Neuraxial Block in Pediatrics

Essay
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CONTENTS

LIST OF ABBREVIATIONS

ABP	: Arterial blood pressure.
CNS	: Central nervous system.
CSF	: Cerebrospinal fluid.
ECG	: Electrocardiogram.
EBP	: Epidural blood patch.
ES	: Epidural space.
HR	: Heart rate.
ICT	: Intracranial tension.
LA	: Local anesthesia.
LAs	: Local anesthetics.
LOR	: Loss of resistance.
LRA	: Loco regional anesthesia.
NAB	: Neuraxial block.
NSAIDS	: Non-steroidal anti-inflammatory drugs.
PDPH	: Post-Dural puncture headache.
PTT	: Partial thromboplastin time.
SA	: Spinal anesthesia.
SCM	: Sacrococcygeal membrane.
TNS	: Transient neurologic syndrome.
U/S	: Ultrasound.

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Introduction

Regional anesthetic techniques for children have recently enjoyed a justified resurgence in popularity. Intra operative blockade of the neuraxis, whether by the spinal or epidural route, provides excellent analgesia with minimal physiologic alteration and, with an indwelling catheter, can provide continuous pain relief for many days postoperatively. As a supplement to general anesthesia, local anesthetic blockade of the neuraxis decreases the total amount of the general anesthetic required for surgery, hastens emergence, and allows for a better postoperative experience by providing a pain free emergence from general anesthesia *(Davison J.K., 1995).*

A better knowledge of the pharmacokinetics and pharmacodynamics of local anesthetic substances in infants and children, the development of regional anesthetic techniques, as well the availability of better equipment specifically designed for children, have all allowed the implementation of regional anesthesia in pediatric surgery. In recent years, the use of regional anesthesia in pediatric surgery is more frequent due to the growing number of premature infants who are discharged with chronic and acute morbidities that need to be operated on. These infants are at a greater risk of developing respiratory failure and postoperative apnea compared to term infants of the same age (*Rasch D.K., 1995).*

Historical Perspective

The origins of regional anesthesia go back to 1899 when August Bier in Germany (considered the father of regional anesthesia) discovered the “cocainization of the spinal cord”. Ten years after Bier's 1899 paper on the subarachnoid injection of cocaine, regional anesthesia was described in children.In May 1900, Baimbridge published a report on spinal anesthesia in an infant of three months for the repair of a strangulated hernia. In 1901, Siccard and Cathelin studied independently caudal epidural anesthesia in France, they introduced to the late 19^{th} century medical world the novel concept of anesthesia for selected regions of the human body *(Welborn L, et al., 1986).*

The biggest modern series of spinal anesthesia was published in 1909 by Tyrell-Gray; a British surgeon who described 300 procedures used for below-the-diaphragm surgeries .Then followed this initial report with an extension of his series a year later. Pediatric spinal anesthesia continued to be popular well into the 1940s and in 1948 Leigh and Belton published the Textbook of Pediatric Anesthesia. In 1954, Rouston F G in Canada (Canadian Anesthesia Society) and Stringer R M first described in Anesthesia and Analgesia lumbar epidural anesthesia for inguinal hernia repair in infants and children. However, with the introduction of neuromuscular blocking drugs in the late 1940s and modern volatile anesthetics in the late 1950s and 1960s, regional anesthesia for children was almost forgotten but spinal pediatric anesthesia did not disappear *(Jo Rice L, Brilton., 1992).*

Thereafter, in 1983, in the American Society of Anesthesiologists Regional Anesthesia Breakfast Panel, Abajian et al started the "frenzy" of modern pediatric spinal anesthesia when they reported several cases in 78 infants.

In 1986, Anand published his work in infants to demonstrate that pain relief provided in the intra operative period decreases morbidity. This paper changed the thinking and attitude of anesthesiologists on pain management in children from no pain relief at all to aggressive pain management. Around the same time it was appreciated that regional anesthesia blocks, produce excellent intra operative analgesia. Papers on regional anesthetic techniques in children again began to appear in the literature, and interest in pediatric regional techniques has grown steadily since *(Anand KJ., 1987).*

Safer local anesthetic drugs are now available, and their pharmacologic and physiologic effects are well documented. Technical difficulties have been overcome with the introduction of regional equipment specifically designed for infants and children. The technology and clinical understanding of anatomical sonography has evolved greatly over the past decade aiming to secure an accurate needle position and to monitor the distribution of the local anesthetic in real time. The advantages over conventional guidance techniques, such as nerve stimulation and loss of resistance procedures, are significant *(Bosenberg A. 2004).*

Indications and contraindications

Indications:

Neuraxial blocks may be used alone or in conjunction with general anesthesia for nearly any procedure below the neck. In some European centers, cardiac surgery has been routinely performed under thoracic epidural anesthesia (typically with light general anesthesia) *(Giaufre E, et al., 1996).*

As a primary anesthetic, neuraxial blocks have proved most useful for lower abdominal, inguinal, urogenital, rectal and lower extremity surgery.

