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Anestesia Venosa Total em Infusão Alvo-Controlada Associada a Bloqueio do Nervo Femoral para Meniscectomia do Joelho por Acesso Artroscópico

Target-Controlled Total Intravenous Anesthesia Associated with Femoral Nerve Block for Arthroscopic Knee Meniscectomy

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RESUMO

Nora FS — Anestesia Venosa Total em Infusão Alvo-Controlada Associada a Bloqueio do Nervo Femoral para Meniscectomia do Joelho por Acesso Artroscópico.

***JUSTIFICATIVA E OBJETIVOS**: O aumento da popularidade de técnicas operatórias minimamente invasivas reduziu os tempos de recuperação de procedimentos que, anteriormente, eram associados a período de internação longo. Este trabalho apresenta técnica de anestesia geral venosa total com propofol e remifentanil combinada a bloqueio do nervo femoral, por acesso perivascular inguinal.*

***MÉTODO**: Foram incluídos 90 pacientes submetidos à artroscopia do joelho para meniscectomias. A indução anestésica foi feita com propofol em infusão alvo-controlada (IAC) (alvo = 4 µg.mL^{-1}) e com remifentanil em IAC (alvo = 3 ng.mL^{-1}). As alterações das concentrações de propofol e remifentanil eram realizadas de acordo com a eletroencefalografia bispectral (BIS) e a pressão arterial média (PAM). A ventilação era mecânica e controlada a volume e a via aérea mantida com máscara laríngea. Os valores das concentrações no local efetor de propofol e remifentanil eram obtidos através dos modelos farmacocinéticos dos fármacos, inseridos nas bombas de IAC e corresponderam a concentrações preditivas. Local efetor refere-se à área de ação dos fármacos. O tempo de alta hospitalar compreendeu o espaço de tempo entre a chegada do paciente na sala de recuperação até o momento da alta.*

***RESULTADOS**: As concentrações médias no local efetor (ng.mL^{-1}), máximas e mínimas, de remifentanil foram de 3,5 e 2,4, respectivamente. As concentrações médias no local efetor (µg.mL^{-1}), máximas e mínimas de propofol, foram respectivamente de 3,1 e 2,6. A vazão média de infusão de propofol e de remifentanil foi de 8,54 mg.kg^{-1}.h^{-1} e de 0,12 µg.kg^{-1}.min^{-1}, respectivamente. Os tempos de alta hospitalar foram, em média, de 180min.*

***CONCLUSÕES**: Todos os pacientes foram mantidos dentro dos parâmetros estabelecidos.*

Unitermos: ANESTESIA, Geral: venosa; ANESTÉSICO, Venoso: propofol, remifentanil; CIRURGIA, Ortopédica: meniscectomia**;** TÉCNICAS ANESTÉSICAS, Regional: bloqueio femoral

SUMMARY

Nora FS — Target-Controlled Total Intravenous Anesthesia Associated with Femoral Nerve Block for Arthroscopic Knee Meniscectomy.

***BACKGROUND AND OBJECTIVES:** The increased popularity of minimally invasive surgical techniques reduced recovery time of procedures that were usually associated with prolonged hospitalization. This study reports the technique of total intravenous anesthesia with propofol and remifentanil associated with femoral nerve block using the inguinal perivascular approach.*

***METHODS:** Ninety patients undergoing knee arthroscopy for meniscectomy were included in this study. Target-controlled infusion (TCI) of propofol (target = 4 µg.mL^{-1}) and remifentanil (target = 3 ng.mL^{-1}) was used for induction of anesthesia. The concentrations of propofol and remifentanil were changed according to the bispectral index (BIS) and mean arterial pressure (MAP). Volume-controlled mechanical ventilation with a laryngeal mask was used. The concentrations of propofol and remifentanil at the effector site, corresponding to the predictive concentrations, were obtained using the pharmacokinetic models of the drugs inserted in the TCI pumps. Time for hospital discharge encompassed the period between the moment the patient arrived at the recovery room and hospital discharge.*

