Republic of Yemen
Ministry of high education &
Scientific research
Alrazy University
Faculty of Medical Sciences
Division of Medical Sciences

الجمهورية اليمنية
وزارة التعليم العالي والبحث العلمي
جامعة الرازي
كلية العلوم الطبية
قسم العلوم الطبية

Title of the study:

Perception of Anesthesiologists Toward Patient Anxiety Under Regional Anesthesia

Submitted by

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2016

بسم الله الرحمن الرحيم

قال تعالى:

هل يستوي الذين يعلمون والذين لا يعلمون إنما يتذكر أولوا الألباب

الإهداء

إلى الذي علم بالقلم علم الإنسان ما لم يعلم ....ربنا عزوجل

إلى الذي أخرج الله به الناس من الظلمات إلى النور ....الرسول (ص)

إلى صاحب الفضل الكبير ....آبائنا وأمهاتنا

إلى الذين دعموا وعززوا البناء..........إخواننا

إلى رموز المحبة والعطاء الذين قدموا لنا جهودا متميزة ....الأساتذة الكرام

إلى من جمعتني معهم مقاعد الدراسة وأبحاث العلم ....زملاء الدراسة

إلى كل هؤلاء نهدي بحثنا المتواضع

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List of abbreviations

Abbreviation	Explanation
APAIS	Amsterdam Preoperative Anxiety and Information Scale
APAIS	Amsterdam Preoperative Anxiety and Information Scale
ARNI	Anesthesia-Related Nerve Injury
AXB	Axillary Block
EA	Epidural Anesthesia
EAAC	European Anesthesiology Adequacy Committee
DGAI	German Society for Anesthesia and Intensive Care
HADS	Hospital Anxiety and Depression Scale
ISB	INTERSCALENE Brachial Plexus Block
PBs	Peripheral Blocks
RA	Regional Anesthesia
RB	Regional Block
RRCA	Residency Review Committee for Anesthesiology
SA	Spinal Anesthesia
STAI	State Trait Anxiety Inventory
TAICS	Turkish Anesthesiology and Intensive Care Society
VAS	Visual Analogue Scale
VAS-A	Visual Analogue Scale for Anxiety

Perception of Anesthesiologists Toward Patient Anxiety Under Regional Anesthesia

Background: Anxiety is an emotional state characterized by apprehension and fear resulting from anticipation of a threatening event. Common causes of patients' anxiety are fear of surgery, anesthesia and complications, and previous unpleasant experience of anesthetics or surgery.

Objective: The aim of this study was to assess anesthesiologists' perception of patients' anxiety under regional anesthesia, at Sana'a city, Yemen.

Methodology: A cross-sectional descriptive design was utilized in the current study. Study populations composed 73 anesthesiologists working at Sana'a city Hospitals, Yemen. A self-administered questionnaire adopted from Jlala et al 2010, was used to collect necessary data, after obtaining verbal consents.

Result: The participants comprised 73 anesthesiologists, more than the half worked full time duty, worked for ≤ 5 years, and their age between 31–40 years and 30.1% had Arabic Board. Different advice from surgeon and anesthesiologist increases patient anxiety. The common causes of patient anxiety were fear of anesthesia and misinformation from lay people, family, friends. Moreover, communication was the main strategy used by anesthesiologists to control patient anxiety.

Conclusion: Fear of anesthesia; misinformation; and fear of surgery were the most common causes of patients' anxiety. Communication, use of relaxation techniques and sedation were the most common techniques used to manage patients' anxiety. Regional anesthesia provide good analgesia and promote patients' satisfaction.

Key word:-
Patient Anxiety; Regional Anesthesia; Anesthesiologists.

Chapter one: INTRODUCTION

Chapter 1: INTRODUCTION

1.1 Background and problem statements

Anxiety is an emotional state characterized by apprehension and fear resulting from anticipation of a threatening event. Preoperative anxiety may have a significant effect on anesthesia. More anxious patients may need larger anesthetic induction dose (Goldmann et al 1988). Also, anxiety can affect the unpleasant emotion and jeopardized overall systems especially cardiovascular and endocrine system (Granot & Ferber 2005 & Uyarel et al 2006). Common causes of patients' anxiety are fear of surgery, anesthesia and complications (eg, pain and nausea), previous unpleasant experience of anesthetics or surgery or a predisposing personality (Mitchell 2000, & Carr et al 2006). Previous "good" experiences (of anesthetics or surgery) invariably mean a more relaxed patient (Kindler et al 2000).

Patients' expectations of the attitude and behavior of the staff toward them are another important factor that may affect their anxiety and overall hospital experience. If patients are unduly anxious and apprehensive about their operation, their physical recovery, well-being, and overall experience may be negatively affected. Many studies have investigated different interventions and their effect on patients' anxiety. These interventions include pharmacological anxiolytics, (Mackenzie 1996) distraction therapy, Bechtold et al 2006) and provision of information (Hughes 2002, Klopfenstein, 2000).

Anesthesiologists' have a variable perception of patients' anxiety. Controversy exists on the ability of anesthesiologists to assess and predict patients' anxiety before surgery. Badner et al (1990) reported that anesthesiologists are frequently inaccurate when assessing patients' anxiety and that they usually tend to underestimate it (Badner et al 1990).They recommended using more objective measures of anxiety (eg, visual analog scale) rather than relying on the assessment of the care provider. Nurses also inaccurately assess patients' anxiety, the commonest inaccuracy being overestimation (Johanna et al 1998).

In contrast to Badner, anesthesiologists (using their clinical judgment) were found to accurately predict patients' anxiety (Hicks & Jenkins 1988). However, this study only examined a restricted group of patients (obstetrics) and a modest correlation was found. Huppe et al (2000) concluded that reliable estimation of anxiety is best sourced from patients.

1.2 Justification of the study

Anxiety is common pre-operatively, with a prevalence of up to 80% (Hashimoto et al, 1993, Shevde et al, 1991). Preoperative anxiety might increase the occurrence of complications, such as prolongation of mechanical ventilation, higher incidence of hemodynamic impairment, increase in postoperative pain, major consumption of analgesics, and increased anesthetic requirements, in the immediate postoperative period (Caumo & Ferreira 2003, Navarro-Garcia et al 2011 & Rothenhausler et al 2005). It has also been shown that high preoperative anxiety levels were related to an altered neuroendocrine response which might be deleterious in postoperative period (Ai et al 2005 & Pearson 2005).

With the growing number of surgical procedures that are performed under regional anesthesia; studies are needed to investigate patients' anxiety undergoing procedures under regional anesthesia and anesthesiologists' ability to assess and predict preoperative anxiety of patients having regional anesthesia. There is no single solution to a problem such as this; however there are many factors that can contribute to making the issue better and tolerable. A possible solution to consider may involve exploring patients' anxiety as perceived by anesthesiologists, and causes of anxiety, its frequency, and effects. In addition to their management strategies towards anxious patients having surgery under regional anesthesia. This knowledge can be used to develop a tailor made training to enhance anesthesiologists knowledge on patients anxiety prevention and control.

1.3 Research question

The following research questions are formulated to achieve the aim of the current study:

- ☒ What is anesthesiologists' perception of patients' anxiety under regional anesthesia?

1.4 General objective:

The aim of this study was to assess the Anesthesiologists' perception of patients' anxiety under regional anesthesia, Sana'a city, Yemen.

Specific Objectives:

1) To determine the anesthesiologists' perception of patients' anxiety under regional anesthesia.
2) To identify causes of patients' anxiety under regional anesthesia.
3) To assess anesthesiologists' perception of patients' experience with regional anesthesia block
4) To determine techniques used by anesthesiologists in response to anxiety

Chapter two:

REVIEW OF LITERATURE

Chapter 2: Review of literature

2.1: Introduction

During the last 30 years, the demand for regional blocks (RBs) from both patients and surgeons has significantly increased in anesthesia practice (Broking & Waurick 2006, Clergue et al 1999). Although the studies show a reduction in attendant complications, there are still some serious ramifications of these techniques which can be prevented by adequate training programs (Bouaziz et al 1997). There are some studies on these training programs in USA and Canada which endower to educate the residents on the applications, indications, contraindications and complications of these techniques. Teaching methods like cadaver workshops, electronic models and ultrasound-guided regional anesthesia are recommended to improve the quality of the techniques (Broking & Waurick 2006, Hargett et al 2005).

According to the Residency Review Committee for Anesthesiology (RRCA) in the United States, residents should carry out at least 40 spinals, 50 epidurals and 40 unspecified peripheral blocks (PBs) as well as 25 nerve blocks in pain management (Hadzic et al 2002). Similarly, the German Society for Anesthesia and Intensive Care (DGAI) demands 100 neuraxial blocks (NBs) and 50 PBs during residency (Bartusseck et al 2004). Turkish Anesthesiology and Intensive Care Society (TAICS) Adequacy Committee has taken the suggestions of European Anesthesiology Adequacy Committee (EAAC) as a model and designs residency training based on these suggestions. During five years of training the minimum recommended target numbers for RB techniques are 50 for spinal anesthesia (SA), 50 for epidural anesthesia (EA) and 50 for PBs. However, training time for regional anesthesia (RA), required educational tools for the process, details such as how to evaluate resident's performance and success are not presented in detail in this report.

2.2: Perioperative anxiety:

Anxiety is the subjective unpleasant feelings of dread over something unlikely to happen, such as the feeling of imminent death. It is often accompanied by restlessness, fatigue, problems in concentration, and muscular tension. Perioperative anxiety is described as a vague, uneasy feeling, the source of which is often nonspecific and unknown to the individual (Klopfenstein et al 2000) but known to cause abnormal hemodynamics as a consequence of sympathetic, parasympathetic and endocrine stimulation. Anxiety occurs in any person in a transient or chronic form and can produce aggressive reactions that result in increased stress experienced by the patient, thus causing more difficult pain management in the postoperative period. Perioperative period is a stressful event that triggers specific emotional, cognitive, and physiological responses of a patient.

The incidence of preoperative anxiety varies according to the setting of surgery, gender and motives for surgery. The prevalence is higher ranging from 32% in a study done on patients awaiting general surgery to 50% in patients awaiting coronary artery bypass graft surgery (CABG) (Koivula et al 2001).

