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Dosage Formula in Anesthesia for Manual Intrauterine Aspiration Post-Abortion in Resource-Limited Settings

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Abstract

Setting: Provincial General Reference Hospital of Bukavu, General Reference Hospital of Panzi, General Reference Hospital of Ciriri, General Reference Hospital of Nyatende and Biopharm Hospital Center. **Objective:** Contribute to the improvement of the anesthetic ECP of patients benefiting from MVA for incomplete abortion, Describe the methodology used for adoption of the dosage formula in Anesthesia for MVA, present the mathematical demonstration leading to the dosage formula in anesthesia for MVA. **Materials and Methods:** Our study was descriptive by mathematical demonstration of obtaining the equilibrium constant of the dosage formula of bipuvacaine 0.1% and Fentanyl 50 µg% adapted to the weight and specific size of patients treated anesthetically in MVA cases for incomplete abortion. We also carried out an operational research by first determining the interval where our equilibrium constant is included and secondly by means of the ends of the intervals found correlated to the ends of intervals of possible weights and sizes in the being normal human female of childbearing age to arrive at the real numerical value of the equilibrium constant of the BUKAVU Dosage Formula in the case of anesthesia for MVA during the management of incomplete abortions. **Results:** TWO-STAGE OPERATIONAL RESEARCH: • Determination of the interval where the equilibrium constant $x = -0.95 < x < 3.2$ is located; • Obtaining the numerical value of the balance finding x by crossing the means between the extremes of volumes of anesthetic drugs giving a satisfactory sensory block without hemodynamic disturbance and the extremes of normal weight and height for women of childbearing age. We ended up with $X = 0.37$. **Conclusion:** At the end of our study which had the general objectives of contributing to the improvement of the anesthetic PEC of patients receiving MVA for incomplete abortion and specific objectives of describing the methodology used for adoption of the dosage formula in Anesthesia for MVA and present the mathematical demonstration which resulted in the dosage formula in nesthesia for MVA, it appears that the dosage formula of Bukavu, in case of intrathecal spinal analgesia of MVA for incomplete abortion provides precision on the specificity of the doses of bipuvacaine hypobarre 0.1% and Fentanyl 50 µg% reported to each patient according to her weight and height. Its application could therefore reduce morbidity and mortality and improve patient-practitioner comfort in the event of MVA for incomplete abortion following the dosage precision it provides.

Keywords

Dosage, Anesthesia, Intrauterine Aspiration, DR Congo

1. Introduction

1.1. Problematic

Pain management has, since the dawn of time, fascinated human beings. This is how the two spectrums of anesthesia-resuscitation were developed which deal with pain management, namely algology in its general aspect and anesthesia in the aspect linked to the reversible suppression of pain. pain to anticipate painful surgical procedures [1]. In gyneco-obstetrics, there are painful surgical procedures taking place exclusively in the operating room under anesthesia (AG, ALR or AL) depending on their complexity, the type of patient and the site of intervention. But there are also certain procedures, including Manual Intra Uterine Aspiration (MVA), which are painful but also take place under anesthesia in the delivery room.

MVA is an ECP technique for incomplete abortions which consists of aspiration by negative pressure following a syringe by suction of embryonic debris [2]. This is the gyneco-obstetric technique currently recommended in cases of ECP of incomplete abortions [3].

To date, two anesthetic techniques are recommended for performing MVA for incomplete abortions, these are GA (Narcosis) and AL (Paracervical Block) [4]. These anesthetic techniques have shown their limits in terms of heaviness, risk of Mendelson syndrome (Patients with a full stomach because they are taken in an emergency) and extension of the duration of post MVA monitoring for GA (Narcosis) and in terms of insufficient comfort by block leading to pain and vomiting during the MVA procedure leading to discomfort in patients and practitioners for LA (Paracervical block) [5]. Spinal analgesia would be an alternative to compensate for the observed weaknesses of the anesthetic techniques currently recommended for performing MVA for incomplete abortions.

Spinal analgesia is a technique aimed at a sensitive medullary block of the sensory fibers of the spinal cord by epidural or intrathecal infiltration of opioids alone or combined with low-dose local anesthetics.

The principle of spinal analgesia is the same as that of epidural anesthesia in terms of intensity and extension of the block on the sensitive metameres [6]. Thus, the intensity of the block depends on the concentration and the M-LAC of the local anesthetic as well as the type of associated opioid while the extension of the block depends on the baricity and the volume of LA used [7].