***RESULTS:** Maximal and minimal mean concentrations at the effector site (ng.mL^{-1}) of remifentanil were 3.5 and 2.4, respectively. Maximal and minimal mean concentrations of propofol at the effector site (µg.mL^{-1}) were 3.1 and 2.6, respectively. The mean flow of infusion of propofol and remifentanil was 8.54 mg.kg^{-1}.h^{-1} and 0.12 µg.kg^{-1}.min^{-1}, respectively. Mean hospital discharge time was 180 min.*

***CONCLUSIONS:** All patients were maintained within established parameters.*

Key Words: ANESTHESIA, General: intravenous; ANESTHETIC, Intravenous: propofol, remifentanil; ANESTHETIC TECHNIQUES, Regional: femoral block; SURGERY, Orthopedic: meniscectomy.

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Nas condições deste estudo, foi possível concluir que a anestesia geral com anestésicos venosos como o propofol e o remifentanil, em IAC, associados ao bloqueio de nervo periférico, como alternativa à anestesia geral convencional, à MAC e aos bloqueios do neuroeixo, mostrou-se uma técnica efetiva.

A infusão de remifentanil em IAC se revelou mais econômica quando comparada às doses utilizadas em infusão manual, embora este estudo não possa concluir se isso ocorreu por causa do bloqueio femoral, da forma de infusão do remifentanil ou de ambos.

O uso da máscara laríngea assegurou controle da via aérea em presença de depressão respiratória, potencialmente perigosa durante a modalidade MAC. Da mesma forma, apresenta menos efeitos adversos que a intubação traqueal, empregada na anestesia geral convencional. Sedações associadas à utilização de anestésicos locais (MAC) já são empregadas, em vez de bloqueio do neuroeixo ou anestesia geral, em 10 a 30% dos procedimentos ambulatoriais e têm diversas vantagens em relação às demais [15]. Algumas vantagens são a preservação dos reflexos protetores, menos dor pós-operatória, menos náuseas e vômitos, redução dos eventos colaterais respiratórios e cardiovasculares bem como tempos de recuperação mais rápidos [15]. Embora MAC tenha sido definido como uma técnica de anestesia em que são utilizados hipnóticos e sedativos de forma que ofereça conforto, ansiólise e mantenha mínima depressão respiratória e resposta verbal presente e em procedimentos pequenos, o mesmo princípio tem sido descrito para sedação em procedimentos de médio porte e até em craniotomias [15-17]. De fato, a principal diferença entre anestesia geral utilizada neste estudo e MAC, quando utilizados fármacos e princípios de sedação e analgesia semelhantes, são as doses utilizadas em cada uma delas e a forma de proteção da via aérea. Em MAC, a ventilação é espontânea e as doses são tituladas, entre outros aspectos, a fim de manter a ventilação adequada. Na anestesia geral a ventilação é controlada e a titulação dos anestésicos é realizada de acordo com o plano anestésico, uma vez que a via aérea está devidamente protegida.

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Target-Controlled Total Intravenous Anesthesia Associated With Femoral Nerve Block For Arthroscopic Knee Meniscectomy

Fernando Squeff Nora, TSA, M.D.

INTRODUCTION

The increased popularity of minimally invasive surgical techniques reduced the recovery time of procedures previously associated with long hospitalization [1]. White et al. reported that specific anesthetic care, among other factors, can facilitate hospital discharge by decreasing the incidence of nausea and vomiting, pain, and unpleasant pre-, intra-, and postoperative events that may delay or reduce the quality of awakening and hospital discharge. Following those steps seem to improve perioperative efficiency by optimizing the main factors that most often hinder a satisfactory clinical outcome [2,3].

In this setting, the anesthesiologist plays an important role since he is responsible for providing satisfactory perioperative conditions by following the steps: 1) evaluating preoperative clinical conditions to minimize the risk of associated diseases, 2) choosing an adequate anesthetic technique that provides good operative conditions, safety, and comfort, and 3) offering an anesthetic technique compatible with the proposed procedure, i.e., fast recovery associated with a low incidence of adverse events. If all those pre-, intra-, and postoperative factors are properly observed, they collaborate to increase the incidence of success of the technique, leading to an early hospital discharge.