2.2.1 Factors related to perioperative anxiety

Factors responsible for preoperative fears depend on age, gender, single or divorce, education, uncertainty of the exact day of surgery, patient's ability to understand the events that occur during surgical anesthesia, fear of surgery, separation from their family, financial loss, postoperative pain, fear of death and fear of unknown origin (Caumo et al 2001 & Sukantarat et al 2007]. Lack of adequate and timely information to patients during the preanesthetic consultation increases patient anxiety. Study by Kiyohara et al 2004] found that patients receiving better preanesthetic information during the visit with the anesthesiologist showed reduced rates of anxiety compared to those who did not receive it. The day of admission can also be very stressful, as patients have to cope with both the stress of hospitalization and the anxiety about the impending surgery.

2.2.2 Psychological response to perioperative anxiety.

The extent of anxiety levels varies individually. It fluctuates over time, starting prior to the surgery and persists until the late postoperative period. Different patient react perioperative periods in different ways. Some find it as relief as they are going to have a disease free life. Other considered it as one of the stressful event of lifetime. They are preoccupied with their discomfort or concerned about the success of surgery, strong fear of failure combined with career and family problems, postoperative state of physical health and problems adapting to the changed situation (Saur et al 2001).

The consequences of perioperative anxiety are major cardiac events (Saur et al 2001) (acute myocardial infarction, heart failure, pulmonary edema), high readmission rate (1st 6 month, 1 years), (Scheier et al 1999) poor quality of life and high rate of cardiac mortality. Impact correlate with high postoperative pain, increased analgesic and anesthetic consumption, prolonged hospital stay, adverse influence during anesthetic induction and patient recovery and decrease patient satisfaction with perioperative experience.

The reasons of increased morbidity in anxious patient are associated with the development of cardiovascular lesions as a consequences of health-related behaviors (Rozanski et al 1999) (such as smoking, poor diet, poor compliance with treatment, or an inactive lifestyle) and direct influence on the myocardial perfusion, autonomic nervous system regulation, platelet activation, increased hypothalamo-pituitary-adrenal axis activity and exaggerated inflammatory processes (Kubzansky et al 1998).

Preoperative anxiety level is difficult to measure accurately. However, it can be estimated indirectly by measuring blood pressure, pulse, and decreased heart rate variability and patient irritability. Directly, it can also be estimated by measuring the plasma of cortisol and urinary level of catecholamine. At present, several validated questionnaires (Matthias et al 2012) are available and used to measure preoperative anxiety. These include Amsterdam Preoperative Anxiety Information Scale (APAIS), the State Trait Anxiety Inventory (STAI), Hospital Anxiety and Depression Scale (HADS), Visual Analogue Scale (VAS), Multiple Affect Adjective Check List (MAACL). The APAIS is a widely accepted (Matthias et al 2012) screening tool which has been translated and used in many countries including Germany, the Netherlands, Mexico, Thailand, Turkey Korea and Japan.

2.2.3 Management

These patients need to be intervened before and after surgery to reduce the morbidity and mortality. Interventions before surgery include developing good rapports and doctor patient relationships, education and structured interviews, psychotherapy, selective serotonin reuptake inhibitors (SSRIs) and benzodiazepine. The routine evaluation and effectively addressing the preoperative psychological distress facilitate early postoperative recovery. Early intervention in postoperative period to patients with evidence of psychological distress offers reduction of hospital length of stay, analgesic use, postsurgical morbidity and help patients to adopt more effective coping strategies in their everyday lives.

Previous studies state that preoperative anxiety may have a significant effect on anesthesia. More anxious patients may need larger anesthetic induction dose (Goldmann et al 1988). Moreover, anxiety can affect the unpleasant emotion and jeopardized overall systems especially cardiovascular and endocrine system (Granot & Ferber 2005 & Uyarel et al 2006). Since preoperative anxiety is very common and adversely affects patient's physical and psychological outcomes. Many assessment tools have been introduced in clinical practices either in anesthesia and psychiatry for example: Spielbergerûs State Trait Anxiety Inventory (STAI-state), the visual analogue scale for anxiety (VAS) and the Amsterdam Preoperative Anxiety and Information Scale (APAIS) Boker et al 2002.

Anxiety is an emotional state characterized by apprehension and fear resulting from anticipation of a threatening event. The incidence of preoperative anxiety ranges from 11% to 80% in adult patients, and also varies among different surgical groups. Diverse studies performed on patients scheduled for cardiac surgery estimated preoperative anxiety as a leading cardiovascular risk factor (Caumo & Ferreira 2003, Navarro-Garcia et al 2011 & Rothenhausler et al 2005). These studies showed that preoperative anxiety might increase the occurrence of complications, such as prolongation of mechanical ventilation, higher incidence of hemodynamic impairment, increase in postoperative pain, major consumption of analgesics, and increased anesthetic requirements, in the immediate postoperative period (Caumo & Ferreira 2003, Navarro-Garcia et al 2011 & Rothenhausler et al 2005). It has also been shown that high preoperative anxiety levels were related to an altered neuroendocrine response which might be deleterious in postoperative period (Ai et al 2005 & Pearson 2005). A recent study indicated that anxiety, but not preoperative depression, was associated with an increase in cardiovascular morbidity and mortality, with anxiety being an independent predictor for cardiovascular postoperative events and 4-year mortality (Szekely et al 2007).

Furthermore, patients scheduled for cardiac surgery may present additional worries and nervousness due to the nature of their cardiac pathology, the concept of heart surgery, and uncertainty about the result. Therefore, it may be desirable to evaluate or quantify anxiety in patients scheduled for cardiac surgery. Up to now, several diverse instruments have been used to evaluate anxiety, including Visual Analogue Scale for Anxiety (VAS-A) (Kindler et al 2000), State-Trait Anxiety Inventory (STAI) (Padmanabhan et al 2005), Hospital Anxiety and Depression Scale (HADS), and Amsterdam Preoperative Anxiety and Information Scale (APAIS) (Moerman et al 1996). HADS and STAI have been widely used in psychological studies on cardiac surgery patients (Navarro-Garcia et al 2011, Martin et al 2004, & Williams et al 2013). However, despite their utility and simplicity, no studies have reported the use of APAIS and VAS-A quantitative scales for assessment of degree of anxiety and preoperative information in these patients.

2.3: Local Anesthetics

Few large controlled studies compare the various local anesthetics for brachial plexus blockade. Analysis of these studies is difficult by virtue of the many possible variations during a brachial plexus block procedure—which block technique is chosen, which adjuvant is added, pH of the injected solution, how duration is defined and measured, the surgical model, and individual patient characteristics. Despite these limitations, available literature provides insight into how local anesthetic agent selection, dose, concentration and volume, and physical modifications can affect onset, spread, quality, and duration of anesthesia.

2.3.1. Local Anesthetic Selection—Selecting a specific local anesthetic should be tailored to specific goals. In general, the intermediate-acting agents lidocaine and mepivacaine demonstrate faster onset and lower failure rates than bupivacaine or ropivacaine but at the expense of shorter analgesic duration (Schroeder et al 1996). However, 1 study of ISB found 8-min faster onset and 2-times longer analgesic duration with plain 1% ropivacaine as compared with plain 2% mepivacaine (Casati et al 1999). Whether prolonged analgesia is desirable depends on how much the patient desires a numb extremity, the ability to protect the insensate arm from injury, and the surgeon's need to assess neurovascular function.

Contemporary studies mostly compare ropivacaine and levobupivacaine to racemic bupivacaine. Although 0.5% ropivacaine and 0.25% bupivacaine provide excellent analgesia, (Al-Kaisy et al 1998 & Klein et al 2001) neither consistently provides surgical anesthesia. For surgical anesthesia, sensory and motor block onset and duration were not different with plain 0.75% ropivacaine compared with plain 0.5% bupivacaine. Increasing plain ropivacaine concentrations up to 1% did not improve sensory and motor block success or analgesic duration as compared with plain 0.5% bupivacaine (Casati et al 1999). Thus, 0.75% ropivacaine and 0.5% bupivacaine seem to be equivalent for brachial plexus anesthesia. Limited and somewhat conflicting studies have found levobupivacaine to have similar block characteristics as racemic bupivacaine (Cox et al 1998) and equal concentration ropivacaine (Casati et al 2003).

Similar to single-shot applications, there is no evidence to support the superiority of one local anesthetic over another when used for continuous techniques. Direct comparison of ropivacaine and bupivacaine is difficult because their precise equipotency is unknown. Equivalent analgesia has been reported using 0.125% bupivacaine and 0.125% ropivacaine for AXB, (Rawal et al 2002) or 0.2% ropivacaine and 0.125% levobupivacaine for ISB (Casati et al 2003). Preservation of motor function during continuous ISB seems to be minimally better with 0.2% ropivacaine than with 0.15% bupivacaine (Borgeat et al 2001).

2.3.2. Dose, Concentration, and Volume—Whether increasing local anesthetic mass (mass = concentration × volume) results in a higher success rate is controversial in clinical settings. Laboratory studies clearly indicate that neural blockade requires very little local anesthetic. A variety of animal models have shown that neural blockade can be successfully accomplished with extremely small amounts of local anesthetic. For example, neural blockade occurs with only 1.6% of the total injected volume of local anesthetic, with only 0.02% lidocaine concentration within the nerve, (Popitz-Bergez et al 1995) or with local anesthetic deposited along only 3 cm of nerve length. Although these animal data represent an idealized state wherein local anesthetic is deposited directly on nerves, they suggest that anesthesiologists may well overdose local anesthetic in their clinical practice. Studies using ultrasonography vary in their findings on the ability to reduce local anesthetic volume without sacrificing block quality (Duggan et al 2009).

