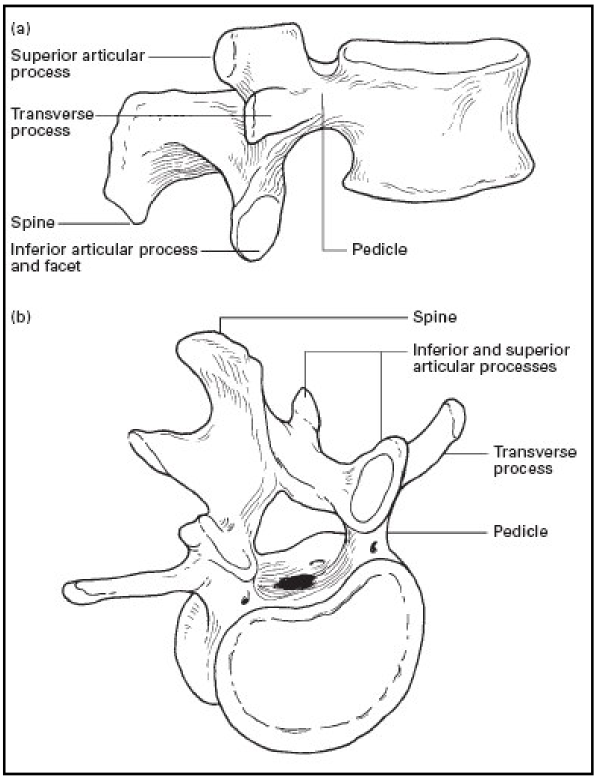

Fig.1 A Lumbar vertebra in (a) lateral and (b) antero-superior views. [5]

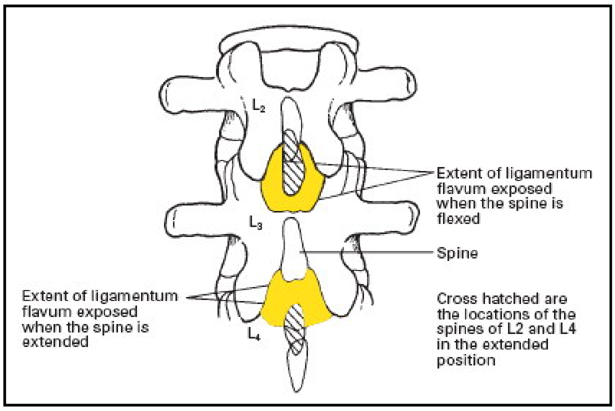

Fig.2 The Lumbar interlaminar gap, this anatomical fact makes lumbar puncture possible. [5]

2- <u>Anatomy of Lumbar Puncture:</u>

Lumbar puncture (or Spinal anesthesia) is usually performed with the patient in the lateral or sitting position. Whichever position is chosen, the patient should be asked to flex his/her spine as much as possible, there by widening the gaps between the Lumbar spinous processes (Fig.3). The line that joins the top of the iliac crests (the inter-cristal line) usually passes through the body of the 4^{th} Lumbar vertebra, and is therefore a useful landmark. The space above this line is usually the $L_{3/4}$ interspace, that below is usually the $L_{4/5}$ interspace. The choice of interspace is important, as the Spinal needle should not be introduced at a level that may cause it to enter the Spinal cord. In the adult, the Spinal cord usually ends at the level of the 1^{st} Lumbar vertebra. However, in children, it may end as far distally as the 2^{nd} or even 3^{rd} Lumbar vertebra. Spinal needles inserted for diagnostic or anesthetic reasons should not therefore be introduced above the $L_{3/4}$ inter-space except in exceptional circumstances. [5]

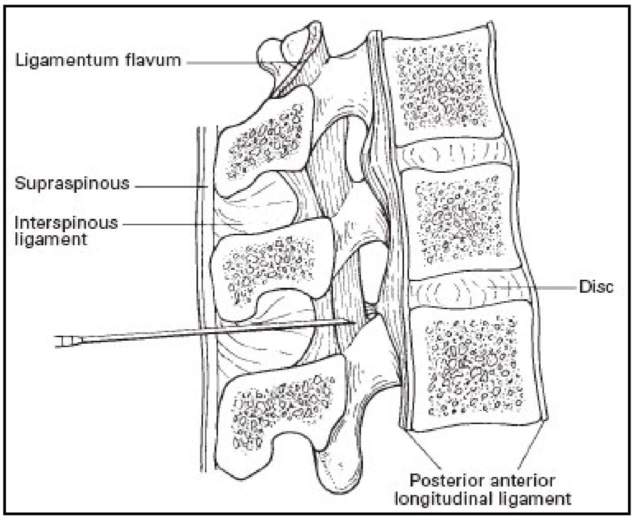

Fig.3 The anatomy of Lumbar puncture. [5]