There are some situations in which neuraxial blockade may be of significant benefit:

- The child who is morbidly fearful of unconsciousness. (Frequently this is a child who has had numerous surgical procedures in the past).
- The child with a family history or a personal history of malignant hyperthermia.
- The child with a neuromuscular disease whose respiratory reserve would potentially be adversely affected by the administration of a general anesthetic.
- The premature or ex-premature infant with a history of abnormal ventilatory control who is at risk of post operative apnea.

- The child with chronic pulmonary disease such as cystic fibrosis or severe asthma for whom airway manipulation may pose a significant risk (*Pavlin J., 1995).*

The advantages of regional anesthesia are:

- Pre-operative (pre-emptive analgesia): it provides complete block of sensory transmission, hence offers complete pain relief.
- Intra operative: the anesthetic requirement (inhalational agents) comes down drastically; there is opiate sparing effect, so the recovery from general anesthesia is faster and smoother.
- Post operative (Pain control): it can be extended to the post operative period especially after major operations to provide pain relief *(Saint C and Schulte O., 1995).*

The advantages of pain relief:

- It decreases respiratory complications.
- It allows return of the bowel function rapidly and decreases post operative ileus.
- It allows early hospital discharge.

Contraindications

A. Absolute:

- Lack of parental consent (parental refusal).
- Infection at the site of injection *(Dalens B and Mansoor O., 1996).*

- Any coagulation disorder (untreated clotting abnormalities).
- Uncorrected hypovolemia and shock.
- Increased intracranial tension (ICT) (as a spinal block produces a leak that is harmful, and an epidural block increases cerebrospinal fluid (CSF) pressure that is harmful too).
- Severe aortic or mitral stenosis:

  Patients with severe stenotic valvular heart disease:

Left ventricular outflow obstruction (valvular aortic or hypertrophic subaortic stenosis) and mitral stenosis limit compensatory increase in cardiac output response to hypotension; regional anesthesia-induced sympathectomy can result in severe refractory hypotension with these cardiac lesions.

- History of allergy to local anesthetic agents, which is rare *(Gall H et al., 1996).*

B. relative:

- Septicemia:

  Neuraxial anesthesia in the presence of sepsis or bacteremia may predispose patients to hematogenous spread of the infectious agents into the epidural or subarachnoid space, but this is controversial.

- Abnormal sacral neuroanatomy, such as myelo-meningocele:

  The presence of a congenital lumbosacral anomaly is not itself an absolute contraindication to safe neuraxial blockade.

However radiological investigation of the vertebral column is essential prior to insertion of an epidural catheter at a level of a normal vertebral anatomy.

- Pre existing neurological disease (demyelinating lesions):

There is no objective data to support the supposition that pre existing neurological diseases constitute a contraindication to regional anesthesia. Abnormal nervous tissue has not shown to be more susceptible to the toxic effects of local anesthetics (LAs). However, regional anesthesia should be avoided in patients with progressive disease involving the cord, as these patients may report worsening symptoms following a block and it may be impossible to discern effects or complications of the block from pre existing deficits or unrelated exacerbation of pre existing disease *(Cooper MG and Sethna NF., 1996).*

- Mini-dose heparin, aspirin or other anti-platelet drugs:

Patients receiving fibrinolytic/thrombolytic medications are at risk of serious hemorrhagic events, particularly those who have undergone an invasive procedure. Subcutaneous (SC) administration of 75U/kg heparin every 12 hours has been used extensively and effectively for prophylaxis against deep venous thrombosis. There is often no detectable change in the clotting parameters, as measured by the activated partial thromboplastin time (aPTT). There are a minority of patients, perhaps up to 15%, who may develop measurable changes in coagulation, although the aPTT rarely exceeds 1.5 times the normal level. The widespread use of SC heparin and paucity of complications suggest that there is little risk of spinal hematoma associated with this therapy *(Horlocker TT and Wedel DJ. 1998).*