In a series of studies involving continuous AXB using 1% mepivacaine with epinephrine, systematically evaluated the role of volume, concentration, and dose on block efficacy. When dose was held constant, increasing volume from 20 to 40 to 80 mL had little effect on sensory blockade of most nerves, (Vester-Andersen et al 1983) although motor block was superior at lower volumes, probably reflecting a concentration effect Vester-Andersen et al 1984. When volume was held constant, sensory blockade was 70% to 100% successful in all nerve groups, regardless of increasing concentration (0.5% to 1% to 1.5%) Vester-Andersen et al 1984. Increasing the dose from 400 to 500 to 600 mg resulted in no difference in sensory or motor anesthesia Vester-Andersen et al 1984. Ultimately, isolated changes in volume, concentration, or dose had minimal effect on sensory nerve blockade. Minor improvements in block quality were achievable only with the combination of increasing volume and drug mass. More recent studies corroborate these findings. Equivalent clinical axillary blockade occurs with 20-, 28-, or 38-mL volumes of 1% mepivacaine, (Serradell et al 2003) whereas 5 or 20 mL 0.5% ropivacaine manifests equivalent analgesia after ultrasound-guided ISB (Riazi et al 2008). Similarly, 30, 40, or 60 mL of ropivacaine does not affect the onset of axillary sensory block (Krenn et al 2003). Purely analgesic block has been reported with as little as 10 mL of 0.25% bupivacaine or 0.5% ropivacaine. Increasing ropivacaine concentration does not significantly alter ISB characteristics (Casati et al 1999). In summary, onset, quality, and duration of brachial plexus local anesthetic blockade are not improved by arbitrarily increasing drug mass or its determinants, volume and concentration. Indeed, doing so may worsen local anesthetic systemic toxicity and neurotoxicity in the event of accident.

The onset and duration of brachial plexus block can also be linked to patient-related conditions. Block onset and duration are unaffected by altitude (Fuzier et al 2007). Anesthetic duration is not prolonged in patients with chronic renal failure (Crews et al 2002). The pharmacokinetic profile of levobupivacaine does not vary between patients with or without uremia, (Crews et al 2002) whereas ropivacaine plasma concentrations 24 hrs after AXB are higher in patients with renal failure (Pere et al 2003). Block onset is delayed in areas of local infection as compared with noninfected areas within the distribution of the same nerve (Iohom et al 2005).

2.3.3. Local Anesthetic Mixtures—Mixtures of local anesthetics are intended to provide faster block onset than long-acting agents and to extend the duration typically seen with intermediateor short-acting agents. Overall, mixtures provide few clinically significant advantages but instead result in a profile similar to a pure intermediate-acting agent (Martin et al 1993). Furthermore, combined administration of local anesthetics produces epileptogenic effects that are additive. A more elegant approach to tailoring local anesthetic profile involves selective application of different local anesthetic agents or clonidine (Iskandar et al 2001) to individual nerves. By injecting lidocaine on the musculocutaneous and radial nerves, and bupivacaine on the median and ulnar nerves, one can achieve faster recovery from motor block but longer analgesic duration when compared with injecting a mixture of lidocaine and bupivacaine on all 4 nerves (Bouaziz et al 1998).

Clinical studies are inconclusive regarding alkalinization of local anesthetics as a means of hastening block onset. The presence or absence of epinephrine is a central dividing point for analyzing this topic (Tetzlaff et al 1995). Alkalinization seems most effective with commercially prepared epinephrine-containing local anesthetics, probably because these solutions are formulated at a lower pH and the relative effects of raising pH are greater than with plain local anesthetic solutions. However, when fresh epinephrine is added to plain lidocaine, onset times of brachial plexus anesthesia with alkalinization are similar to those seen without alkalinization (Chow et al 1998). The clinical significance of faster onset is questionable. For instance, adding sodium bicarbonate to mepivacaine with epinephrine significantly decreased sensory block onset time from 1.8 ± 0.2 to 1.0 ± 0.2 mins. Effects on other block characteristics are similarly unconvincing. For example, alkalinization does not improve sensory block success rate, (Chow et al 1998) nor does it affect plasma mepivacaine levels in the absence of epinephrine. There are no well-controlled clinical observations of the impact of alkalinization on peripheral nerve block intensity and duration in humans, but in rats, alkalinization of plain 1% lidocaine decreased block intensity by 25% and decreased block duration by more than 50%. Similar effects were not observed with 1% lidocaine with epinephrine (Sinnott et al 2000). In summary, clinical data do not support the alkalinization of local anesthetics used for brachial plexus blockade.

2.4: Adjuvants

Significant prolongation of brachial plexus analgesia is ideally accomplished with placement of continuous catheters. For moderate prolongation of analgesia (<24 hrs), various adjuvant drugs can be admixed with local anesthetic. There are no ultralong-acting local anesthetics or slow-release formulations clinically available (Rose et al 2005).

2.4.1. Epinephrine—Epinephrine prolongs duration and intensity of most local anesthetics used for peripheral nerve block. For example, a 1:200,000 dilution (5 µg/mL) significantly increases the mean duration of lidocaine (264 with vs 186 mins without epinephrine). These effects are due to vasoconstriction, which prolongs the nerve's exposure to local anesthetic drug mass by limiting clearance (Bernards et al 1999). Other benefits of epinephrine include acting as a marker of intravascular injection and potentially limiting systemic local anesthetic toxicity by reducing time-topeak concentration and peak plasma concentration, although the latter effect is not seen with ropivacaine (Hickey et al 1990). Adjunctive epinephrine is most effective with lipophobic local anesthetics such as mepivacaine or lidocaine, where it prolongs anesthetic duration in a dose-dependent manner up to a 1:200,000 dilution. Stronger concentrations are associated with hemodynamic side effects— increased heart rate and cardiac output and decreased peripheral vascular resistance (Dogru et al 2003). A 1:400,000 dilution (2.5 µg/mL) slightly decreases block duration as compared with 1:200,000 dilution (240 vs 264 mins, respectively) but is associated with minimal hemodynamic alteration and does not decrease nerve blood flow (Partridge et al 1991).

Routine use of adjunctive epinephrine clearly prolongs brachial plexus block duration with little, if any, risk. However, on a theoretical basis with some supporting animal data, anesthesiologists may prefer to use weaker concentrations (1:400,000) or avoid epinephrine altogether in patients at risk for cardiac ischemia or potentially prone to nerve injury as a consequence of decreased blood flow secondary to chemotherapy, diabetes, or atherosclerotic disease (Neal et al 2003). Safety and efficacy data for admixing epinephrine in continuous perineural infusions are limited (Partridge et al 1991). For digital nerve blocks, there is no convincing evidence that epinephrine-containing local anesthetics are causally linked to digital ischemia (Denkler et al 2001).

2.4.2. Clonidine—Clonidine is a useful adjuvant for brachial plexus blockade, particularly when admixed with intermediate-acting local anesthetics for AXB (McCartney et al 2007). Clinical evidence generally supports its use and has been extensively reviewed (McCartney et al 2007). Clonidine does not serve as an intravascular marker, nor does it significantly affect local anesthetic plasma levels. Prolongation of anesthesia and analgesia with brachial plexus clonidine is most likely peripherally mediated (Iskandar et al 2001, & McCartney et al 2007) and, like its side effect profile, dose-dependent. Brachial plexus clonidine 150 μg delays the onset of pain by 2-fold when compared with systemic control, and 0.1 μg/kg prolongs analgesia by 50% compared with placebo

(492 vs 260 mins). When added to mepivacaine, the minimum dose required to prolong analgesia is 0.1 μg/kg, whereas that needed to prolong anesthesia is 0.5 μg/kg. Side effects (hypotension, bradycardia, sedation) do not occur up to a dose of 1.5 μg/kg or a maximum dose of 150 μg or less.

The choice of local anesthetic affects the effectiveness of clonidine. Dose-dependent prolongation of clonidine admixed with mepivacaine or lidocaine is well established, but its ability to increase analgesic duration after brachial plexus blocks with long-acting local anesthetics is less pronounced (McCartney et al 2007). Clonidine accelerates block onset in areas of localized infection (Iohom et al 2005). Clonidine has no beneficial effects when used with continuous perineural infusions (Ilfeld et al 2003). Once pain occurs, the presence of clonidine does not alter its intensity (Foxall et al 2007). Clonidine does not affect tourniquet pain. Whether clonidine is better than, or adds value to, epinephrine-containing mixtures is uncertain, but 2 human studies that independently assessed the effects of epinephrine and clonidine using the same experimental model demonstrated greater lidocaine block prolongation with epinephrine (Bernards et al 1999 & Kopacz et al 2001).

2.4.3. Other Adjuvant Drugs—A variety of other adjuvants for prolonging brachial plexus blockade have been reported but either are ineffective, are associated with side effects, or have unresolved issues related to neurotoxicity. Adenosine does not improve brachial plexus block quality (Apan et al 2003) . Tramadol, an analgesic with peripheral effects similar to local anesthetics and clonidine, moderately increases sensory block duration (approximately to the same degree as epinephrine or clonidine) in a dose-dependent manner up to 200 mg when compared with placebo or systemic control (Robaux et al 2004). The neurotoxicity of tramadol is unknown; however, it causes skin rash when administered subcutaneously (Altunkaya et al 2003). Brachial plexus verapamil offers little advantage over epinephrine if expected surgical duration is less than 3.5 hrs. Neostigmine does not improve sensory or motor block qualities but is associated with a 30% incidence of gastrointestinal side effects (Bouaziz et al 1999). Dexamethasone has been shown to prolong analgesia, based on an underpowered study without benefit of systemic control. (Movafegh et al 2006) There are theoretical concerns that dexamethasone may adversely affect peripheral nerve blood flow in diabetic patients and/or cause hyperglycemia. Ketamine does not improve ropivacaine blockade but is associated with side effects (Lee et al 2008). Magnesium prolongs prilocaine AXB to the same extent as epinephrine (Gunduz et al 2006); its peripheral neurotoxicity profile has not been studied. Midazolam has been shown to prolong bupivacaine block by 2 hrs, (Jarbo et al 2005) but concerns have been raised regarding its neurotoxicity (Lavand'homme et al 2006). Hyaluronidase does not hasten block onset, reduce the incidence of failed block, or affect local anesthetic blood concentration, but it does shorten block duration. To date, there have been no studies evaluating nonsteroidal anti-inflammatory drugs as adjuvants for brachial plexus blockade (Steinberg et al 1998).

In summary, local anesthetic and adjuvant selection, as well as dosing, clearly affects brachial plexus block characteristics. Yet, despite our ability to modify local anesthetic solutions, it is unclear to what extent block spread and quality are more a function of technical intervention than pharmacological adjustment. Whereas no studies evaluate the pharmacological contributions of local anesthetic and adjuvant selection versus the technical issues of block selection and performance, anesthesiologists should be aware that both profoundly affect the success of brachial plexus anesthesia.

