Journal of Anesthesia & Clinical Research

Consani et al., J Anesth Clin Res 2014, 5:3
DOI: 10.4172/2155-6148.1000391

Case Report Open Access

Thoracic Epidural Anaesthesia in Awake Upper Abdominal Surgery: Safety/Validity of Bromage's Formula

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Abstract

Objective: Subtotal gastrectomy has been successfully performed using thoracic epidural anaesthesia alone in two high-risk surgical patients. We describe these two cases by using the Bromage's formula to calculate the required doses for a satisfactory segmental block.

Case Report: Two high-risk surgical patients were scheduled for sub-total gastrectomy. They received thoracic epidural anaesthesia alone. An 18-gauge Tuohy needle was introduced at T8/T9 intervertebral space and the tip of the catheter was advanced 3 cm cephalad beyond the tip of the needle (T7/T6). Epidural anaesthesia was established with 0.5% levobupivacaine and sufentanil. The used doses were calculated according to the formula:

x mg=(n. of dermatomes+6) · mg/segment.

Conclusions: Thoracic epidural anaesthesia provides optimal perioperative anaesthesia and analgesia after thoracic and major abdominal surgery and decreases postoperative morbidity and mortality, mainly by blocking sympathetic nerve fibers. An experienced operator can use it as the sole anesthetic technique in selected cooperative patients. The Bromage's formula can be a useful clinical aid for the anaesthetist in the described settings.

Introduction

Thoracic Epidural Anaesthesia (TEA) is commonly used for everyday procedures. The use of TEA can reduce the incidence of myocardial infarction in the perioperative period. After thoracotomy and major abdominal surgery, TEA results in pain free ventilation and increases the abdominal ventilation, resulting in a lower incidence of postoperative complications [1,2]. Moreover, epidural anaesthesia blocks the fibers innervating the mesenterial blood vessels and improves the mucosal blood flow leading to a lower rate of anastomosis dehiscences after abdominal surgery. Finally, TEA improves the immune response, increases wound tissue oxygen tension. These effects have a strong impact on the quality of life [2]. In spite of these features, there is a paucity of data in the literature regarding this technique being performed under epidural anaesthesia alone, especially in patients who are deemed at high risk for general anesthesia. There are even less data about the volume and concentrations of local anaesthetic to be used in this settings. In this case report, we describes two cases of awake major abdominal surgery in two high-risk surgical patients performed under TEA as a sole technique. Bromage's formula was used to calculate the dose of local anaesthetic to administer. To authors' knowledge no similar cases are reported in medical literature.

Case Report

Case 1

A 79-year-old male patient underwent elective sub-total gastrectomy under awake epidural anesthesia. He was ASA grade III due to: obesity (BMI 32 kg/m^2), mild COPD (FEV1/FVC=0.60), arterial hypertension. His past medical history was characterized by respiratory failure, following laparotomic nephrectomy, solved by emergency endotracheal intubation, controlled by mechanical ventilation and admission in intensive care unit stays for 7 days.

Case 2

The second patient was a 75-years old man. He was ASA grade IV due to: smoke, obesity (BMI 32.53 kg/m^2), arterial hypertension, atrial fibrillation, dilated cardiomyopathy, pulmonary hypertension (PAPs 49 mmHg), severe COPD (FEV1/FVC=0.42), moderate decrease of DLCO. At blood gas analysis: pH 7.39; $PaCO_2$ 47 mmHg; PaO_2 56 mmHg; HCO_3–28.80 mEq/L. His medical notes included history of lung cancer (small cell carcinoma) treated with chemotherapy and radiations, rheumatoid arthritis, deafness and anxiety disorder. Because of the high anaesthetic risk, another institution previously denied to perform the surgery.

A risk-benefit analysis was made pre-operatively and we decided to proceed to open radical surgery under awake thoracic epidural anaesthesia. We obtained the patients' consents to complete the surgical performance under exclusive regional anaesthesia. We obtained written consents from the patients for a possible publication of their data. The patients were premedicated with 1 mg of midazolam ev before the procedure. Continuous pulse oximetry, blood pressure cuff and electrocardiographic monitoring were performed. The patients were placed in seated position. A nasogastric tube was inserted. For epidural anaesthesia, a midline approach was used under complete aseptic preparation. Local anaesthesia (2% lidocaine 5 ml was injected into the skin. An 18-gauge Tuohy needle was introduced at T8/T9 intervertebral space. The epidural space was identified using the loss of resistance technique and an epidural catheter was passed through the needle. The

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Received February 21, 2014; **Accepted** March 21, 2014; **Published** March 24, 2014

Citation: Consani G, Nunziata A, Amorese G, Boggi U (2014) Thoracic Epidural Anaesthesia in Awake Upper Abdominal Surgery: Safety/Validity of Bromage's Formula. J Anesth Clin Res 5: 391. doi:10.4172/2155-6148.1000391

tip of the catheter was advanced 3 cm cephalad beyond the tip of the needle (T7/T6) and secured with a steril dressing. Aspiration test for subarachnoid and intravascular placement was negative. A test dose of 2% lidocaine 1 ml was administrated through the epidural catheter with no change noted in the heart rate, blood pressure, or sensorimotor examination [3].

