COMPARING SEDATIVE EFFECTS OF EPIDURAL BUPIVACAINE WITH ROPIVACAINE ON BISPECTRAL INDEX DURING AWAKE PHASE AND GENERAL ANAESTHESIA

By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ASA	American Society of Anesthesiology
BIS	Bispectral index scale
BMI	Body mass index
BP	Blood pressure
EEG	Electroencephalogram
$ETCO_2$	End tidal concentration of carbon dioxide
HR	Heart rate
ICU	Intensive Care Unit
IMF	Isometric muscle force
LA	Local anaesthetic
MAC	Minimum alveolar concentration
MAP	Mean arterial pressure
OAA/S	Observer's Assessment of Awareness/Sedation
PCA	Patient controlled anaesthesia
SD	Standard deviation
SPSS	Statistical Package of Social Science
TEA	Thoracic epidural anaesthesia
TES	Transcutaneous electrical stimulation

ABSTRAK

PERBANDINGAN KESAN SEDATIF PADA PEMBIUSAN EPIDURAL BUPIVACAINE DAN ROPIVACAINE TERHADAP INDEX BISPEKTRAL SEBELUM DAN SEMASA PEMBIUSAN UMUM

PENGENALAN

Kombinasi pembiusan epidural dan umum telah digunakan secara meluas untuk pembedahan abdomen, anggota kaki dan torasik. Pembiusan epidural telah menunjukkan kesan sedative terhadap pembiusan umum dan mengurangkan keperluan penggunaan ubat bius. Tujuan kajian ini adalah untuk mengenalpasti jika terdapat perbezaan kesan sedative di antara pembiusan epidural bupivacaine dan ropivacaine terhadap index bispektral (BIS) sebelum dan selepas pembiusan umum dijalankan.

METODOLOGI

Satu kajian klinikal yang prospektif, rawak 'double-blind' telah dijalankan ke atas seramai 54 orang pesakit yang dijadualkan untuk menjalani pembedahan elektif abdomen dan anggota kaki secara kombinasi pembiusan epidural dan umum. Kajian ini telah dijalankan dalam jangkamasa setahun di dewan bedah Hospital Universiti Sains Malaysia (HUSM) selepas mendapat kebenaran Badan Etika dan Penyelidikan, Fakulti Perubatan, Universiti Sains Malaysia, Kubang Kerian, Kelantan.

Seramai 54 orang pesakit telah dipilih secara rawak untuk diberi sebanyak 10 mls 0.5% epidural ropivacaine (kumpulan R) dan juga 10 mls 0.5% bupivacaine untuk kumpulan B. Skala index bispektral telah digunakan untuk menilai kesan sedative sebelum pembiusan umum dimulakan. Penilaian ini bermula pada minit ke 5, 10, 12, 14, 16, 20 dan 25 selepas suntikan epidural. Kemudian, pembiusan umum dimulakan dengan pemberian ubat bius fentanyl, propofol dan rocuronium. Keadaan tidak sedar sewaktu dibius dikawal dengan penggunaan sevoflurane 2.0%. Lebih kurang 10 minit, setelah proses intubasi dilakukan, kesan sedatif dinilai dengan menggunakan skala index bispektral untuk setiap 1 minit selama 10 minit. Jumlah sevoflurane yang diberi akan dikawal supaya skala indeks bispektral berada dalam lingkungan 40 dan 60.

KEPUTUSAN

Keputusan kajian menunjukkan tiada perubahan signifikan pada data demografik di antara kedua-dua kumpulan. Daripada kajian ini didapati perubahan signifikan mean pada nilai BIS di antara epidural bupivacaine (kumpulan B) dan epidural ropivacaine (kumpulan R) sebelum pembiusan umum. Tetapi, nilai BIS semasa pembiusan umum menunjukkan tiada perubahan signifikan di antara kumpulan B dan kumpulan R. Kajian ini juga mendapati bahawa keperluan sevoflurane semasa pembiusan umum adalah tidak signifikan di antara kedua-dua kumpulan.

KESIMPULAN

Mean pada nilai BIS adalah signifikan lebih rendah pada epidural ropivacaine berbanding dengan epidural bupivacaine pada fasa sebelum pembiusan umum. Walaubagaimana pun, nilai mean BIS semasa pembiusan umum adalah tiada perbezaan signifikan di antara ke dua-dua kumpulan. Keperluan sevoflurane semasa pembiusan umum didapati tiada perubahan signifikan pada kedua-dua kumpulan.

ABSTRACT

COMPARING SEDATIVE EFFECTS OF EPIDURAL BUPIVACAINE WITH ROPIVACAINE ON BISPECTRAL INDEX DURING AWAKE PHASE AND GENERAL ANAESTHESIA

INTRODUCTION

Combined epidural/general anaesthesia technique has widely been used in major abdominal, lower limbs and thoracic surgery. Epidural anaesthesia has been shown to produce sedative effect and to reduce the requirements of volatile and IV anaesthetic agents. The aim of this study is to evaluate the sedative effect of epidural anaesthesia between bupivacaine and ropivacaine on the bispectral index (BIS) during awake and general anaesthesia.