2.5: COMPLICATIONS OF LOCAL ANESTHESIA

As with any medical procedure, brachial plexus anesthesia is associated with risks. Large outcome studies of major complications after brachial plexus block are limited (Auroy et al 2002, Candido et al 2005, & Lee et al 2008). The incidence of various complications ranges from the extremely rare to the relatively common. For instance, a large study in France 292 included (Murphy et al 2000), peripheral nerve blocks, in which the incidence of cardiac arrest (0.01%), death (0.005%), seizures (0.08%), and radiculopathy (0.02%) was extremely small. In a follow-up study, the same group reported that the overall risk of a serious adverse event after peripheral nerve block was 0.04% (Auroy et al 2002). In its 1999 report, the American Society of Anesthesiologists (ASA) database of closed malpractice claims concerning anesthesia-related nerve injury (ARNI) noted that 28% involved the ulnar nerve (only 15% of these were associated with regional anesthesia) and 20% involved the brachial plexus (only 16% of which were directly attributable to regional anesthesia) (Cheney et al 1999). Subsequent reports noted that 10% of brachial plexus injuries were for pneumothorax, whereas claims for death and brain damage were most commonly linked to local anesthetic systemic toxicity (Lee et al 2008, Lee et al 2004). Overall, the incidence of severe short- and long-term complications after ISB (catheter and single-shot techniques) is quite low (0.4%) (Borgeat et al 2001). Less serious complaints are common—for instance, 50% of patients undergoing AXB report at least 1 side effect such as soreness (40%), transient numbness (11%), or bruising (23%) (Finucane, 2007).

2.6: Spinal, Epidural, & Caudal Blocks: Introduction

Spinal, caudal, and epidural blocks were first used for surgical procedures at the turn of the twentieth century. These central blocks were widely used prior to the 1940s until increasing reports of permanent of the agents employed, diligently employ sterile techniques, and anticipate and quickly treat physiological derangements (Butterworth, 2013).

2.6.1. The Role of Neuraxial Anesthesia in Anesthetic Practice

Almost all operations below the neck can be performed under neuraxial anesthesia. However, because intrathoracic, upper abdominal, and laparoscopic operations can significantly impair ventilation, general anesthesia with endotracheal intubation is also necessary. So why do a regional anesthetic for these cases, or for any other cases (Butterworth, 2013).

Some clinical studies suggest that postoperative morbidity—and possibly mortality—may be reduced when neuraxial blockade is used either alone or in combination with general anesthesia in some settings. Neuraxial blocks may reduce the incidence of venous thrombosis and pulmonary embolism, cardiac complications in high-risk patients, bleeding and transfusion requirements, vascular graft occlusion, and pneumonia and respiratory depression following upper abdominal or thoracic surgery in patients with chronic lung disease. Neuraxial blocks may also allow earlier return of gastrointestinal function following surgery. Proposed mechanisms include amelioration of the hypercoagulable state associated with surgery, sympathectomy-mediated increases in tissue blood flow, improved oxygenation from decreased splinting, enhanced peristalsis, and suppression of the neuroendocrine stress response to surgery. For patients with coronary artery disease, a decreased stress response may result in less perioperative ischemia and reduced morbidity and mortality. The increasing use of perioperative-blockade to reduce perioperative cardiac complications, however, may minimize or eliminate the potential advantage of neuraxial anesthesia in this setting. Reduction of parenteral opioid requirements may decrease the incidence of atelectasis, hypoventilation, and aspiration pneumonia. Postoperative epidural analgesia may also significantly reduce the time until extubation and reduce the need for mechanical ventilation after major abdominal or thoracic surgery (Morgan, 2006).

Anesthesiologists are all too familiar with situations in which a consultant "clears" a sick elderly patient with significant cardiac disease for surgery "under spinal anesthesia." But is a spinal anesthetic really safer than general anesthesia for such a patient? A spinal anesthetic with no intravenous sedation may reduce the likelihood of postoperative delirium or cognitive dysfunction, which is sometimes seen in the elderly. Unfortunately, some, if not most, patients require some sedation during the course of the procedure, either for comfort or to facilitate cooperation. And is spinal anesthesia always safer for a patient with severe coronary artery disease or a decreased ejection fraction? Ideally an anesthetic technique in such a patient should not involve either hypotension (which decreases myocardial perfusion pressure) or hypertension or tachycardia (which increase myocardial oxygen consumption), and should not require large fluid infusion (which can precipitate congestive heart failure). Unfortunately, a spinal anesthetic is often associated with hypotension and bradycardia, which may be rapid in onset and is sometimes profound. Moreover, treatment may require rapid administration of intravenous fluid, vasopressors, and/or an anticholinergic, which can cause fluid overload (when the vasodilatation wears off), rebound hypertension, and tachycardia. The slower onset of hypotension and bradycardia following epidural anesthesia may give the anesthesiologist more time to correct hemodynamic changes, although they still occur. Some clinicians avoid epidural anesthesia in elderly patients who may have spinal stenosis, fearing the mass effect of the bolus of anesthetic might compromise spinal cord perfusion. General anesthesia, on the other hand, also poses potential problems for patients with cardiac compromise (Butterworth, 2013).

Neuraxial anesthesia has had a great impact in obstetrics. Currently, epidural anesthesia is widely used for analgesia in women in labor and during vaginal delivery. Cesarean section is most commonly performed under epidural or spinal anesthesia. Both blocks allow a mother to remain awake and experience the birth of her child. Large population studies in Great Britain and in the United States have shown that regional anesthesia for cesarean section is associated with less maternal morbidity and mortality than is general anesthesia. This may be largely due to a reduction in the incidence of pulmonary aspiration and failed intubation (Butterworth, 2013).

2.6.2. Mechanism of Action

The principal site of action for neuraxial blockade is the nerve root. Local anesthetic is injected into CSF (spinal anesthesia) or the epidural space (epidural and caudal anesthesia) and bathes the nerve root in the subarachnoid space or epidural space, respectively. Direct injection of local anesthetic into CSF for spinal anesthesia allows a relatively small dose and volume of local anesthetic to achieve dense sensory and motor blockade. In contrast, the same local anesthetic concentration is achieved at nerve roots only with much higher volumes and quantities of local anesthetic with epidural and caudal anesthesia. Moreover, the injection site (level) for epidural anesthesia must generally be close to the nerve roots that must be anesthetized. Blockade of neural transmission (conduction) in the posterior nerve root fibers interrupts somatic and visceral sensation, whereas blockade of anterior nerve root fibers prevents efferent motor and autonomic outflow (Butterworth, 2013).

2.6.3. Somatic Blockade

By interrupting the transmission of painful stimuli and abolishing skeletal muscle tone, neuraxial blocks can provide excellent operating conditions. Sensory blockade interrupts both somatic and visceral painful stimuli, whereas motor blockade produces skeletal muscle relaxation. Spinal nerve roots contain varying mixtures of these fiber types. Smaller and myelinated fibers are generally more easily blocked than larger and unmyelinated ones. This, and the fact that the concentration of local anesthetic decreases with increasing distance from the level of injection, explains the phenomenon of differential blockade. Differential blockade typically results in sympathetic blockade (judged by temperature sensitivity) that may be two segments higher than the sensory block (pain, light touch), which in turn is usually two segments higher than the motor blockade (Morgan, 2006).

2.6.4. Autonomic Blockade

Sympathetic outflow from the spinal cord may be described as thoracolumbar, whereas parasympathetic outflow is craniosacral. Sympathetic preganglionic nerve fibers (small, myelinated B fibers) exit the spinal cord with the spinal nerves from T1 to the L2 level and may course many levels up or down the sympathetic chain before synapsing with a postganglionic cell in a sympathetic ganglia. In contrast, parasympathetic preganglionic fibers exit the spinal cord with the cranial and sacral nerves. Neuraxial anesthesia does not block the vagus nerve (tenth cranial nerve). The physiological responses of neuraxial blockade therefore result from decreased sympathetic tone and/or unopposed parasympathetic tone (Butterworth, 2013).

2.6.5. Cardiovascular Manifestations

Neuraxial blocks typically produce variable decreases in blood pressure that may be accompanied by a decrease in heart rate and cardiac contractility. These effects are generally proportional to the degree (level) of the sympathectomy. Vasomotor tone is primarily determined by sympathetic fibers arising from T5 to L1, innervating arterial and venous smooth muscle. Blocking these nerves causes vasodilation of the venous capacitance vessels, pooling of blood, and decreased venous return to the heart; in some instances, arterial vasodilation may also decrease systemic vascular resistance. The effects of arterial vasodilation may be minimized by compensatory vasoconstriction above the level of the block. A high sympathetic block not only prevents compensatory vasoconstriction but also blocks the sympathetic cardiac accelerator fibers that arise at T1–T4. Profound hypotension may result from vasodilation combined with bradycardia and decreased contractility. These effects are exaggerated if venous return is further compromised by a head-up position or by the weight of a gravid uterus (Barash et al 2006).

Deleterious cardiovascular effects should be anticipated and steps undertaken to minimize the degree of hypotension. Volume loading with

10–20 mL/kg of intravenous fluid for a healthy patient will partially compensate for the venous pooling. Left uterine displacement in the third trimester of pregnancy helps minimize physical obstruction to venous return. Despite these efforts, hypotension may still occur and should be treated promptly. Fluid administration can be increased, and autotransfusion may be accomplished by placing the patient in a head-down position. Excessive or symptomatic bradycardia should be treated with atropin, and hypotension should be treated with vasopressors. Direct -adrenergic agonists (such as phenylephrine) increase venous tone and produce arteriolar constriction, increasing both venous return and systemic vascular resistance. Ephedrine has direct -adrenergic effects that increase heart rate and contractility and indirect effects that also produce some vasoconstriction. If profound hypotension and/or bradycardia persist despite these interventions, epinephrine (5–10g intravenously) should be administered promptly (Barash et al 2006). .

2.6.6. Spinal Anesthesia

Spinal anesthesia blocks nerve roots as they course through the subarachnoid space. The spinal subarachnoid space extends from the foramen magnum to the S2 in adults and S3 in children. Injection of local anesthetic below L1 in adults and L3 in children helps avoid direct trauma to the spinal cord. Spinal anesthesia is also referred to a subarachnoid block or intrathecal injection (Morgan, 2006).