Some studies have focused on spinal analgesia, in particular:

- Florient SANZ and Coll, in their study in Flanders on painless childbirth by spinal analgesia, demonstrated that spinal analgesia leads to good tolerance of uterine contractions without motor block, a rapid effect but lasting less than 100 min and bipuvacaine as a coupled isobaric or sufentanyl is the recommended protocol for pain-free delivery by spinal analgesia [8].
- Lamine MD and Coll, in his study carried out in Bamako on spinal analgesia with bipuvacaine + neostigmine versus bipuvacaine + morphine postoperatively for digestive surgery showed that spinal analgesia with bipuvacaine + neostigmine prevents hemodynamic disturbances by strengthening of sympathetic tone [9].
- Rakotondrainibe A. and Coll, in their study carried out in a Malagasy hospital, came to the conclusion that intrathecal analgesia with opioids significantly reduced the additional need for major analgesics postoperatively during the first 24 hours postoperatively [10].

From these studies, it emerged that isobaric products and preferably associated bipuvacaine or sufentanyl are recommended products and recommended protocol in the case of epidural spinal analgesia for childbirth [8]. mastered by the majority of anesthesia practitioners in environments with limited resources such as in the DRC, intrathecal spinal analgesia (Simple and mastered technique for most practitioners) because it is similar to that of spinal anesthesia with the exception of the dilution of local anesthetic products), already used for several indications such as small surgeries of the pelvis and perineum below the T10 metameric level, would be a good alternative [11].

From where we focused our study on the available products (isobaric Bipuvacaine 0.1% and Fentanyl 50 µg%) and of which no study has, until now, precisely determined the dosage adapted to the specific weight and size of patients which allows to obtain a satisfactory sensory block without significant side effects in the case of MVA for incomplete abortions which are a public health problem in view of their frequency and their morbidity and mortality [12]. Hence the interest of our study.

1.2. Objectives

- General:

❖ Contribute to the improvement of the anesthetic ECP of patients benefiting from MVA for incomplete abortion.

- Specifics:
- ❖ Describe the methodology used for the adoption of the dosage formula in Anesthesia for MVA.
- ❖ Present the mathematical demonstration leading to the anesthesia dosage formula for MVA.

2. Methodology

2.1. Type of Study

Descriptive study type research article by mathematical demonstration of obtaining the equilibrium constant of the dosage formula of bipuvacaine 0.1% and Fentanyl 50 µg% adapted to the weight and specific size of patients treated on an anesthetic level in MVA cases for incomplete abortion.

2.2. Mathematical Study Procedures

We proceeded with operational research by first determining the interval where our equilibrium constant is included and secondly by means of the ends of the intervals found correlated with the ends of the intervals of possible weights and sizes in humans. The normal female of childbearing age to arrive at the actual quantified value of the equilibrium constant of the BUKAVU Dosage Formula in case of anesthesia for MVA during the management of incomplete abortions.

3. Results

He explanations on the 2 main steps of calculating the dosage formula were clearly demonstrated in particular: Step 1: definition of the interval where the equilibrium constant is located and Step 2: calculates the numerical value.

In fact, we did operational research to determine a correlation between weight and height based on the dosage of Bupivacaine and fentanyl.

During our practice of intrathecal spinal analgesia in the saddle, with regard to the volume of Bipuvacaine 0.1% obtained after dilution of bipuvacaine 0.5% and Fentatyl 50 µg/ml which gave us analgesia and sensitive anesthesia satisfactory without significant autonomous effects. These volumes are located for:

- Bupivacaine: 1.8 - 2.2 ml
- Fentatyl (50 µg/cc): 5 - 10 µg or 0.1 - 0.2 ml

According to our weight-height dependent dosage formula during intrathecal spinal analgesia in the saddle which states that:

$$\begin{cases} \text{vol Biqu } 0.1(\text{ml}) = \dfrac{T}{P} - 0.4 \\ \text{Poso Fenta}(\mu\text{g}) = \dfrac{T-P}{10} - 0.4 \text{ Soit} \end{cases}$$

$$\begin{cases} 1.8 \text{ - } 2.2 \text{ ml} = \dfrac{T}{P} - \\ 5 \text{ - } 10\ \mu\text{g} = \dfrac{T-P}{10} \end{cases}$$

$$\begin{cases} 1.8\text{ - }2.2\text{ ml} = \dfrac{T}{P} - 0.4 \\ \text{Soit} \end{cases}$$

$$\begin{cases} 1.8\text{ - }2.2\text{ ml} = \dfrac{T}{P} - 0.4 \\ 0.1\text{ - }0.2\text{ ml} = \dfrac{T-P}{500} \end{cases}$$

To print everything in volume by relating the dosage of Fentatyl 50 Mg to the volume it represents, the formula can be written as follows by dividing the numbers of µg by 50:

$$\begin{cases} \text{vol Biqu } 0.1(\text{ml}) = \dfrac{T}{P} - 0.4 \\ \text{vol Fenta}(\text{ml}) = \dfrac{T-P}{500} - 0.4 \end{cases}$$

