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RETROSPECTIVE CROSS-SECTIONAL TRIAL

Regional Anesthesia for Antipersonnel Landmines: A Military Hospital Experience in Colombia

[1]Camilo Eduardo Velez-Escobar, [2]Dora Milena Muñoz-Barrios, [3]Norton Perez

ABSTRACT

Background: Lower extremity blast injuries are frequent in Colombia as a result of the ongoing internal conflict. General anesthesia has been the preferred method of anesthesia for the surgical treatment of these injuries; spinal anesthesia is a safe alternative, which allows hemodynamic management.

Design: A retrospective cross-sectional trial was designed, reviewing clinical charts of patients with lower extremity blast injuries in a military hospital in Villavicencio, Colombia, from June 2005 to June 2012. Descriptive and bivariate analysis was performed. Chi-square or Fisher's exact test or Student's t-tests were used to establish statistical significance when $p < 0.05$.

Results: The medical records of 63 male patients were included for analysis. The average age was 25 years; the majority were professional soldiers, who had selective (unilateral) spinal anesthesia. Additionally, 39 of them received sedation with midazolam. Hypotension was observed in 36% of the patients. This was easily handled with crystalloids and in 5% of the cases with vasopressors. None of the patients required postoperative admission to the intensive care unit. The patients that received blood transfusions had more infections than those patients who did not receive blood transfusions (47 *vs* 26%). However, the risk of infection was lower when preoperative antibiotic prophylaxis, that included penicillin and amikacin, was utilized (17 *vs* 33%). The difference was not statistically significant.

Conclusion: Spinal anesthesia is a safe technique in lower extremity blast injuries. Transfusion might be restricted, and the incidence of infection might be lowered when a regimen of preoperative antibiotic prophylaxis with penicillin and amikacin is utilized.

Keywords: Blast injuries, Leg injuries, Traumatic amputations, Spinal anesthesia, Colombia.

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[1]Anesthesiologist and Lieutenant Colonel, [2]Nurse, [3]General Surgeon

[1,2]Department of Surgery, East Military Hospital, Colombia

[3]Department of Official Care Medicine, Villavicencio State Hospital, Meta, Colombia

Corresponding Author: Norton Perez, Anesthesiologist and Lieutenant Colonel, Department of Official Care Medicine Villavicencio State Hospital, Meta Colombia, Phone: 6729698 e-mail: norton.perez@hotmail.com

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RESUMEN

Antecedentes: Las lesiones de miembros inferiores por mina antipersonal son frecuentes en el escenario del conflicto interno en Colombia. La anestesia general ha sido la técnica de predilección para el manejo quirúrgico de estas lesiones; la anestesia espinal es una alternativa segura que permite el manejo hemodinámico.

Diseño: Estudio de corte transversal, retrospectivo, mediante la revisión de historias clínicas de pacientes atendidos por lesiones de miembros inferiores por mina antipersonal en el Hospital Militar de Oriente en Villavicencio, Colombia, entre Junio de 2005 y Junio de 2012. Se realizaron análisis de estadística descriptiva y bivariado y se realizaron pruebas de significancia estadística definiendo como significancia cuando $p < 0,05$.

Resultados: Se incluyeron 63 registros para el análisis de datos, de sexo masculino, con un promedio de edad de 25 años, principalmente soldados profesionales, que recibieron anestesia espinal selectiva y en 39 de ellos se adicionó sedación con midazolam. La hipotensión se presentó en 36%, pero fue fácilmente manejada con cristaloides y vasopresor en algunas oportunidades (5%), sin necesidad de cuidado intensivo en el post operatorio. Los pacientes transfundidos tuvieron mayor frecuencia de infección (47 *vs* 26%), mientras que fue menor en los pacientes con esquema de profilaxis antibiótica con penicilina y amikacina (17 *vs* 33%); no se encontró significancia estadística.

Conclusiones: La anestesia espinal es una técnica segura en lesión de extremidades por mina antipersonal. La transfusión sanguínea puede ser más limitada, al igual que pudiera haber menos riesgo de infección con profilaxis antibiótica preoperatoria con penicilina y amikacina.

Palabras clave: Traumatismo por explosión, Traumatismos de la pierna, Amputación traumática, Anestesia espinal, Colombia.