2.6.7. Specific Technique for Spinal Anesthesia

The midline, paramedian, or prone approach can be used for spinal anesthesia. As previously discussed, the needle is advanced from skin through the deeper structures until two "pops" are felt. The first is penetration of the ligamentum flavum and the second is penetration of the dura–arachnoid membrane. Successful dural puncture is confirmed by withdrawing the stylet to verify free flow of CSF. With small-gauge needles (< 25 g), particularly in the presence of low CSF pressure (eg, a dehydrated patient), aspiration may be necessary to detect CSF. If initially free flow occurs but then CSF cannot be aspirated after attaching the syringe, the needle may have moved. Persistent paresthesia or pain upon injection should alert the clinician to withdraw and redirect the needle (Barash et al 2006).

2.6.8. Factors Influencing Level of Block

Factors that have been shown to affect level of neural blockade following spinal anesthesia. The most important determinants are baricity, position of the patient during and immediately after injection, and drug dosage. In general, the higher the dosage or site of injection, the higher the level of anesthesia obtained. Moreover, migration of the local anesthetic cephalad in CSF depends on its specific gravity relative to CSF (baricity). CSF has a specific gravity of 1.003–1.008 at 37°C. The specific gravity of commonly used local anesthetic solutions. A hyperbaric solution of local anesthetic is denser (heavier) than CSF, whereas a hypobaric solution is less dense (lighter) than CSF. The local anesthetic solutions can be made hyperbaric by the addition of glucose or hypobaric by the addition of sterile water. Thus, with a head-down position, a hyperbaric solution spreads cephalad and a hypobaric anesthetic solution moves caudad. A head-up position causes a hyperbaric solution to settle caudad and a hypobaric solution to ascend cephalad. Similarly, in a lateral position, a hyperbaric spinal solution will have a greater effect on the dependent (down) side, whereas a hypobaric solution will achieve a higher level on the nondependent (up) side. An isobaric solution tends to remain at the level of injection. Anesthetic agents are mixed with CSF (at least 1:1) to make their solutions isobaric. Other factors affecting the level of neural blockade include the level of injection and the patient's height and vertebral column anatomy. The direction of the needle bevel or injection port may also play a role; higher levels of anesthesia are achieved if the injection is directed cephalad than if the point of injection is oriented laterally or caudad (Morgan, 2006).

Hyperbaric solutions tend to move to the most dependent area of the spine (normally T4–T8 in the supine position). With normal spinal anatomy, the apex of the thoracolumbar curvature is T4). In the supine position, this should limit a hyperbaric solution to produce a level of anesthesia at or below T4. Abnormal curvatures of the spine, such as scoliosis and kyphoscoliosis, have multiple effects on spinal anesthesia. Placing the block becomes more difficult because of the rotation and angulation of the vertebral bodies and spinous processes. Finding the midline and the interlaminar space may be difficult. The paramedian approach to lumbar puncture may be preferable in patients with severe scoliosis and kyphoscoliosis, particularly if there is associated degenerative joint disease. The paramedian approach is easiest for spinal anesthesia at the L5–S1 level. In the Taylor approach, a variant of the standard paramedian approach described previously, the needle enters 1 cm medial and 1 cm inferior to the posterior superior iliac spine and is directed cephalad and toward the midline. Reviewing radiographs of the spine before attempting the block may be useful. Spinal curvature affects the ultimate level by changing the contour of the subarachnoid space. Previous spinal surgery can similarly result in technical difficulties in placing a block. Correctly identifying the interspinous and interlaminar spaces may be difficult at the levels of previous laminectomy or spinal fusion. The paramedian approach may be easier, or a level above the surgical site can be chosen. The block may be incomplete, or the level may be different than anticipated, due to postsurgical anatomic changes (Morgan, 2006).

CSF volume, are associated with higher blocks. This would include conditions such as pregnancy, ascites, and large abdominal tumors. In these clinical situations, higher levels of anesthesia are achieved with a given dose of local anesthetic than would otherwise be expected. For spinal anesthesia on a term parturient, the dosage of anesthetic can be reduced by one-third compared with a nonpregnant patient. Age-related decreases in CSF volume are likely responsible for the higher anesthetic levels achieved in the elderly for a given dosage of spinal anesthetic. Severe kyphosis or kyphoscoliosis can also be associated with a decreased volume of CSF and often results in a higher than expected level, particularly with a hypobaric technique or rapid injection. Conflicting opinion exists as to whether increased CSF pressure caused by coughing or straining, or turbulence on injection has any effect on the spread of local anesthetic in the CSF (Butterworth, 2013).

Hyperbaric spinal anesthesia is more commonly used than the hypobaric or isobaric techniques. The level of anesthesia is then dependent on the patient's position during and immediately following the injection. In the sitting position, "saddle block" can be achieved by keeping the patient sitting for 3–5 min following injection so that only the lower lumbar nerves and sacral nerves are blocked. If the patient is moved from a sitting position to a supine position immediately after injection, the agent will move more cephalad to the dependent region defined by the thoracolumbar curve, as full protein binding has not yet occurred. Hyperbaric anesthetics injected intrathecally with the patient in a lateral decubitus position are useful for unilateral lower extremity procedures. The patient is placed laterally with the extremity to be operated on in a dependent position. If the patient is kept in this position for about 5 min following injection, the block will tend to be denser and achieve a higher level on the operative dependent side (Butterworth, 2013).

2.6.9. Epidural Anesthesia

Epidural anesthesia is a neuraxial technique offering a range of applications wider than the typical all-or-nothing spinal anesthetic. An epidural block can be performed at the lumbar, thoracic, or cervical level. Sacral epidural anesthesia is referred to as a caudal block and is described at the end of this chapter. Epidural techniques are widely used for operative anesthesia, obstetric analgesia, postoperative pain control, and chronic pain management. It can be used as a single shot technique or with a catheter that allows intermittent boluses and/or continuous infusion. The motor block can range from none to complete. All these variables are controlled by the choice of drug, concentration, dosage, and level of injection (Barash et al 2006). .

The epidural space surrounds the dura mater posteriorly, laterally, and anteriorly. Nerve roots travel in this space as they exit laterally through the foramen and course outward to become peripheral nerves. Other contents of the epidural space include fatty connective tissue, lymphatics, and a rich venous (Batson's) plexus. Recent fluoroscopic studies have suggested the presence of septa or connective tissue bands. Epidural anesthesia is slower in onset (10–20 min) and may not be as dense as spinal anesthesia. This can be manifested as a more pronounced differential block or a segmental block, a feature that can be useful clinically. For example, by using relatively dilute concentrations of a local anesthetic combined with an opioid, an epidural can block the smaller sympathetic and sensory fibers and spare the larger motor fibers, providing analgesia without motor block. This is commonly employed for labor and postoperative analgesia. Moreover, a segmental block is possible because the anesthetic is not spread readily by CSF and can be confined close to the level at which it was injected. A segmental block is characterized by a well-defined band of anesthesia at certain nerve roots; nerve roots above *and* below are not blocked. This can be seen with a thoracic epidural that provides upper abdominal anesthesia while sparing cervical and lumbar nerve roots (Finucane, 2007).

Epidural anesthesia and analgesia is most often performed in the lumbar region. The midline or paramedian approach can be used. Lumbar epidural anesthesia can be used for any procedure below the diaphragm. Because the spinal cord typically terminates at the L1 level, there is an extra measure of safety in performing the block in the lower lumbar interspaces, particularly if an inadvertent dural puncture occurs (Morgan, 2006).

Thoracic epidural blocks are technically more difficult to accomplish than lumbar blocks because of greater angulation and marked overlapping of the spinous processes at the vertebral level. Moreover, the potential risk of spinal cord injury with inadvertent dural puncture, although small with good technique, may be greater than that at the lumbar level. Thoracic epidural blocks can be accomplished with either a midline or paramedian approach. Rarely used for primary anesthesia, the thoracic epidural technique is most commonly used for intra- and postoperative analgesia. Single shot or catheter techniques are used for management of chronic pain. Infusions via an epidural catheter are very useful for providing analgesia and may obviate or shorten postoperative ventilation for patients with underlying lung disease and following chest surgery (Finucane, 2007).

2.6.10. Specific Technique for Epidural Anesthesia

Using the midline or paramedian approaches detailed previously, the epidural needle courses from the skin just through the ligamentum flavum. In epidural anesthesia the needle must stop short of piercing the dura. Two techniques make it possible to determine when the tip of the needle has entered the potential (epidural) space: the "loss of resistance" and "hanging drop" techniques (Barash et al 2006).

The loss of resistance technique is preferred by most clinicians. The needle is advanced through the subcutaneous tissues with the stylet in place until the interspinous ligament is entered, as noted by an increase in tissue resistance. The stylet or introducer is removed and a glass syringe filled with approximately 2 mL of fluid or air is attached to the hub of the needle. If the tip of the needle is within the ligament, gentle attempts at injection are met with resistance and injection is not possible. The needle is then slowly advanced, millimeter by millimeter, with either continuous or rapidly repeating attempts at injection. As the tip of the needle just enters the epidural space there is a sudden loss of resistance and injection is easy (Finucane, 2007).

Once the interspinous ligament has been entered and the stylet has been removed, the hanging drop technique requires that the hub of the needle be filled with solution so that a drop hangs from its outside opening. The needle is then slowly advanced deeper. As long as the tip of the needle remains within the ligamentous structures, the drop remains "hanging." However, as the tip of the needle enters the epidural space it creates negative pressure and the drop of fluid is sucked into the needle. If the needle becomes plugged the drop will not be drawn into the hub of the needle and inadvertent dural puncture may occur. Some clinicians prefer to use this technique for the paramedian approach and for cervical epidurals (Finucane, 2007).

2.6.11. Factors Affecting Level of Block

Factors affecting the level of epidural anesthesia may not be as predictable as with spinal anesthesia. In adults, 1–2 mL of local anesthetic per segment to be blocked is a generally accepted guideline. For example, to achieve a T4 sensory level from an L4–L5 injection would require about 12–24 mL. For segmental or analgesic blocks, less volume is needed (Morgan, 2006).