With the advent of arthroscopic knee surgery to repair meniscal lesions, the duration of the surgery, degree of tissue lesion and, therefore, severity of intra- and postoperative pain decreased dramatically when compared with conventional surgeries [2,3]. Arthroscopic surgeries, which initially were longer than conventional surgeries, are currently much shorter. The need of an anesthetic technique that is associated with a lower incidence of side effects and, consequently, shorter recovery time, similarly to the surgical procedure, came forth. In an attempt to offer an anesthetic technique with lower side effects and faster recovery times when compared with general anesthesia and neuroaxis blocks, the concept of MAC – monitored anesthesia care – was developed around 1997. Monitored anesthesia care is based on the use of local anesthetics for peripheral nerve blocks or local infiltration of the surgical wound associated with intravenous analgesics and sedatives with a faster onset of action to reduce the length of recovery [4]. Monitored anesthesia care can be used with the patient conscious or not, and associated with moderate or deep sedation, as described by Twersky et al. [5].

Respiratory depression secondary to the association of hypnotic drugs and opioids is the main problem associated with MAC. Adequate control of the airways associated with the use of the same agents used more often in MAC, but using general anesthesia, has not been described in the literature as an alternative to MAC and conventional general or balanced anesthesia. In this context, monitoring and control of the airways are as important as the use of an anesthetic technique that allows for fast recovery with a low incidence of adverse effects.

The objective of the author was to present the proposal of general anesthesia with fast acting intravenous anesthetics in target-controlled infusion (TCI) associated with femoral nerve block for arthroscopic knee surgeries – meniscectomies. Thus, the primary objective of this study included: 1) to analyze maximal and minimal propofol concentrations at the effector site necessary to maintain BIS (bispectral index) between 40 and 50; 2) to analyze maximal and minimal remifentanil concentrations at the effector site to maintain MAP (mean arterial pressure) variations within 20% of baseline levels; and 3) to determine the total consumption of propofol and remifentanil used, according to the infusion times, and the mean flow rate of remifentanil and propofol. The time to hospital discharge was also recorded.

METHODS

After approval by the Ethics Committee and signing of the informed consent, 90 patients scheduled for arthroscopic knee surgery for simple meniscectomies were included in this study. Exclusion criteria considered: patients with lung, heart, kidney or liver diseases, drug or alcohol abuse, muscular disease, history of intraoperative awakening, and use of hypno-analgesics less than 12 hours before the procedure, as well as patients younger than 18 years and older than 80 years and patients with difficulty communicating. Patients did not receive pre-anesthetic medication.

A 22G catheter was used to catheterize a peripheral vein for administration of NS, hypnotics, and analgesics. Monitoring consisted of non-invasive blood pressure (NIBP) for the determination of the systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP), pulse oximeter, electrocardiogram on the D_{II} derivation to analyze the electrocardiogram and heart rate (HR), and bispectral electroencephalogram (BIS) with an ASPECT® XP device. Ventilation monitoring consisted of continuous capnography and capnometry to maintain $P_{ET}CO_2$ between 28 and 30 mmHg. All patients received target-controlled general anesthesia with the Marsh pharmacokinetic model incorporated in the pump (propofol PFS®) and TCI of remifentanil with a pump using the pharmacokinetic model described by C. Minto (Alaris PK®). Predicted concentrations at the effector site of both drugs were furnished by the infusion pumps according to the pharmacokinetic models of each one. The effector site is the site of action, or biophase, or compartment where the drug exerts its actions [15]. The target concentration determines the target regulated by the anesthesiologist in the infusion pump. Once the target has been determined, the pump administers an initial dose of the drug followed by the continuous infusion to maintain the predetermined target. Since the central compartment or plasma in which the drugs are administered is not their site of action, predictive calculation using the pharmacokinetic model of the drugs administered to determine their concentration at the effector site is necessary [15]. A lag period between the administration of the drug, which determines the plasma concentration, and its equilibrium at the effector site is seen. This period is determined by the pharmacokinetic properties of each drug. Therefore, the anesthesiologist should regulate the target plasma concentration in the infusion pump and monitor its peak through the predicted concentration at the effector site. A new target is administered only after the equilibrium between both concentrations is achieved.