INTRODUCTION

Antipersonnel landmines are intended to produce severe injuries and mutilation in its victims, as a strategy to collapse enemy medical facilities and decrease troop confidence.[1,2] The main type of landmine in Colombia produces an explosion when the victim's weight is directly placed upon the triggering mechanism. This produces a severe injury to the lower extremity, leading to amputation, genital mutilation, muscle, bone and soft

tissue damage. There are approximately 110 millions landmines in more than 64 countries and 20,000 people die every year (one victim every minute).[3] Colombia is the second most mined country in the world after Afghanistan and it is the only country in Latin America where they are still routinely used (there are landmines between the Bolivian-Chilean border that were placed in the 70's). Anti-personnel mines are found in 31 of 32 states in Colombia, with the majority of blast injuries occurring in rural areas. Eighty-eight percent of the victims are young or still productive adults which affects the country socially, politically and economically.[4]

Hospital Militar de Oriente – HOMIO – is a level II medical facility, 20 minutes from Villavicencio, Meta, Colombia. It provides medical service to 24,000 individuals, 1/3 of which are military personnel who are tasked with combatting guerrilla and drug cartel operations in the south of the country.

Since 2005, spinal anesthesia has been the preferred technique for these procedures in an effort to reduce the risks and complications of emergency general anesthesia in addition to providing a fast postoperative recovery without the need for admission to an intensive care unit and with minimal risk of renal, pulmonary and cardiovascular dysfunction.[5]

Additionally, no publications were found in medical databases about the use of this anesthetic technique in the same patient population.

The objective was to describe the experience with spinal anesthesia in military patients injured by antipersonnel landmines.

MATERIALS AND METHODS

A retrospective, descriptive cross sectional trial was designed by reviewing clinical charts of patients who were treated from June 2005 to 2012 at the HOMIO. No sample calculation was designed. All injured patients admitted to the emergency room that were active duty military personnel and admitted to the facility, within 8 hours of injury, due to a traumatic amputation of the lower limbs by a landmine blast were nonrandomly and consecutively included in the study. Informed consent for the surgical and anesthetic procedures was obtained. Patients, who had received more than 3,000 cc of crystalloids prior to induction of anesthesia or blood products, colloids, gelatin, albumin, hypertonic solutions or any non-crystalloid solution, were excluded. Further exclusion criteria include patients who had surgical control of bleeding by a health professional prior to there arrival to the hospital as well as those who received vasopressors, inotropes or were injured by firearms, knives, had self-inflicted wounds, or when another site, other than the lower extremities, was involved, especially head injury.

The lumbar puncture was performed with a Quincke® needle through which 0.5% bupivacaine (Heavy 0.5% Bupirop®, Rohpson) was infused at a rate of 1 cc in 15 seconds. The patients were then positioned in lateral decubitus with the head of the table elevated 30 degrees for 5 minutes until selective blocking was achieved. Then they were positioned in a supine position and sedated with 3 mg of midazolam as well as 2 liters of oxygen via nasal cannula. The decision to administer blood products was made jointly by the orthopedic surgeon and anesthesiologist during the course of the operation. Pain was evaluated with the visual analog scale (VAS). Postoperative control (What do you mean by postoperative control?) was performed at 6, 12 and 24 hours, and then on the 3rd and 5th day and right before hospital discharge.

Data were entered into an Excel spreadsheet. Statistical analysis was performed using the SPSS software, version 18. Descriptive, univariate and bivariate analysis were performed. Chi-square or exact Fisher tests were used for statistical comparison. The association of independent variables with the main outcome was calculated using the odds ratio (OR) with Mantel-Haenzel test with a 95% confidence interval. Findings were considered significant when $p < 0.05$. The hypothesis was that regional anesthesia is a safe technique in patients with lower extremity injuries due to a landmine.