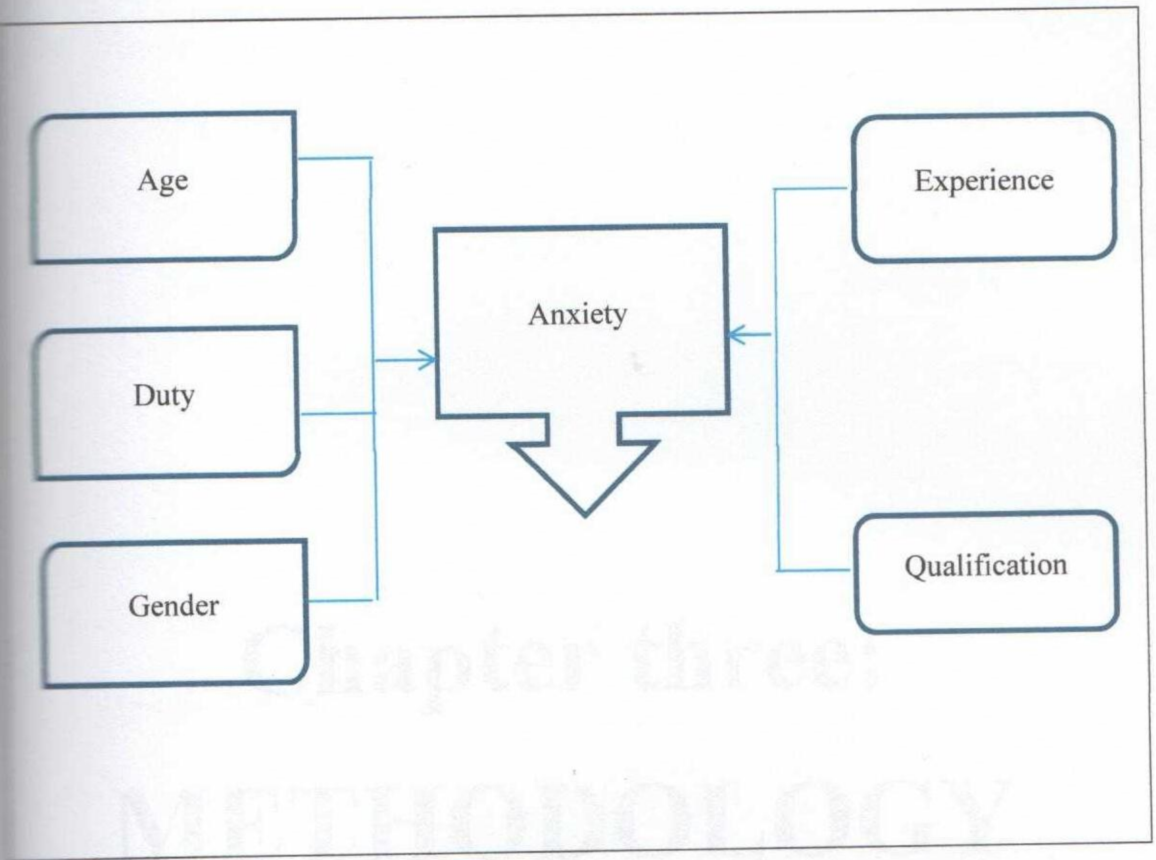
The dose required to achieve the same level of anesthesia decreases with age. This is probably a result of age-related decreases in the size or compliance of the epidural space. Although there is little correlation between body weight and epidural dosage requirements, patient height affects the extent of cephalad spread. Thus, shorter patients may require only 1 mL of local anesthetic per segment to be blocked, whereas taller patients generally require 2 mL per segment. Although less dramatic than with spinal anesthesia, spread of epidural local anesthetics tends to be partially affected by gravity. The lateral decubitus, Trendelenburg, and reverse Trendelenburg positions can be used to help achieve blockade in the desired dermatomes. Injection in the sitting position appears to deliver more local anesthetic to the larger L5–S1 and S2 nerve roots; patchy anesthesia or sparing of those dermatomes is sometimes encountered with lumbar epidural anesthesia (Barash et al 2006). .

Additives to the local anesthetic, particularly opioids, tend to have a greater effect on the quality of epidural anesthesia than on the duration of the block. Epinephrine in concentrations of 0.005 mg/mL prolongs the effect of epidural lidocaine, mepivacaine, and chloroprocaine more than that of bupivacaine, levobupivacaine, etidocaine, and ropivacaine. In addition to prolonging the duration and improving the quality of block, epinephrine decreases vascular absorption and peak systemic blood levels of epidurally administered local anesthetics. Phenylephrine generally is less effective than epinephrine as a vasoconstrictor for epidural anesthesia (Finucane, 2007).

2.6.12. Epidural Anesthetic Agents

The epidural agent is chosen based on the desired clinical effect, whether it is to be used as a primary anesthetic, for supplementation of general anesthesia, or for analgesia. The anticipated duration of the procedure may call for a short- or long-acting single shot anesthetic or the insertion of a catheter. Commonly used short- to intermediate-acting agents for surgical anesthesia include lidocaine, chloroprocaine, and mepivacaine. Long-acting agents include bupivacaine, levobupivacaine, and ropivacaine. Levobupivacaine, the S-enantiomer of bupivacaine, is less toxic than bupivicaine but is no longer available in the United States. Only preservative-free local anesthetic solutions or those specifically labeled for epidural or caudal use are employed (Barash et al 2006). .

Figure 2.5. Conceptual framework



Chapter three:

METHODOLOGY

Chapter 3: METHODOLOGY

3.1: Study area:

The current study was conducted at Hospitals, Sana'a city, Yemen., private, general hospital.

3.2: Study design:

Cross-sectional descriptive design was utilized in the current study. This design was concerned with description of a phenomenon of interest and focused on anesthesiologist s' characteristics without trying to make interference.

3.3: Study population:

All anesthesiologists who work in the Hospital, Sana'a city, Yemen, who voluntarily agree to participate in this study were included.

3.4: Sample size:

Due to the relatively small population of potential participants, and time restraint, (73 anesthesiologists) were invited to participate in this study.

3.5: Inclusion criteria:

All anesthesiologists working in Hospital, Sana'a city, Yemen regardless of their age, gender, and level of education, and who are professionally active for 1 year or more and gave informed consent to participate in the study.

3.6: Exclusion criteria:

Newly appointed anesthesiologists (less than three months) during the time of study

3.7: Sampling method:

All the anesthesiologists from above mentioned setting who agree to participate in this study and fulfilled the inclusion criteria was introduced in the study. The total sample size was (73 anesthesiologists).

3.8: Study Tools:

Part I: Sociodemographic characteristics

This part was designed by the researcher to collect data about anesthesiologists' socio-demographic characteristics such as gender, age, qualification, experience, etc.

Part II: Anesthesiologists' perception of patients' anxiety

This part was adopted from Jlala et al. (2010). It was designed to assess anesthesiologists' perceptions of patient anxiety under RA with a total of 39 items. The tool is a self-administered questionnaire designed in English language. The questionnaire was primarily designed to report the findings of some common problems facing anxious patients under regional anesthesia and how anesthesiologists deal with them in accordance with anesthetic practice in the UK. The questions in this survey consisted of a series of closed statements answered “Yes” or “No”. In addition, other questions were answered using a grading scale (1 = never/rarely, 2 = often, 3 = always). Anesthesiologists were instructed to report their opinions on how they perceive patients’ anxiety, its frequency and causes. Additionally, from a list of anxiety management strategies, respondents were instructed to select which technique they routinely use to alleviate their patients’ anxiety. Respondents were also asked about their perception of patients’ satisfaction following regional anesthesia. Finally, anesthesiologists were encouraged to add any comments as free text.

Moreover, pilot study was implemented on 5 anesthesiologists to explore clarity and content validity of the translated tool.

Operational definition of variables (Dependent and independent variables):

Dependent variables:

Anesthesiologists' perceptions of patient anxiety under regional anesthesia (appendix Part II)

Independent variables:

Anesthesiologists' sociodemographic characteristics; (appendix Part I)

3.9: Data Analysis:

The collected data was coded then entered into an IBM compatible computer, using SPSS version 20 for windows. Quantitative variables were expressed as number and percentages while qualitative variables were expressed as mean (X) and standard deviation (SD). The arithmetic mean (X) was used as a measure of central tendency, while the standard deviation (SD) was used as a measure of dispersion.

3.10: Pilot study:

A pilot study was carried out on 5 anesthesiologists to test feasibility, objectivity, and applicability of the data collection tool. Based on results of the pilot study needed refinements and modifications were done.

3.11: Ethical consideration:

1. Verbal consents were obtained from anesthesiologists after explaining the purpose and nature of the study.
2. Study Tool: this tool was translated into Arabic language then was translated again into English language. Experts of anesthesia and nursing educators were given both the original and translated tools to test feasibility, applicability and content validity of the translated tools. Necessary modifications were

carried out and were revised again until final agreement was achieved.

3. Each anesthesiologist was free to either participate or not in the current study and had the right to withdraw from the study at any time without any rational. Also, anesthesiologist will be informed that obtained data will be used only for research purpose and not for their evaluation.
4. Confidentiality and anonymity of each subject was assured through coding of all data.

Chapter four: RESULTS

Chapter 4: RESULTS

Table I: Sociodemographic data of the participated anesthesiologists

	Number	%
1) Hospital owner		
Public	41	56.2
Private	32	43.8
2) Hospital services		
General	55	75.3
Specialty	18	24.7
3) Age		
≤ 30	8	11
31–40	42	57.5
41–50	15	20.5
≥ 51	8	11
Mean & SD	39.92±8.01	
4) Gender		
Female	7	9.6
Male	66	90.4
5) Education level		
Diploma degree	21	28.8
Bachelor degree	11	15.1
Consultant	19	26
Arabic Board	22	30.1
6) Years of experience		
≤ 5	41	56.2
6-10	15	20.5
≥ 11	17	23.3
Years of experience	7.14±5.92	
7) Duty		
Part time duty	36	49.3
Full time duty	37	50.7

Table 4.1 showed that about three quarters (75.3%) of the hospitals in which study was implemented were general hospitals, and motre than the half of them (56.2%) were public hospital. High percentage (57.5%) of the participants their age range between 31-40 years, the mean age of the anesthesiologist's is 39.92±8.01, and the majority (90.4%) of them were

males, and nearly one third (30.1%) had Arabic board. Regarding years of experience, more than the half (56.2%) worked in anesthesia for ≤ 5 years, the mean years of experience was 7.14±5.92 years, and about the half (50.7%%) of the anesthesiologist's were working full time duty.