METHODOLOGY

A prospective, randomized double-blinded clinical trial was conducted on 54 patients planned for elective abdominal or lower limbs surgery under combined epidural and general anaesthesia. This was done in a time frame of twelve (12) months at the operation theater of Hospital Universiti Sains Malaysia (HUSM) after approval by the Research and Ethics Committee, School of Medical Science, University Sains Malaysia, Kubang Kerian, Kelantan. The patients were randomly allocated to 2 groups receiving

either 10 mls of 0.5% epidural ropivacaine (group R) or the same volume of 0.5% bupivacaine (group B). The BIS measurements during awake phase were performed at 5, 10, 12, 14, 16, 20 and 25 minutes after the epidural injection. General anaesthesia was then induced with fentanyl, propofol and rocuronium and maintained with 2.0% sevoflurane. From approximately 10 minutes after tracheal intubation, the BIS measurements were made at 1 minute intervals for 10 minutes. Amount of sevoflurane administered was adjusted to maintain the bispectral index scale between 40 and 60.

RESULT

There were no significant differences in demographic data among the groups. There was statistically significant mean difference in the BIS values between epidural bupivacaine (group B) and epidural ropivacaine (group R) during awake phase. However, the BIS value during general anaesthesia was not significantly different between two groups. This study also demonstrated that the requirement of sevoflurane was not statistically significant different between two groups.

CONCLUSION

Mean BIS values during awake phase was statistically significant lower in epidural ropivacaine compared to epidural bupivacaine. However, the mean BIS values during general anaesthesia phase between two groups were not significantly difference. The requirement of sevoflurane concentration between two groups during general anaesthesia was not significantly different statistically.

CHAPTER 1 : INTRODUCTION

Combined epidural – general anaesthesia has been widely used in major abdominal and thoracic surgeries. Epidural anaesthesia reduced the requirements of volatile (Hodgson et al.,1999; Casati et al.,2002) and intravenous (Tverskoy et al.,1996) anaesthetics. Sedative effects of epidural anaesthesia without volatile and intravenous anaesthetic also have been evaluated (Ishiyama et al., 2005) and found epidural anaesthesia decreased the Bispectral Index (BIS) during awake phase and general anaesthesia.

Theoretically, epidural anaesthesia blocks the nociceptive input originating from the surgical site to some degree. In addition, the results of the recent clinical study (Hodgson et al., 1999) suggests that epidural anaesthesia has supra spinal effect that requires less general anaesthesia for adequate depth of anaesthesia.

Two studies (Glass et al., 1997; Katoh et al., 1998) reported that the BIS correlates well with the level of responsiveness and the sedative and hypnotic effects of anaesthetic drugs. Therefore, the BIS can quantify the degree of sedation produced by epidural anaesthesia. Concentration and dosage of local anaesthetic affect the quality of epidural anaesthesia (Hodgson et al., 2001) and thus may alter general anesthetic requirements.

The purpose of the study is to compare the sedative effects of epidural ropivacaine and bupivacaine anaesthesia measured by BIS during awake phase and general anaesthesia phase.

CHAPTER 2: LITERATURE REVIEW

2.1 EPIDURAL ANAESTHESIA

2.1.1 HISTORY AND BACKGROUND

Epidural anaesthesia is a form of central neuraxial blockade. Corning was the first person to describe the epidural space in 1901. Two decades later, Fidel Pages used epidural anaesthesia in humans. In 1945, Touhy introduced the needle used for epidural anaesthesia.

2.1.2 ANATOMY

The epidural space is that part of the vertebral canal not occupied by the duramater and its contents. It is a potential space that lies between the dura and the periosteum lining the inside of the vertebral canal. It extends from the foramen magnum to the sacral hiatus. The anterior and posterior nerve roots in their dura covering pass across this potential space to unite in the intervertebral foramen to form segmental nerves. The anterior border consists of the posterior longitudinal ligament covering the vertebral bodies, and the intervertebral discs. Laterally, the epidural space is bordered by the periosteum of the vertebral pedicles, and the intervertebral foraminae. Posteriorly, the bordering structures are the periosteum of the anterior surface of the laminae and articular processes and their connecting ligaments, the periosteum of the root of the spines, and the

interlaminar spaces filled by the ligamentum flavum. The space contains venous plexuses and fatty tissue which is continuous with the fat in the paravertebral space.