The intravenous route was used for anesthetic induction with the simultaneous infusion of propofol with an initial TCI of 4 $\mu g.mL^{-1}$, and remifentanil with an initial TCI of 3 $ng.mL^{-1}$. After the patient showed loss of verbal contact, a single intravenous bolus dose of rocuronium 0.2 $mg.kg^{-1}$ was administered. With the BIS below 50 associated with the absence of corneal and light reflexes and verbal response or voluntary movements, a proper size laryngeal mask was placed. All patients were maintained on mechanical volume-controlled ventilation with an oxygen and compressed air mixture and expired fraction of oxygen of 0.5. Volume and respiratory rate were regulated by capnometry to keep the $P_{ET}CO_2$ between 28 and 30 mmHg.

Anesthesia was maintained according to the anesthetic plane. The degree of hypnosis was determined by the BIS, which was maintained between 40 and 50 in all patients. Analgesia was evaluated by the levels of MAP, which should not vary beyond 20% of baseline. Thus, after anesthesia induction, propofol was regulated to maintain BIS between 40 and 50, and remifentanil was regulated to maintain a MAP within 20% of baseline levels.

Whenever BIS was above 50, the TCI of propofol was increased in increments of 0.1 $\mu g.mL^{-1}$ until the concentration at the effector site, furnished by the infusion pump, caused a reduction of BIS to the predetermined levels. Subsequent increases in propofol target concentration were only done when the concentration at the target and effector sites reached an equilibrium, i.e., the concentration of propofol was increased only when BIS did not show a reduction after the target and effector site concentrations were balanced, according to the data provided by the infusion pump. If BIS was below 40, the target concentration of propofol was decreased by 0.1 $\mu g.mL^{-1}$ until the concentration at the effector site was such that the BIS remained between 40 and 50, and subsequent changes were done only when the equilibrium between the concentrations at the effector and target sites was achieved. Whenever MAP reached a level below 20% of

baseline, with BIS between 40 and 50, the target concentration of remifentanil was decreased by 0.1 ng.mL^{-1}. Similarly, subsequent changes were instituted only after the equilibrium between the target and effector site concentrations was achieved. Whenever BIS and MAP fell below the predetermined limits, the concentrations of propofol and remifentanil were reduced simultaneously at the same time intervals described previously, i.e., immediately after the equilibrium between the effector and target sites was achieved. Similarly, whenever the BIS and MAP increased simultaneously above the predetermined parameters, the concentrations of remifentanil and propofol were increased.

The femoral block was performed after induction of general anesthesia. Lidocaine 2% (400 mg) with epinephrine 1:200,000 and 0.75% ropivacaine (150 mg) were injected in the inguinal perivascular space, after antisepsis and puncture with a 20G catheter, 1 cm lateral to the femoral artery.

After anesthetic induction, all patients received intravenous dexamethasone 4 mg, dypirone 20 mg.kg^{-1}, ondansetron 4 mg, and ketorolac 30 mg.

Hospital discharge time, defined as the length of time between arrival of the patient to the recovery room and hospital discharge was recorded in the chart of the patient.

The data was described by descriptive analysis and means and standard deviations of the result obtained were calculated.

RESULTS

Table I presents the mean age, height, and weight, which were 46.4 years, 174 cm, and 77 kg, respectively. Sixty-one male and 29 female patients, physical status ASA I (64) and II (26), were evaluated. Table II presents the mean maximal and minimal concentrations of remifentanil at the effector site (ng.mL^{-1}), which were 3.5 and 2.4, respectively. Mean maximal and minimal propofol concentrations (µg.mL^{-1}) at the effector site were 3.1 and 2.6, respectively. Table III shows the mean total consumption of propofol, 493.48 mg, and remifentanil, 454.43 µg, for a mean infusion time of 45.88 min for both anesthetics. The mean rate of infusion of propofol and remifentanil was 8.54 mg.kg^{-1}.h^{-1} and 0.12 µg.kg^{-1}.min^{-1}, respectively. All patients were maintained with the parameters of BIS and MAP established. The mean time to hospital discharge was 180 min.