By relating the formulas for variation of the volumes used by the two products in ml (cc) it emerges that:

$$\begin{cases} 1.8\text{ - }2.2 = \dfrac{T}{P} - 0.4 \\ 0.1\text{ - }0.2 = \dfrac{T-P}{500} \end{cases}$$

And so

$$\begin{cases} 1.8\text{ - }2.2 = \dfrac{T}{P} - 0.4 \\ 0.1\text{ - }0.2 = \dfrac{T-P}{500} \end{cases}$$

The constant 0.4 was deduced by operational research method taking into account the variability intervals then the averages according to the variability of the volumes of two products in the ranges presented above, the variation of the size T between 140 - 200 cm as well that weight P between 40 and 120 Kg.

To determine the margin of variability where X is located we proceed as follows:

$$\begin{cases} 1.8 < \dfrac{T}{P} - x0.4 < 2.2 \ (1) \\ 0.1 < \dfrac{T-P}{500} - < 0.2 \ (2) \\ 150 < T - < 200 \ (3) \\ 40 < P < 120 \ (4) \end{cases}$$

Let's find x

4. Solution

(4): $40 < P < 120 \quad \dfrac{1}{40} > \dfrac{1}{P} > \dfrac{1}{120}$

$$\frac{1}{120} < \frac{1}{P} < \frac{1}{40} \quad (4')$$

(3) * (4): $$150 * \frac{1}{120} < T * \frac{1}{P} < 200 * \frac{1}{40}.$$

$$\frac{5}{4} < \frac{T}{P} < 5.$$

$$\Leftrightarrow \frac{-5}{4} > \frac{-T}{P} > -5.$$

$$\Leftrightarrow -5 < \frac{-T}{P} < \frac{-5}{4} \quad (5)$$

(1) + (5): $$1.8 - 5 < -x < 2.2 \frac{-5}{4}.$$

$$-3.2 < -x < 0.95$$

$$3.2 > x > -0.95.$$

$$-0.95 < x < 3.2$$

(2), (3) et (4) constituent un système de 3 équations à 2 inconnues.

Dégageons-en que 2 équations.

(2): $$0.1 < \frac{T}{P} < 0.25 \Leftrightarrow 0 < T - P < 100$$

$$\Leftrightarrow -50 > P - T > -100.$$

$$-100 < P - T < 50 \quad (7)$$

(6) + (4): $$\begin{array}{l} 50 < T - P < 100 \\ \underline{+40 < P < 120} \\ 90 < T < 220 \end{array} \quad (8)$$

(3) et (8) $\Rightarrow 150 < T < 200 \quad (a)$

(7) + (3): $$\begin{array}{l} -100 < P - T < -50 \\ \underline{+150 < T < 200} \\ 50 < P < 150 \end{array} \quad (9)$$

(4) et (9) $\Leftrightarrow 150 < T < 200 \quad (a)$

D'où (a) et (b) remplacent (2), (3) et (4).

(b) $$\Leftrightarrow \frac{1}{50} > \frac{1}{P} > \frac{1}{120}$$

$$\Leftrightarrow \frac{1}{120} < \frac{1}{P} < \frac{1}{50} \quad (10)$$

(a) * (10): $$\begin{array}{l} 150 < T < 200 \\ \underline{\frac{1}{120} < \frac{1}{P} < \frac{1}{50}} \\ \frac{150}{120} < \frac{T}{P} < \frac{200}{50} \end{array}$$

$$1.25 < \frac{T}{P} < 4$$

$$-1.25 > \frac{-T}{P} > -4$$

$$-4 < \frac{-T}{P} < -1.25 \quad (11)$$

$$(1) + (11): \quad 1.8 < \frac{T}{P} - x < 2.2 .$$

$$\begin{array}{c} -4 < \dfrac{-T}{P} < -1.25 \\ \hline -2.2 < -x < 0.95 \\ 2.2 > x > -0.95 \\ -0.95 < x < 2.2 \end{array}$$

where x is between −0.95 and 2.2

And as a demonstration of its discovery as an average applicable in practice by anesthesia practitioners, we replace it by X in the equation which becomes:

$$\begin{cases} 1.8\text{ - }2.2 = \dfrac{T}{P} - X \\ 0.1\text{ - }0.2 = \dfrac{T-P}{500} \end{cases}$$

X will therefore be obtained by taking the average of obtained by the selection of the lower ranges of the volumes and obtained by the selection of the upper ranges of the volumes

And so: $X = \dfrac{X_1 + X_2}{2}$

However, depending on the range of weight variability:

$$X_1 = \frac{X_1' + X_2''}{2}$$

- X_1'' being the variable obtained in relation to low volumes and weights and low volumes and high limit weights.