Table II: Anesthesiologist's perception of patients' anxiety during regional anesthesia

	Agree n (%)	Disagree n (%)
1. Patients' anxiety concerns me a lot	50(68.5%)	23(31.5%)
2. Patients' anxiety is common during regional anesthesia	35(47.9%)	38(52.1%)
3. Anxiety is mostly pre-operative	43(58.9%)	30(41.1%)
4. I am always prepared to manage patients' anxiety	39(53.4%)	34(46.6%)
5. I underestimate patients' anxiety	10(13.7%)	63(86.3%)
6. Differing advice from surgeon and anesthesiologist increases patient anxiety	57(78.1%)	16(21.9%)
7. Patients' anxiety may affect my anxiety	36(49.3%)	37(50.7%)
8. Patients' anxiety affects my confidence performing regional anesthesia	32(43.8%)	41(56.2%)
9. Patients' anxiety may affect block success	32(43.8%)	41(56.2%)
10. Patient satisfaction has high importance to the practice	65(89%)	8(11%)

Table (2), discusses the anesthesiologist's perception of patients' anxiety during regional anesthesia. The results showed high response rate (89%) for the item " Patient satisfaction has high importance to the practice", followed by (78.1%) for the item "Differing advice from surgeon and anesthesiologist increases patient anxiety". On the other hand underestimation of patient anxiety had the least response (13.7%).

Table III: Causes of patients' anxiety from anesthesiologists point of view

	WAR	N(%)
1. Fear of the anesthesia	2.5	40(54.8%)
2. Misinformation from lay people, family, friends, and surrounding media.	2.3	36(49.3%)
3. Fear of the surgery	2.3	26(35.6%)
4. Fear of complications (pain/nerve damage)	2.1	18(24.7%)
5. Fear of unknown	1.9	18(24.7%)
6. Giving patients little anesthetic information pre-op	1.8	15(20.5%)
7. Recall of previous bad experience	1.6	12(16.4%)
8. Needle-phobia	1.8	9(12.3%)
9. Giving patients detailed anesthetic information pre-op	1.5	5(6.8%)
10. Regional anesthesia might make operation less successful	1.2	2(2.7%)

Notes: WAR = weighted average responses (1 = never/ rarely; 2 =often; 3 =always); n =number of respondents who agree with the statements; % =percentages

Regarding the cause of patient anxiety, fear of anesthesia had the highest score (54.8%), followed by the item "Misinformation from lay people, family, friends, and surrounding media" which had 49.3%. The least score (2.7%) was for the item "Regional anesthesia might make operation less successful" and (6.8%), was for the item "Regional anesthesia might make operation less successful".

Table IV: Patients' experience with regional anesthesia block from anesthesiologists point of view

	N(%)
1. Patients find the block unpleasant	10(13.7%)
2. Patients remember the events during the block	3(4.1%)
3. Patients experience pain during the block	13(17.8%)
4. Patients experience pain during surgery	1(1.4%)
5. Patients have adequate pain relief after surgery	9(12.3%)
6. Following regional anesthesia, patients would have a block again	67(91.8%)
7. Patients are satisfied with the block.	56(76.7%)

Regarding patients' experience with block, the result of the present study showed that the item "following regional anesthesia, patients would have a block again" had the highest score (91.8%). The item "patients are satisfied with the block" had the second high score with (76.7%). The lowest score (1.4%) was regarding the item "Patients experience pain during surgery".

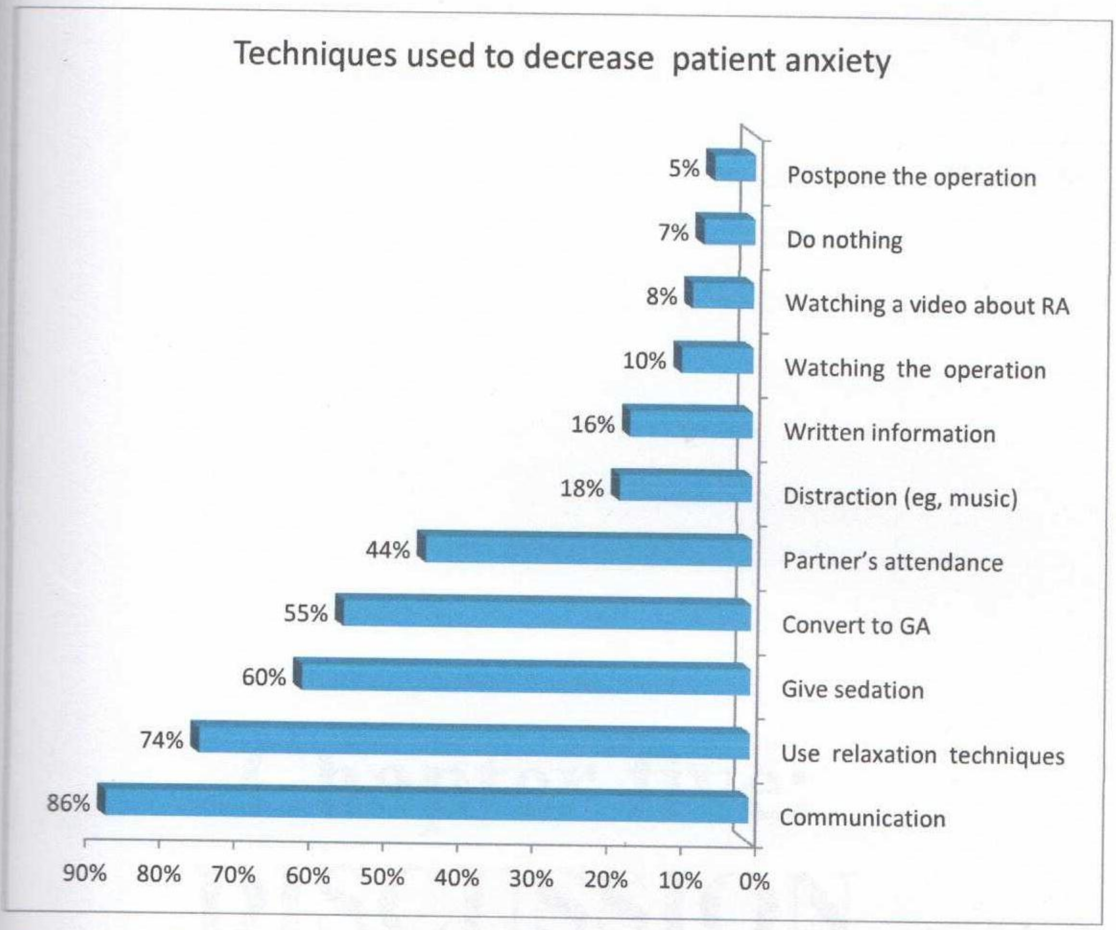


Figure (1): Techniques use by anesthesiologists in response to anxiety

Figure (1) showed anesthesiologist's response to patients' anxiety under regional anesthesia. The highest technique used (86%) was communication. The second response (74%) was using relaxation techniques. In the other hand, the least techniques used to alleviate patient's anxiety was postpone operation, do nothing or watching video about regional anesthesia or operation, with (5%, 7%, 8% & 10% respectively).

Chapter five:
DISCUSSION

Chapter 5: DISCUSSION

The participants in this study comprised 73 anesthesiologists, the majority (90.4%) of them were males, and more than the half (57.5%) their age range between 31–40 years with a mean age 39.92 years and standard deviation 8.01years. According to educational level, nearly one third (30.1%) of the anesthesiologists had Arabic Board and 28.8% diploma. Moreover, more than the half (56.2%) of anesthesiologists worked in the field for ≤ 5 years, and 50.7% of them worked full time duty.

The results in the present study showed that nearly the half (47.8%) of the respondents thought that anxiety is common among patients with regional anesthesia. This results is higher than that reported by Mitchell (2008), in which the self-reported anxiety was (36%) among regional anesthesia patients. More than the half (53.4%) of the participants reported they are prepared to manage patients' anxiety. This result was against that was reported by (Badner et al 1990) and Jlala et al (2010), in which most surveyed anesthesiologists felt they are always prepared to manage anxiety. Also small percentages (13.7%) of the respondents in the present study, underestimate patients' anxiety, compared to the half of the participants in study performed by Jlala et al (2010.

In line with that reported in other studies, anesthesia was found as the most common anxiety-provoking factors in this study (Mitchell, 2000,and Carr et al 2006) and surgery have been rated as; similar findings have been reported by other studies. Other causes as misinformation from lay people, family, friends, and surrounding media were among the highest causes of patients' anxiety. Also fear of the surgery was among common causes of patient anxiety.

In agreement with previous studies, most anesthesiologists believe that too much or too little information seems to have a small effect on patients' anxiety; this leaves anesthesiologists with the doubt of what is the amount of conveyed information necessary to patients without increasing their anxiety (Garden et al 1996, and Jlala et al 2010). More than one third of respondents think patients' fear of complications may increase their anxiety, this result is higher than that found by (Jalala et al 2010), This may suggest inaccuracy by underestimating patients' fear due to any possible complications.

In accordance with (Jalala et al 2010), communication was the main strategy used by anesthesiologists to control patient anxiety. Adequate explanation of benefits and risks, along with constant communication and reassurance throughout the procedure, would establish rapport, build confidence and trust, and alleviate fears. Such patients do not usually feel pressurized (Hu et al 2007). Respondents' comments have suggested that simple reassurance and the affirmation that the patient always "has the option to go to sleep if needed", is usually enough to allay most anxieties.

In the present study sedation was the third techniques used by 60% of the anesthesiologists in response to patients' anxiety. Anesthesiologists often give sedative drugs or advise patients to listen to music of their preference, either preoperatively or during the operation. All of these measures are well established methods to reduce patients' anxiety, (Mackenzie 1996, & Bechtold et al 2006) and patients usually gain benefit from them (Hyde et al 1998). A few in the present study mentioned that watching a video about regional anesthesia could be used to alleviate patients' anxiety. In accordance with this result, Jalala et al (2010) reported that several respondents commented upon the effectiveness of using anatomy slides and an orthopedic spine model to demonstrate how/where spinal/epidural needles are inserted, emphasizing they do not go into the cord itself.