Table I – Demographic Data

Weight (kg)	77 ± 10.9
Age (years)	46,4 ± 10.8
Height (cm)	174 ± 8.5

Results expressed as Mean ± SD

Table II – Maximal and Minimal Concentrations of Remifentanil (ng.mL^{-1}) e Propofol (µg.mL^{-1}) and Mean Infusion Times (min)

	Remifentanil	Propofol
Maximal concentration	3.5 ± 0.31	3.1 ± 0.22
Minimal concentration	2.4 ± 0.23	2.6 ± 0.21
Mean infusion time	45.88 ± 7.6	45.88 ± 7.6

Results expressed as Mean ± SDP.

Table III – Total Mean Remifentanil (µg) and Propofol (mg) Consumption. Total mean flow rate of remifentanil (µg.kg^{-1}.min^{-1}) and propofol (mg.kg^{-1}.h^{-1}).

	Remifentanil	Propofol
Total mean consumption	454.43 ± 122.6	493.48 ± 88.6
Total mean flow rate	0.12	8.54

Results expressed as Mean ± SD.

DISCUSSION

The discussion on the most adequate anesthetic technique for outpatient surgical procedures is extensive and focuses on the positive and negative aspects of each one. This study described the anesthetic alternatives that can minimize risks and emphasized the advantages of each technique described for knee arthroscopy for meniscectomy using the conceptual aspects of each one. The techniques used more often in this procedure include neuroaxis block, local anesthesia or regional block associated with sedation (defined, in the present study, as MAC), and general anesthesia associated or not with regional block or local anesthesia.

The incidence of adverse events is a decisive factor when choosing the most adequate anesthetic technique for outpatient knee arthroscopy for meniscectomy. The most frequent problems associated with neuroaxis block include-intraoperative hemodynamic instability, and urinary retention and prolonged sympathetic and motor blockade, postoperatively, besides pruritus and respiratory depression when opioids are used. The increased incidence of nausea and vomiting, pain, dizziness, and delay of cognitive function during recovery are the main setbacks of general anesthesia. Intraoperative respiratory depression is the main complication of MAC when hypnotics and opioids are associated. The variable incidence of intraoperative partial or total failure and the absence of adequate muscular relaxation represent the main problems associated with peripheral nerve blocks, explaining why they are often associated with MAC or general anesthesia. Most studies comparing the different anesthetic techniques in different outpatient surgical procedures present conflicting results and do not show absolute advan-

tage of a specific technique. But it is still possible to indicate a few concordant directives among most studies. Infiltration with local anesthetics to treat intra- and postoperative pain has been recommended in superficial surgeries, such as inguinal herniorraphy, breast or anorectal procedures, and arthroscopies of the shoulder and knee, although this simple procedure is not routinely used [6-10]. Hypnotics and analgesics are used concomitantly when isolated local anesthesia is not capable of generating enough comfort for the procedure, but this adds the side effects associated with the drug, route of administration, and doses. Nausea and vomiting and respiratory depression are the most frequent side effects observed [3,6]. A review of the literature failed to show any study on anesthetic options for knee arthroscopy that included the technique proposed here, which motivated the following discussion on the techniques used more often, indicating the advantages and disadvantages of each one. A systematic analysis of knee arthroscopy by Moiniche et al. and other studies recommended the use of intraarticular local anesthetics [6-11]. This route is used more often when one expects pain of low severity. Peripheral nerve blocks, as the primary analgesic technique in knee arthroscopies, are related with a reduced incidence of side effects and shorter hospital stay when compared with general anesthesia [10].The short duration of analgesia (30 to 50 min) is the main limitation of this technique [11]. The use of the pneumatic tourniquet in knee arthroscopies, besides the painful manipulation of the meniscus, is the limiting factor of isolated local anesthesia. Recovery time and analgesia in anesthesia for knee surgeries comparable to that of MAC are found in neuroaxis block with the administration of small doses of local anesthetics and opioids [9]. Femoral nerve block associated or not with sciatic nerve block represents another alternative and, if necessary, it can be associated with general anesthesia or MAC.