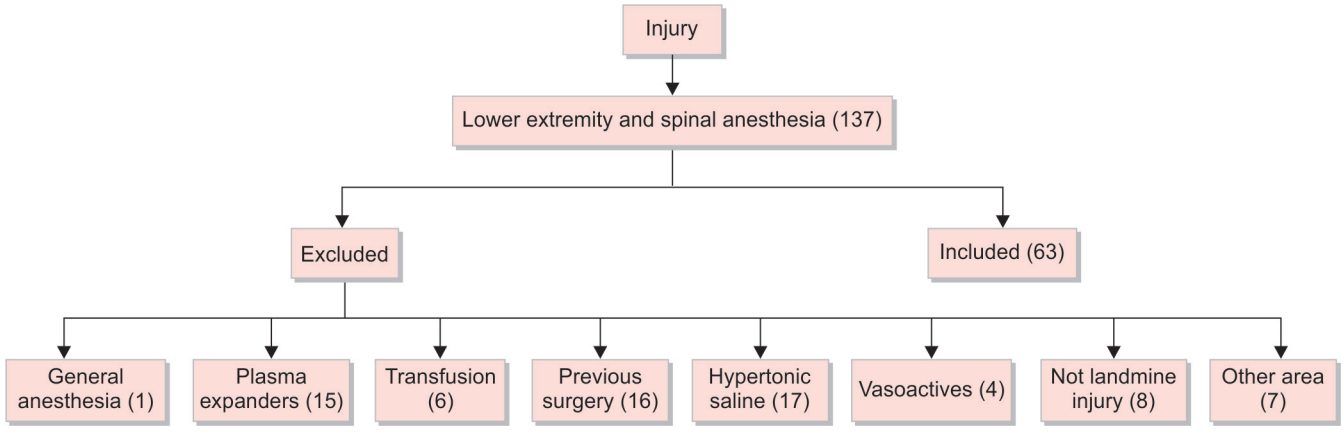
ETHICAL FEATURES

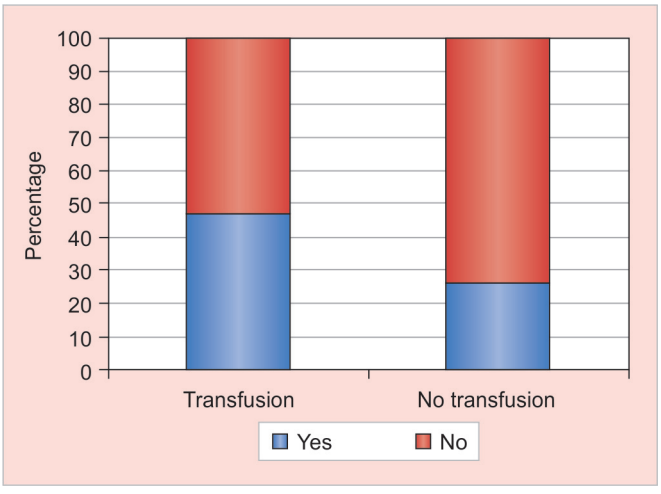
This is a descriptive, retrospective study that does not entail any risk to the participants. Hence, no informed consent was required. The research committee of the hospital and Universidad Cooperativa de Colombia approved this study.

RESULTS

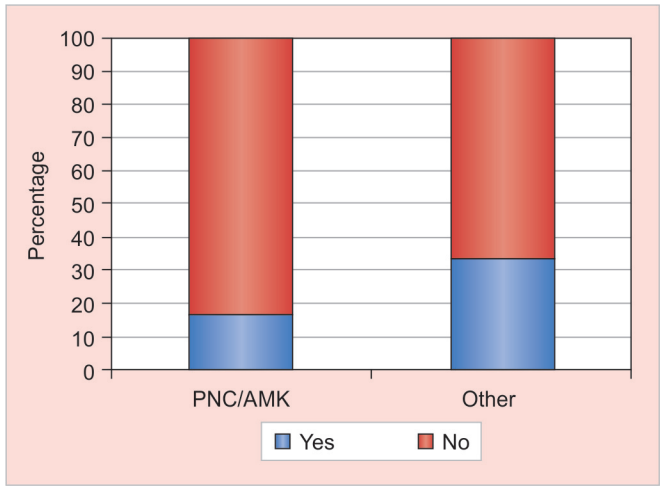
Two hundred and one surgical records of patients with landmine injuries to the lower extremities were reviewed. All of the participants were male soldiers and 137 of them received spinal anesthesia, but only 63 were included for analysis (Flow Chart 1). The average age was 26 ± 4 years and 86% were professional soldiers. Average time between injury and anesthesia was roughly 210 minutes. Seventeen patients had a heart rate (HR) >100 beats per minute (BPM) and 2 patients had a HR <50 BPM, but no associated symptoms. Only one patient needed atropine for associated bradycardia. Sedation with midazolam was administered to 39 of the patients, with no hemodynamic or ventilator deterioration. Twenty-three patients (36%) had a systolic blood pressure (SBP) < 90 mm Hg. Of these,