Epidural anaesthesia was established with 0.5% levobupivacaine and sufentanil according to formula

x mg=(n. of dermatomes+6) · mg/segment

The following assessments were considered:

- The onset of sensory block (8-30 min), maximum upper spread (T7-T8 after L2-L3 or L3-L4 lumbar injection) and duration (4-6 hours) are similar after equal doses of levobupivacaine and bupivacaine (15 ml 0,5%) [4];

- In 80-year-old patients, the segmental dose requirement of 0.5% bupivacaine is about 3,8 mg [5];

- The increasing dose of 30% in higher than 180 cm [6];

- Neural blockade from T6 to T12 was required for upper abdominal surgery.

- In this way, we calculated ≈ 10 ml of 0.5% levobupivacaine in the first case and ≈ 12 ml of 0.5% levobupivacaine in the second one (his height was 188 cm). In both cases 2 ml of sufentanil (5 γ/ml) were added. Ten minutes after the bolus injection, a sensory block to temperature extending from T3 to L1 was achieved. Intraoperative and postoperative pain was controlled by continuous thoracic epidural infusion of levobupivacaine 0.125% and sufentanil 0.5 γ/ml at 8 mL/h. In the second case, depending on patient's discomfort threshold, due to the sustainable position and to symptoms corresponding to the level of innervation of diaphragm (C4) by the phrenic nerve, a continuous infusion of intravenous 0.03 γ/kg/min remifentanil was started. We used VAS scale to assess that.

The patients were kept sufficiently alert so as to protect the airways and allow them to answer questions, but sedated enough in order to maintain their protective reflexes. They were stable throughout the procedures. The surgery was performed without complications. Three hours later the patients were transferred to the ward after satisfactory haemodynamic stability, blood gas analysis, and complete neurologic examination. Epidural analgesia was maintained through the following 24 hours. Back pain, numbness, paresthesia, or motor weakness was not present and the patient was comfortable and pain-free during this time. A 10-cm visual analogue pain scale (VAS) was employed to assess for analgesic requirements and the score always resulted to be less than 2 cm. On the second postoperative day the catheter was removed. The length of hospitalization was 9 days in total.

Discussion

This case series describe two subtotal gastrectomy surgeries performed under TEA in two high risk patients with no complications. In addition to changes to mucociliary transport associated with anesthetic agents, abdominal surgery–particularly upper abdominal surgery-is associated in normal individuals with adverse effects on respiratory mechanics such as functional Residual Capacity (FRC), Vital Capacity (VC), Tidal Volume (TV), and closing volume [7]. Because mucociliary escalator is an important pulmonary defense mechanism against infection, general anaesthesia may be deleterious to the patient with COPD undergoing surgical procedure [7,8]. Furthermore, it has been shown that patients with COPD are at risk to developing pulmonary complications after upper abdominal surgery [9]. The goal of anaesthesia management in these patients should include avoidance of anaesthetics that depress mucociliary transport, provision of postoperative pain relief adequate to prevent deterioration of respiratory mechanics, and leading to early mobilization of patient. Moreover, epidural anaesthesia blocks the fibers innervating the mesenterial blood vessels and improves the mucosal blood flow, even under conditions of reduced perfusion pressure. In this way, TEA leads to a lower rate of anastomosis dehiscence after abdominal surgery [2]. Finally, TEA improves the immuneresponse, increases wound tissue oxygen tension allowing a better health-related quality of life.

But how much drug can be safely used? As a general rule, 0.75 to 1.25 ml for segment of blockade is a good rule of thumb [1]. Furthermore, some authors suggest 6-8 ml for a thoracic segmental block with increasing doses of 2-6 ml or decreasing doses of 1-2 ml if necessary [10]. In this case, we used Bromage's formula to define the correct dose according to the surgery and to patients' features and we obtained an excellent result: an effective intraoperative and postoperative pain control with a satisfactory relaxation of abdominal musculature during laparotomy surgery. In authors' opinion, an experienced surgical team and short surgical time are essential in the described settings. In addition, patient selection was based on the patient's ability to cooperate during the procedure. On the basis of our experience we believe that thoracic epidural anaesthesia is a valid alternative for high-risk surgical patients undergoing to upper abdominal surgery and that Bromage's formula can help anaesthesiologist into the management of epidural anaesthesia. Considering the intrinsic limitations of a case report, we realize that further studies, such as randomized clinical trials, are warrant to better establish the role and benefits of TEA as a sole anaesthetic technique in patients undergoing upper abdominal surgery.

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