The present study evaluated general anesthesia associated with femoral nerve block to offer an alternative that associates the positive aspects of each anesthetic technique. For this reason, the choice of anesthetics for general anesthesia and their association with femoral nerve block incorporated the concept of MAC, i.e., to offer regional block with local anesthetics associated with fast acting hypnotics and sedatives. The use of laryngeal mask with general anesthesia guaranteed control of the airways and decreased the possibility of respiratory depression. Adverse events such as laryngeal spasm secondary to tracheal intubation can also be reduced with the use of this device [12]. As for the incidence of nausea and vomiting, which, although they constitute one of the most common side effects of outpatient surgeries, was not evaluated; a review by White et al. reported an extremely elevated incidence of nausea and vomiting (63%) associated with general anesthesia [10]. The use of drugs such as propofol, as the hypnotic agent, associated with adequate prophylaxis can reduce dramatically the incidence of nausea and vomiting [12]. Although postoperative pain and nausea and vomiting were not evaluated, one should not forget the importance of the prophylaxis of both of them in outpatient surgeries. For this reason, the choice of antiemetics and analgesics was based on the literature. The use of $5HT_3$ inhibitors and dexamethasone has been recommended in the literature, with NNT (necessary number to treat) below 5 [12].

As for postoperative analgesia, since the effects of the intraarticular administration of morphine has been compared to that of IV ketorolac (NNT = 2) [12], the later was used to avoid the use of morphine in outpatient surgery and, therefore, avoid the collateral effects associated with this drug.

The intraoperative doses of remifentanil and propofol used in the present study were surprising. Although the doses of propofol (8.5 $mg.kg^{-1}.h^{-1}$) necessary to maintain hypnoses (BIS between 40 and 50) were close to those reported in the literature (6 to 10 $mg.kg^{-1}.h^{-1}$) for general anesthesia, the doses of remifentanil were up to 60% lower than those reported (0.3 $\mu g.kg^{-1}.min^{-1}$). It was used a mean infusion dose of remifentanil of 0.12 $\mu g.kg^{-1}.min^{-1}$, approximately 1/3 of the recommended dose [3]. This could be secondary to: adequate analgesia provided by the femoral block, which was not evaluated since it was performed after induction of anesthesia, or the TCI of propofol that can, by itself, reduce total infusion doses; unlike manual infusion with mechanical pumps, TCI can result in better usage of remifentanil, therefore reducing total consumption. The remifentanil infusion algorithm used in this study, which was incorporated in the TCI pump, described by Minto et al., uses mathematical calculations that optimize the infusion of remifentanil according to its distribution in the different body compartments according to the tri-compartmental model [13]. Although the concentrations at the effector site provided by the pump represent predictive values, i.e., are not measured directly from the blood stream, the margin of error of those pumps is within the parameters accepted by the literature, according to the description of Nora [13]. The lack of proper evaluation of the femoral block does not allow us to state whether it was responsible for the reduction in remifentanil consumption. The use of this anesthesia technique for knee arthroscopy has shown to be promising because when it is associated with additional care, such as the multimodal prophylaxis of nausea and vomiting, analgesia, and airways maintenance, minimizes the adverse effects of general anesthesia while adding the advantages of the regional block (more prolonged postoperative analgesia).

Those aspects deserve special attention from anesthesiologists when choosing the anesthetic technique, especially in outpatient surgeries, since the literature has described several aspects associated with the success of this technique [4,12]. The main anesthesia care for minimally invasive outpatient procedures include [4,12]:

1) Multimodal analgesia – the use of local anesthetics for regional blocks or local infiltration has been recommended, as well as non-steroidal anti-inflammatories;

2) Avoid the use of opioids (NNT = 1.8) and use the multimodal approach for the prophylaxis of nausea and vomiting (NNT < 5);
3) Propofol is the sedative of choice, both for general anesthesia and MAC;
4) When using opioids, one should use the lowest dose possible and chose faster acting drugs;
5) One should chose the anesthetic technique that optimizes the surgical condition, i.e., for shorter surgical times with a low degree of tissue trauma one should chose anesthetic techniques that allow for fast recovery and a lower incidence of side effects;
6) Avoid the excessive administration of fluids; and
7) Ensure low postoperative pain score.