And

$$X_2 = \frac{X_2' + X_2''}{2}$$

- X_2 being the variable obtained in relation to the high limit volumes and low limit weight and to the high limit volumes and high limit weight.
- Which means that by applying the formula:

1) X_1

$$\begin{cases} 1.8 = \dfrac{T}{P} - X_1 \\ 0.1 = \dfrac{T-P}{500} \end{cases} \Rightarrow \begin{cases} \dfrac{T}{P} - 1.8 = X_1 \\ 50 = T - P \end{cases}$$

$$1.8 = X_1$$

$$\begin{cases} T = P + 50 \\ \dfrac{T}{P} - 1.8 = X_1 \end{cases} \Rightarrow \frac{P+50}{P} - 1.8 = X_1$$

Or P varies between 40 - 120 kg:

- If $P = 40$ kg

$$X_1' = \frac{P+50}{P} - 1.8 = \frac{40+50}{40} - 1.8 = 0.45$$

- If $P = 120$ kg

$$X_1'' = \frac{P+50}{P} - 1.8 = \frac{12+50}{120} - 1.8 = 0.015$$

So

$$X_1 = \frac{X_1' + X_1''}{2} = \frac{0.45 + (-0.015)}{2} = 0.275$$

$$X_1 = 0.275$$

2) X_2

$$\begin{cases} 2.2 = \frac{T}{P} - X_2 \\ 0.2 = \frac{T-P}{500} \end{cases} \Rightarrow \begin{cases} \frac{T}{P} - 2.2 = X_3 \\ 100 = T - P \end{cases}$$

$$\begin{cases} T = P + 100 \\ \frac{T}{P} - 2.2 = X_2 \end{cases} \Rightarrow \frac{P+10}{P} - 2.2 = X_2$$

Gold P varies between 40 - 120 kg

- If $P = 40$ kg

$$X_2' = \frac{P+100}{P} - 2.2 = \frac{40+100}{40} - 2.2 = 1.3$$

- If $P = 120$ kg

$$X_2'' = \frac{P+100}{P} - 2.2 = \frac{120+100}{120} - 2.2 = 0.37$$

So

$$X_2 = \frac{X_2' + X_2''}{2} = \frac{1.3 + (-0.37)}{2} = 0.465$$

$$X_2 = 0.465$$

3) $X = \frac{X_1 + X_2}{2} = \frac{0.275 + 0.465}{2} = 0.37 \approx 0.4$

From where $X = 0.4$

Thus, the dosage formula of anesthetic drugs during intrathecal spinal analgesia in the saddle for post-abortion intrauterine manual aspiration proposed in our research adapted to the weight and size of the patients and which is stated as follows:

DOSAGE FORMULA OF BUKAVU IN RAIS FOR AMIU:

$$\text{Volume Bupivacaine } 0.1(\text{ml}) \frac{T(\text{cm})}{P(\text{kg})} - 0.4 \text{ Fentatyl dosage}(\mu\text{g})$$

$$= \frac{T(\text{cm}) - P(\text{kg})}{10}$$

And by reporting your two products in volumes used in ml:

BUKAVU IN RAIS FORMULA FOR AMIU:

$$\text{Volume Bupivacaine } 0.1(\text{ml})\frac{T(\text{cm})}{P(\text{kg})} - 0.4 \text{ Fentatyl dosage } 50\ \mu\text{g/ml}(\text{ml})$$

$$= \frac{T(\text{cm}) - P(\text{kg})}{10}$$

4. Conclusion

At the end of our study which had the general objectives of contributing to the improvement of the anesthetic PEC of patients receiving MVA for incomplete abortion and specific objectives of describing the methodology used for adoption of the dosage formula in Anesthesia for MVA and presenting the mathematical demonstration having resulted in the dosage formula in anesthesia for MVA, it appears that the dosage formula of Bukavu, in the case of intrathecal spinal analgesia of MVA for incomplete abortion provides precision on the specificity of the doses of bipuvacaire hypobarre 0.1% and Fentanyl 50 µg% reported to each patient according to her weight and height. Its application could therefore reduce morbidity and mortality and improve patient-practitioner comfort in the event of MVA for incomplete abortion following the dosage precision it provides.

A future study is necessary to apply this dosage formula in different populations in a comparative manner in order to consider other future readjustments.

Strengths

This is an original work, not published in another work, which has just developed a dosage formula that is easy to use, especially in our countries with limited resources, including DR Congo.

Conflicts of Interest

The authors declare no conflict of interest.

Contribution of the Authors

All authors cited here actively contributed to the completion of this work.

1 and 2: Design, methodology and finalization

3 and 5: Methodology and statistics

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