Flow Chart 1: Cause of exclusion from trial in patients with spinal anesthesia for landmine lower limb injury in HOMIO, 2005-2012





Graph 1: Surgical site infection in transfused patients by landmine lower limb injury in HOMIO, 2005-2012



Graph 2: Surgical site infection according to preoperative antimicrobial prophylaxis with penicillin (PNC) and amikacin (AMK) *vs* other schemes, in patients with landmine lower limb injury, in HOMIO, 2005-2012

only 3 patients had a SBP < 80 mm Hg, with nausea and dizziness and required vasopressors (5%), which were suspended immediately after surgery. A pneumatic tourniquet was used in 34 patients (54%) and the majority of the patients underwent a below knee amputations (BKA). Ringer solution was used in 90% of the cases with an average of 2106 ± 640 cc administered during the procedure. Seventeen patients (30%) received a blood transfusion at the request of the orthopedic surgeon; however, only one of the patients had a hemoglobin levels < 7 g/dL. The average amount of blood transfused was 1.8 ± 0.4 units.

Antibiotics were administered to all but two patients and several schemes were used, including crystalline penicillin, first generation cephalosporin and aminoglycosides. Twenty patients had a postoperative infection (32%), 10 required re-intervention for surgical washing and 3 had revision of the amputation level.

Ten patients needed morphine for pain management, 39 received sedation with midazolam and 11 (17%) had phantom limb pain. The average time to obtain an adequate Bromage Score or anesthesia recovery time on average was 132 minutes. Seventy-two percent of the patients received immediate postoperative feeding. All patients that received intravenous benzodiazepine had amnesia of the surgical event and 92% expressed that they would prefer regional anesthesia again. None of the surgeons had any complaints with the anesthetic technique. All patients were classified as injuries type 1,[6] according to inclusion criteria (Tables 1 and 2).

Length of stay (LOS) was 24.3 ± 18 days. Only 7 (11%) patients received prophylaxis for deep vein thrombosis and 31 (49%) patients received tetanus toxoid during their hospitalization. No patient reported post lumbar puncture spinal headache. All of the patients received psychological support, physical therapy and rehabilitation and there were no deaths.

Utilizing bivariate analysis, patients who received a blood transfusion were found to have more surgical site infections (Graph 1). When a combination of penicillin and amikacin was utilized, the rate of infection decreased, but not so when gentamycin was used Graph 2. Nevertheless, this difference was not significant, this finding is most likely due to the limited number of patients in some subgroups. We feel that future trials are

merited and should be designed to answer this query (Table 3).

DISCUSSION

Medical care in a military combat setting is challenging because of logistical limitations, highly contaminated wounds and massive tissue destruction amongst others. In this setting, it is difficult to provide basic care to the patients due to lack of resources and many other variables. There might be a delay in transfer to definitive care, because of limited transportation.[1] Landmine injuries produce severe tissue damage with massive blood loss as well as the possibility of contamination by Gram positive and negative, aerobic and anaerobic microorganisms. Hemorrhagic hypovolemic shock and infection are the main threats to life. These variables pose a challenge to anesthetic management while one attempts to provide cardiovascular stability and diminish the risk of postoperative complications.[7-9] General anesthesia is the most frequent anesthetic technique used in this kind of injury, due to the systemic compromise of the lesion, the presence of hypovolemia, concomitant injuries in other regions besides lower limbs, and most importantly, the urgency of the situation. Unfortunately, general anesthesia often results in prolonged postoperative care due to tracheal intubation, with associated risks, such as bronchial-aspiration, further hemodynamic instability, need for additional administration of crystalloids, vasopressors and/or blood during reanimation, with a risk of cardiopulmonary overload and the need for admission to a postoperative intensive care unit.[10,11]