Under the conditions of the present study, it was possible to conclude that general anesthesia with intravenous anesthetics, like propofol and remifentanil, in TCI associated with peripheral nerve block is an effective alternative to conventional general anesthesia, MAC, and neuroaxis block.

Target-controlled infusion of remifentanil showed to be less expensive than manual infusion, although this study does not allow the conclusion of whether this was a result of the femoral block, type of remifentanil infusion, or both.

The laryngeal mask guaranteed control of the airways in the presence of respiratory depression, potentially dangerous during MAC. It also carries a lower incidence of side effects than tracheal intubation, which is used during conventional general anesthesia. Sedation associated with local anesthetics (MAC), instead of neuroaxis block or general anesthesia, are used in 10 to 30% of outpatient procedures, showing advantages over other techniques [15]. Those advantages include the preservation of protective reflexes, decreased postoperative pain, reduced incidence of nausea and vomiting, decreased incidence of respiratory and cardiovascular side effects, as well as faster recovery times [15]. Although MAC has been defined as an anesthetic technique that uses hypnotics and sedatives to provide comfort, sedation, maintain respiratory depression to a minimum, and preserve verbal response in small-size procedures, the same principle has been described for sedation in medium-size procedures, and even in craniotomies [15-17]. In fact, the doses used and the airways-protection method are the main differences between the general anesthesia used in this study and MAC, when similar drugs and analgesia principles are used. In MAC, ventilation is spontaneous and the doses are titrated, among other aspects, to maintain adequate ventilation. In general anesthesia, ventilation is controlled and the anesthetic is titrated according to the anesthetic plane since the airways are adequately protected.

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RESUMEN

Nora FS — Anestesia Venosa Total en Infusión Objeto-Controlada Asociada al Bloqueo del Nervio Femoral para Meniscectomía de la Rodilla por Acceso Artroscópico.

JUSTIFICATIVA Y OBJETIVOS*: El aumento de la popularidad de técnicas operatorias mínimamente invasivas, redujo los tiempos de recuperación de procedimientos que anteriormente se asociaban a un extenso período de ingreso. Este trabajo presenta una técnica de anestesia general venosa total con propofol y remifentanil combinada con el bloqueo del nervio femoral por acceso perivascular inguinal.*

MÉTODO*: Se incluyeron 90 pacientes sometidos a artroscopia de la rodilla para meniscectomías. La inducción anestésica se hizo*

con propofol en infusión objeto controlada (IAC) (objetivo = 4 μg.mL^{-1}) y con remifentanil en IAC (objeto = 3 ng.mL^{-1}). Las alteraciones de las concentraciones de propofol y remifentanil eran realizadas de acuerdo con la electroencefalografía bispectral (BIS) y la presión arterial promedio (PAM). La ventilación era mecánica y controlada a volumen; la vía aérea se mantenía con máscara laríngea. Los valores de las concentraciones en el local efector de propofol y remifentanil se obtenían a través de los modelos farmacocinéticos de los fármacos, insertados en las bombas de IAC y correspondieron a las concentraciones predictibles. El local efector se refiere al local de acción de los fármacos. El tiempo de alta comprendió el espacio de tiempo entre la llegada del paciente a la sala de recuperación hasta el momento del alta.

***RESULTADOS**: Las concentraciones promedios en el local efector (ng.mL^{-1}), máximas y mínimas de remifentanil fueron de 3,5 y 2,4 respectivamente. Las concentraciones promedios en el local efector (μg.mL^{-1}), máximas y mínimas de propofol, fueron respectivamente de 3,1 y 2,6. El caudal promedio de infusión de propofol y de remifentanil fue de 8,54 mg.kg^{-1}.h^{-1} y de 0,12 μg.kg^{-1}.min^{-1}, respectivamente. Los tiempos de alta fueron como promedio de 180 min.*

***CONCLUSIONES**: Todos los pacientes se mantuvieron dentro de los parámetros establecidos.*