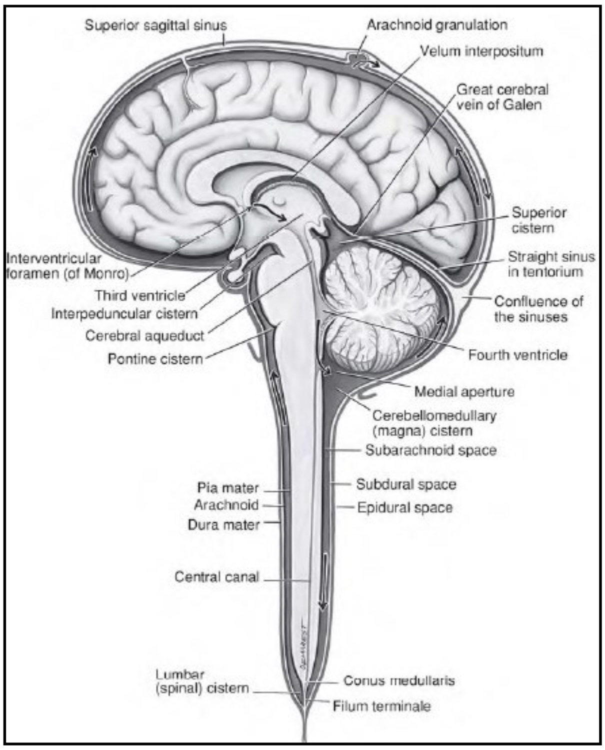

Fig.4 Midsagittal view of the meninges, ventricles, subarachnoid spaces, and cisternae. [5]

3- The Spinal Meninges:

The Spinal cord has three covering membranes or Meninges (Fig.4), the Dura mater, Arachnoid mater and Pia mater. The compartments related to the Spinal meninges are the Subarachnoid, Subdural and Epidural spaces. The Subarachnoid space contains the CSF. It is traversed by incomplete Trabeculaea, the Posterior Subarachnoid Septum and the Ligamentum Denticulatum. [5]

The Subdural space is a potential one only, the Arachnoid is in close contact with the Dural sheath and is separated from it only by a thin film of serous fluid. The Subdural space within the vertebral canal rarely enters the consciousness of the clinician, unless it is the accidental site of catheter placement during attempted Epidural analgesia or anesthesia. The Subdural injection of local anesthetic is thought to be associated with patchy anesthesia, often unilateral and often extensive. The Epidural (Extradural or Peridural) space in the Spinal canal is that part not occupied by the Dura and its contents. [5]

History

1- CSA Needles:

While most were striving to improve the design of Spinal needles to decrease the incidence of complications, some workers were looking at ways of improving the technique of Spinal anesthesia to make it applicable to more surgical procedures.

Dean had described a technique of continuous Spinal anesthesia in 1907 in which he left the Spinal needle in situ during surgery and injected more local anesthetic solution as and when necessary "exploring needle", but his technique was not widely accepted. [6] Lemmon published a paper in 1940 describing a 17G and 18G Nickel ⁄ Silver alloy malleable needle and introducer with a sharp, medium-length, cutting bevel and a small opening in the long side of the bevel to enable free flow of CSF (Fig.5). [7]

The needle was placed in the subarachnoid space, was bent at the skin surface, and was attached to rubber tubing through which local anesthetic solution was injected when required. The patient lay on a mattress and table that had a hole placed so as to accommodate the protruding needle (Fig.6). On the introduction of Stainless Steel, the needle was manufactured from Stainless Steel annealed to render it malleable. [7]

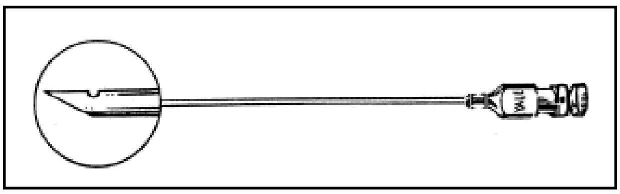

Fig.5 Lemmon needle. [12]

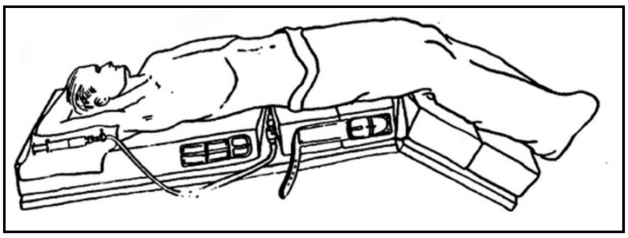

Fig.6 The Patient lying with the CSA needle protruding from his back. [12]

In 1943, Hingson presented his modification of the Lemmon needle. [8] The distal and proximal portions of the needle were rigid, with an annealed middle