Have the patient's partner in attendance during a surgical procedure often not practical, because of that, the vast majority of the respondent reported that patients preferred not to watch the operation. These results was much lower than those found in a study implemented by (Hyde et al 1998), who reported that more than two thirds of the respondents preferred not to watch the operation. The exception of this may be in obstetrics where it is routine (at the mother's request). Anesthesiologists, in our survey, do not think partner attendance may help in improving patients' anxiety. In the literature, this has also shown a small positive effect on patients' anxiety, but was not considered to be clinically important (Prabhu et al 2009).

Chapter six:

CONCLUSION & RECOMMENDATIONS

Chapter 6: CONCLUSION

The result of the present study reported common anxiety during regional anesthesia and that differing advice from surgeon and anesthesiologist, anesthesia, and misinformation from lay people, family, friends surgery were the most common causes of patients' anxiety pre-operatively. Communication, use of relaxation techniques and sedation were the most common techniques used by anesthesiologist to manage patients' anxiety. the vast majority of the respondents reported that regional anesthesia provide good analgesia and promote patients' satisfaction.

Recommendations

1. Conduct future studies among patients to accurately assess patient's anxiety during surgical procedures undergoing anesthesia
2. Design a checklist to assess patients' anxiety before surgical procedure as a part of preoperative patient preparation
3. Improvement of anesthesiologists' communication skills through educational programs, workshop and training
4. Further researches are needed on large scale

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Annex

Annex 1

استبيان تقييم ادراك المخدرين لقلق المرضى الخاضعين للتخدير الناحى

الجزأ الأول: البيانات الشخصية

١) المستشفى: ....

البيانات الشخصية:

٢) العمر بالسنة: .... (سنة)

٣) الجنس:

١. ذكر: ( )

٢. انثى: ( )

٤) المؤهل الدراسى:

١. دبلوم تخدير ( )

٢. بكالوريوس تخدير ( )

٣. اخصائى تخدير ( )

٤. بورد عربى ( )

٥. اخرى تذكر ( )

٥) سنوات العمل فى المستشفى: .... (سنة)

٦) الجنسية: ....

١. يمنى ( )

٢. اجنبى ( )

٧) طبيعة العمل:

١. دوام جزئى ( )

٢. دوام كامل ( )

الجزأ الثانى: استمارة قياس القلق

أ- ادراك المخدرين لقلق المرضى

١. ما مدى انشغالك بان قلق المريض يعتبر مشكلة اثناء التخدير الطرفى	كثير جدا	قليل	لا يوجد
٢. كم تقدر نسبة المرضى القلقين من اجمال المرضى الخاضعين للتخدير الطرفى لديك	معظم	البعض	لا يوجد
٣. فى اعتقادك، ما الوقت الأكثر قلقا للمرضى الخاضعين للتخدير الطرفى	قبل العملية	اثناء العملية	بعد العملية
٤. هل تشعر بأنك مستعد للتعامل مع الانواع المختلفة من سلوك المرضى القلق اثناء التخدير الطرفى	دائما	احيانا	مطلقا
٥. هل يؤثر اختلاف النصح من الجراح والمخدر تجاه تقنيات التخدير المختلفة على زيادة قلق المرضى	نعم	لا	
٦. فى اعتقادك ما مدى دقة تقييمك لقلق المرضى قبل التخدير الطرفى	يبالغ في التقدير	يقلل من التقدير	تقدير سليم
٧. هل لقلق المريض أى تأثير على قلقك	نعم	لا	
٨. هل لقلق المريض أى تأثير على مستوى ثقتك فى تنفيذ التخدير الطرفى	نعم	لا	
٩. هل لقلق المريض أى تأثير على نجاح عملية التخدير الطرفى ذاتها	نعم	لا	
١٠.ما أهمية رضى المرضى لممارستك	عالية	منخفضة	
١١. الى أي حد رضى المرضى بعد الاجراء تحت التخدير الطرفى	مطلقا	احيانا	دائما
١٢.			
١٣.			
١٤.			
١٥.			
١٦.			
١٧.فى رأيك يكون القلق غالبا قبل العملية			
١٨.قلق المريض يشغل بالى كثيرا			

١٩.انا اتوقع قلق المريض			
٢٠.انا دائما جاهز للتعامل مع قلق المريض			
٢١.قلق المريض قد يؤثر على قلقى			
٢٢.قلق المريض قد يؤثر على ثقتى فى تنفيذ التخدير الطرفى			
٢٣.قلق المريض قد يؤثر على نجاح التخدير الطرفى			
٢٤.اختلاف النصح من الجراح والمخدر يزيد من قلق المريض			

ب- أسباب قلق المريض من التخدير

	نادرا/ مطلقا	**غالبا**	**دائما**
٢٥.الخوف من الابر			
٢٦.الخوف من المجهول			
٢٧.الخوف من العملية الجراحية			
٢٨.الخوف من التخدير			
٢٩.تذكر التجارب السيئة السابقة			
٣٠.الخوف من المضاعفات (الالم – تلف العصب)			
٣١.قد يؤدى التخدير الطرفى الى تقليل نجاح العملية			
٣٢.اعطاء المريض معلومات مفصلة عن التخدير ما قبل العملية			
٣٣.اعطاء المريض معلومات قليلة عن التخدير ما قبل العملية			
٣٤.المعلومات الخاطئة من مرافقى المريض، والعائلة، والاصدقاء، والبيئة المحيطة			

ت- معاناة المريض مع التخدير الطرفى من وجهة نظر المخدر

	نادرا/ مطلقا	غالبا	دائما
٣٥.يجد المريض التخدير الطرفى غير مريح			
٣٦.المرضى يتذكرون الحوادث اثناء التخدير الطرفى			

٣٧.يعانى المريض من الالم اثناء التخدير الطرفى			
٣٨.يعانى المريض من الالم اثنا العملية الجراحية			
٣٩.المرضى يحصلون على ما يكفى من مزيل الالم بعد العملية			
٤٠.بعد التخدير الطرفى قد يرغب المريض بتكراره مرة اخرى			
٤١.المرضى راضون التخدير الطرفى			

ث- الى اى مدى تستخدم هذه التقنيات لتخفيف قلق المرضى

	نادرا/ مطلقا	غالبا	دائما
٤٢.لا افعل شيء			
٤٣.اعطى مسكنات الالم			
٤٤.اعطيه معلومات مكتوبة او بروشور			
٤٥.اقوم بتأجيل العملية			
٤٦.استخدم مهارات التواصل والتطمين والقاء النكات			
٤٧.التحول الى التخدير العام			
٤٨.صرف انتباه المريض (الموسيقى، والقراءة)			
٤٩.حضور المرافقين (الاقارب، الاصدقاء، والزوج او الزوجة)			
٥٠.مشاهدة المريض فيديو عن التخدير الطرفى			
٥١.مشاهدة المريض للعملية من خلال كاميرا العمليات			
٥٢.تشجيع المرضى لاستخدام تقنيات الاسترخاء (التنفس العميق والتأمل)			
٥٣.اثناء التخدير الطرفى يشاهد المرضى اعصابهم على شاشة عرض الموجات فوق الصوتية			

ج- من فضلك اظف اى تعليقات او ملاحظات ....

Annex 2

Anesthesiologists' perception of patients' anxiety under anesthesia

Part one: Demographic data

8) Hospital name: ....
9) Age ≤ 30 31–40 41–50 ≥ 51
10) Gender Female Male
11) Education level Diploma degree Bachelor degree Specialist Arabic Board Others (specify) Consultant
12) Years of experience (............ years)
13) Duty Part time duty Full time duty

Part two: Anesthesiologist's perception of patients' anxiety during regional anesthesia

Anesthesiologists' perception of patients' anxiety

1. How concerned are you that anxiety is a problem during regional anesthesia
   (a lot, a little, none)?
2. What proportion of your patients undergoing regional anesthesia are anxious patients

(most, some, none)?

3. In your opinion, what is the most concerning time for patients undergoing regional anesthesia
   (pre-op, intra-op, post-op)?
4. Do you feel prepared to react toward differing types of anxious patients' behaviors during regional anesthesia
   (always, sometimes, never)?
5. Does differing advice from surgeon and anesthesiologist regarding the various anesthetic techniques increase patients' anxiety
   (yes, no)?
6. How accurately do you think you assess your patients' anxiety prior to regional anesthesia
   (overestimate it, underestimate it, correctly estimate it).
7. Does patient anxiety have any effect on your anxiety
   (yes, no)?
8. Does patient anxiety have any effect on your level of confidence in performing the block
   (yes, no)?
9. Does patient anxiety have any effect on the success of the block itself
   (yes, no)?
10. How important is patient satisfaction to your practice
    (high, low)?

How often do you track your patients' satisfaction after a procedure under regional anesthesia

(never, often, always)?

What are the causes of patients' anxiety?

	never/rarely	often	always
11.Needle-phobia			
12.Fear of unknown			
13.Fear of the surgery			
14.Fear of the anesthesia			
15.Recall of previous bad experience			
16.Fear of complications (pain/nerve damage)			

17.Regional anesthesia might make operation less successful			
18.Giving patients detailed anesthetic information pre-op			
19.Giving patients little anesthetic information pre-op			
20.Misinformation from lay people, family, friends, and surrounding media.			

1. **Regarding the block, do you think...? (never/rarely, often, always)**

	never/rarely	often	always
21.Patients find the block unpleasant			
22.Patients remember the events during the block			
23.Patients experience pain during the block			
24.Patients experience pain during surgery			
25.Patients have adequate pain relief after surgery			
26.Following regional anesthesia, patients would have a block again			
27.Patients are satisfied with the block.			

Please rate your answer (never/rarely, often, always).

	never/rarely	often	always
28.Do nothing			
29.Give sedation			
30.Written information/leaflet.			
31.Postpone the operation			
32.Communication/reassurance/tell a joke			
33.Convert to general anesthesia			
34.Distraction (eg, music, read a book)			
35.Partner's attendance (partner/friend/relative)			
36.Patients watching a video about			

regional anesthesia			
37.Patients watching the procedure via operating camera			
38.Encourage them to use relaxation techniques (eg, deep breathing/meditation)			
39.In peripheral nerve blockade, patients seeing their nerves while being anesthetized on ultrasound screen.			

2. Please add any further comments..............