2.1.3 FACTORS AFFECTING THE DISTRIBUTION OF NEURAL BLOCKADE BY LOCAL ANAESTHETICS IN EPIDURAL ANAESTHESIA.

2.1.3.1 PATIENT CHARACTERISTICS

2.1.3.1(a) AGE

Bromage was the first to report a strong correlation between patient age and the epidural segmental dose requirements (Bromage, 1962). A linear relationship between age and spread of blockade is stronger when using volumes up to 10 mL compared to the 10–20 mL range (Sharrock, 1978) and in patients younger than 40 year old, compared to patients over 40 year old (Curatolo et al, 1994). The epidural dose requirement in the elderly (60–79 yr) was demonstrated to be about 40% less than in young adults (20–39 yr) (Hirabayashi et al, 1993). The mechanism for a positive correlation reported by several investigators between age and spread of blockade remains unclear but it has been proposed that a decrease in the number of myelinated nerve fibers in the nerve, and a general deterioration of the mucopolysaccharides of the ground substance, allows local anaesthetic to more easily penetrate nerve roots in older patients (Dorfman et al, 1979).

2.1.3.1(b) HEIGHT

It seems logical to assume that taller patients require more local anaesthetic to establish a certain level of blockade than shorter subjects. Clinical trials evaluating the relationship between height and spread of blockade after epidural administration of local anaesthetic are lacking in thoracic epidural anesthesia. Therefore, it is not possible to definitively draw conclusions on the significance of patient height in predicting the spread of blockade, except perhaps in extremely short or extremely tall individuals.

2.1.3.1(c) WEIGHT AND BODY MASS INDEX

Few studies report on the correlation between weight and spread of sensory blockade. In lumbar epidural anesthesia, no correlation was found (Whalley et al, 1995), although a correlation coefficient of 0.41 was demonstrated for the association of body mass index (BMI) with height of sensory block (Duggan et al, 1988). Weight was not correlated with epidural spread of contrast in thoracic epidural anesthesia (Yokoyama et al, 2004).

2.1.3.1(d) PREGNANCY

In general, less local anaesthetic is required to produce a given level of epidural anesthesia in pregnant patients. Engorgement of epidural veins by increased intra-abdominal pressure has often been implied as the mechanism for this phenomenon. Furthermore, both animal (Flanagan et al, 1987) and clinical studies (Butterworth et al, 1990) have shown that during pregnancy, onset of blockade of nerve conduction by local anaesthetic is faster and the blockade is more intense.

2.1.3.1(e) DURAL SURFACE AREA

It has been demonstrated that the surface area of the lumbosacral dura is correlated with the peak sensory block level in lumbar epidural anesthesia (Higuchi et al, 2004). Although this patient factor may not be clinically useful, future research in this area may further clarify the differences in epidural spread of local anaesthetic among patients.

2.1.3.2 TECHNICAL FACTORS

2.1.3.2(a) CHOICE OF EPIDURAL INSERTION SITE

The length of the lumbar section of the vertebral column is relatively short and the dimensions of the lumbar epidural space are fairly constant. Although statistically significant, only small differences in cranial spread of blockade have been demonstrated after injection of local anaesthetic at three different lumbar interspaces (Curatolo et al, 1994). In contrast, the thoracic part of the spinal column encompasses more than half the length of the entire spine and adjoins many different anatomical structures and spaces, where the thoracic vertebrae and epidural space vary greatly in shape and size.

Therefore, it may be speculated that the distribution of neural blockade may vary with the site of epidural injection. It is alleged that dose requirements are larger in lumbar compared to thoracic epidural anesthesia (Park et al, 1988).

2.1.3.2(b) PATIENT POSITION AND GRAVITY

In lumbar epidural anesthesia, epidural injection of local anaesthetic with the patient in the lateral position produces sensory block levels approximately 0–3 segments greater on the dependent side compared to injection with the patient in the supine position (Soeten et al, 2003). No differences have been reported in maximal cranial spread between groups receiving equal amounts of epidural LA in the sitting or supine position

(Whalley et al, 1995). Some of these studies report slightly faster onset times in the lateral or sitting positions compared to the supine position (Seow et al, 1983).
Head down (Trendelenburg) position of 15° has been shown to result in higher sensory block levels with faster onset times after lumbar epidural injection of local anaesthetic in pregnant women (Setayesh et al, 2001).

2.1.3.2(c) NEEDLE DIRECTION AND CATHETER POSITION

Epidural injection through a Tuohy needle with the bevel oriented to one side (Park, 1988) or caudal (Park et al, 1982) has no or only minor effects on the spread of sensory blockade compared to injection directed cephalad. However, both in lumbar (Dauri et al, 2005) and cervical (Buchheit et al, 2000) epidural anesthesia, threading an epidural catheter with the Tuohy needle rotated 45° toward the operative side has been shown to produce a preferential distribution of sensory and motor blockade toward this side.

Fortunately, computed tomography imaging and clinical experience demonstrate that a large variety of lumbar epidural catheter tip positions and solution distribution result in equally satisfactory epidural anesthesia (Hogan, 1999).