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Review

Myths and mysteries surrounding continuous spinal anaesthesia

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Continuous Spinal Anaesthesia (CSA) is as old as single-shot spinal anaesthesia but it is used mainly by enthusiasts in high risk patients. It remains an underutilized method in current anaesthesia practice because of the myths and mysteries surrounding its application. This article tries to unravel some of the pertinent myths and mysteries behind this anaesthesia technique.

Contents

1. Introduction

Continuous Spinal Anaesthesia (CSA) is a technique in which local anaesthetic agent is injected intermittently into the sub-arachnoid space via an indwelling catheter to achieve spinal nerves block. Though CSA is as old as single-shot spinal anaesthesia, it is used mainly by enthusiasts and remains an underutilized method

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in current anaesthesia practice because of the myths and mysteries surrounding its application since its introduction. According to the Oxford dictionary, a myth is defined as an idea/story believed is not true, or not believed is true. On the other hand, a mystery is something difficult or impossible to understand or explain. This article tries to unravel some of those pertinent myths and mysteries.

1.1. CSA is not a new technique

Although CSA is nearly 100 years old but its use in clinical practice has been limited and left to enthusiasts. The idea of CSA was first conceived by a British surgeon, Henry Percy Dean, who used a specially-made spinal needle and left it in place during the operation so that he could titrate the spinal block level and extend the anaesthesia effect throughout the course of the acute abdominal surgery [1]. Lemmon in 1940 [2] suggested a method of CSA which involved inserting an intrathecal indwelling 17- or 18-gauge malleable needle connected to a rubber rubbing and syringe. The surgical table was also customized with an opening to permit the needle to project from the back of the patient for this method. Lemmon [3] reported successful application of CSA in a wide variety of thoracic surgical procedures; and Apgar [4] in major abdominal surgeries with perfect muscle relaxation and adequate anaesthesia. Tuohy [5] used Lemmon's technique but he noticed dislodgment of malleable needle during its use. To circumvent this, he first introduced a ureteral catheter into the subarachnoid space via a 15-gauge Huber needle in 1944. Although Tuohy's method made it easier to secure the needle this led to an increased incidence of post dural puncture headache (PDPH) presumably due to puncture by the large bore spinal needle.

Popularity of CSA was also marred due to fear of complications which might arise from dural puncture by the needle and neurological injury from nerve root impingement by the stiff catheter. Bizzarri et al. [6] in 1964 attempted to overcome these difficulties and introduced a small 0.010-inch soft vinyl catheter passing through 20 or 21-gauge spinal needle. Two cases out of 27 patients had PDPH during follow up (median 4 days, range 3–14 days) but no neurological injury was reported. In 1975, Giuffrida et al. [7] reported the successful use of CSA for caesarean sections (75 patients) with Bizzarri's small catheter technique. In this series, the incidence of PDPH was 16% (12/75), with no failures or neurological complication observed. A landmark development occurred in 1987 when Hurley and Lambert [8] introduced the microcatheter technique at the annual meeting of the American Society of Regional Anesthesia. The technique involved passing a 32-gauge polyimide microcatheter through a 26-gauge or larger spinal needle. In their initial report, it was found that microcatheter technique did not increase the incidence of PDPH compared to single-shot spinal anaesthesia. The success rate was 85% but there were technical problems which included difficulty with threading, broken catheter and kinked catheter.

However, shortly after introduction of the microcatheter, Rigler et al. [9] reported an unusual cluster of cauda equina syndrome (CES) following CSA. Although there was not any concrete evidence for the catheters or catheter materials being dangerous, the United States Food and Drug Administration (FDA) banned the use of all catheters 24-guage and smaller [10]. As a consequence, CSA popularity declined in the USA but its use continued in other parts of the world. Catheters development progressed with the introduction of different microcatheter sets - such as the needle-over-catheter and the catheter-over-needle sets with sizes ranging from 28 to 32 gauge [11]. The needle-over-catheter set (Kendall CoSpan, Smiths Medical 765 Finchley Road, London, NW11 8DS, UK and PAJUNK GmbH Medical Technology, Karl-Hall-Strasse 1, D-78187 Geisingen, Germany) are introduced via relatively large needles resulting in loss of cerebrospinal fluid (CSF) and thus may be associated with a higher incidence of post-dural puncture headache. The catheter-over-needle set (Spinocath, B.Braun Melsungen AG, PO Box 1120, D-3429 Melsungen, Germany) is considered advantageous [12]. These catheter sets have been designed with tougher material to strengthen the longer microcatheter with stylets to reduce technical difficulties during insertion [11]. The choice of kit depends on individual preference [11,13]. Some clinicians use the standard epidural catheter (macrocatheter) for continuous spinal anaesthesia [14–16]. Recently a new novel catheter-over-needle (Epimed-Wiley Spinal ™) kit has been produced with the microcatheter length ranging from 12 cm to 18 cm [17]. The insertion technique consists of identifying the epidural space using the epidural needle, passing spinal needle with catheter mounted on it through epidural needle, and dural puncture with spinal needle. The rationale behind the design is that the wider bore catheter can seal the cerebrospinal fluid (CSF) leak from the dural hole made by the spinal needle. Initial reports are very encouraging detailing its use in obstetrics [18,19] but experience is required for consistently favourable results. The use of this kit was questioned and recommendations were made to ban its use due to increased paresthesia and PDPH based on the experience gained from the first 5 cases [20]. All in all, CSA has been known for more than a century and its development has continued over several decades; however despite published evidence, CSA remains a technique lesser known and utilized almost exclusively by enthusiasts.

1.2. CSA believed to increase morbidities

It is commonly believed that CSA increases neurological morbidities, including cauda equina syndrome, transient neurologic deficit, PDPH, infection and haematoma.

1.2.1. Cauda equina syndrome (CES)

The CSA technique was gaining momentum after the introduction of microcatheters but it was soon engulfed with controversy when several cases of cauda equina syndrome were reported as sequelae [21,22]. As a result, the FDA in 1992 forbade the use of spinal catheters smaller than 24-gauge in America [10], but its use continued in clinical practice outside the United States.

To our knowledge, there were 7 reported cases of CES (Table 1) since the marketing of small bore spinal microcatheter (<27G). Interestingly, most of them were published as a cluster in the beginning of the 1990s. In 1997, Horlocker et al. [14] published a retrospective review of 603 CSA including 127 micro-catheters. No CES was reported in patients who had the micro-catheter, while 1 case was recorded as sensory CES in the macro-catheter (epidural catheter) group. Another large randomized clinical trial of CSA use in 429 obstetrics patients (329 had 28-g catheter via a 22-g Sprotte-type spinal needle) was reported in 2008 [18]. None of the patients had permanent neurological complications. Taking into consideration the sample size, the author concluded that CSA with sufentanil and bupivacaine via 28-guage catheter has an incidence of neurological complication of less than 1%.

The mechanism and exact pathophysiology of CES following CSA remains unknown. There are several suggested hypotheses. Denny et al. [24] postulated that the cause of CES was due to maldistribution of concentrated lidocaine around the cauda equine, especially when it is injected slowly via small bore catheters. This hypothesis was supported by several spinal column model studies which showed pooling of high concentrations of anaesthetic agent when the catheter is caudally positioned and local anaesthetic injected slowly [25]. Prolonged nerve exposure to hyperbaric

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