Most of the articles about this issue focus on the traumatic point of view, pattern of injury and surgical management, but there is a lack of anesthetic considerations.[12-15] Young military patients with single injuries of lower limbs are candidates for regional anesthesia with several benefits.[6] Spinal anesthesia is comfortable and provides rapid pain control, selective anesthesia in the injured leg, decreased hemodynamic repercussion, does not require ventilator assistance during surgery,

Table 1: Demographic characteristics of patients that received spinal anesthesia for surgical interventions due to landmine injuries in HOMIO, 2005-2012

Categoric variables	*n*	*%*
N	63	100.0
Military rank		
Officer	2	3.2
Noncommissioned officer	5	7.9
Professional soldier	54	85.7
Regular soldier	2	3.2
Transfusion	17	27.0
Midazolam	39	61.9
Penicillin	54	85.7
Cephalotin	42	66.7
Amikacin	13	20.6
Gentamycin	31	49.2
Ranitidine	57	90.5
Diclofenac	31	49.2
Tramal	53	84.1
PNC-AMK	6	9.5
PNC-Ag	11	17.5
Infection	20	31.7

AG: Aminoglycoside; AMK: Amikacin; PNC: Penicillin

Table 2: Characteristics of patients who received regional anesthesia for landmine injuries at HOMIO, 2005-2012.

Cuantitative variables	*Median*	*SD*	*Max.*	*Min.*
Age (years)	26.0	4.1	36	19
Los (days)	24.3	17.8	84	1
Amount anesthetic administered (ml)	12.3	1.9	20	8
Time of anesthesia (minutes)	87.5	36.2	170	30
INI SBP (mm Hg)	100.8	10.7	131	87
INI DBP (mm Hg)	61.7	10.1	93	40
INI MBP (mm Hg)	74.7	9.4	98	57
END SBP (mm Hg)	109.6	11.9	140	90
END DBP (mm Hg)	65.5	8.1	90	50
END MBP (mm Hg)	80.2	7.7	103	63
Initial HR (beats per minute)	85.7	21.9	138	45
End HR	78.6	19.3	122	45
Amount of fluids (ml)	2,106.4	639.5	4,000	1000
Time of surgery (minutes)	76.1	30.2	150	20
Units transfused	1.8	0.4	2	1
Hematocrit (%)	27.2	4.8	47	13
Hemoglobin (gm/dl)	9.8	1.6	16.1	6.9
WBC	14,065	5,312	29,000	1,300
Platelet count	271,610	96,230	595,000	94,000

DBP: Diastolic blood pressure; HR: Heart rate; LOS = Length of stay; MBP: Median blood pressure; SBP: Systolic blood pressure; WBC: White blood count

and allows the surgeon adequate time to complete the procedure without concerns of the anesthesia wearing off during the procedure. Benzodiazepine sedation adds comfort to the patient by acting as an amnestic to the procedure, by lowering the patient's anxiety and improves acceptance of future procedures if surgical revisions are required. The risk of bradycardia, associated with spinal anesthesia, seems to be related mostly with the dose utilized rather than the anesthetic level. We only had one patient with bradycardia that responded favorably to the administration of atropine without any further complications.

Despite the presence of hypotension in 36% of the patients in the study, only 5% of them required pharmacological intervention with vasopressors, which was suspended immediately after surgery without the need for further care in an intensive care unit. This can be attributed to the fact that the population involved in the study is young, preconditioned for adverse situations due to physical and psychological training.

Blood loss cannot be quantified in this scenario, or even controlled, many times; nevertheless, hemoglobin and hematocrit values were acceptable and when these values were low this condition was well tolerated by this patient population. Patients who required a transfusion did not necessarily have lower levels of hemoglobin and hematocrit, but they had a higher risk of infection compared to those who did not receive transfusion. Due to the fact that transfusions in trauma and critically ill patients have been found to increase the risk factor for infection

Table 3: Infection risk, according to independent variables, of blast landmine lower extremity injured patients, surgically operated with spinal anesthesia in HOMIO, 2005-2012

Infection	*Yes*	*%*	*No*	*%*	*Total*	*Or*	*Min.*	*Max.*	*P*
Rank									
Professional soldier	16	29.6	38	70.4	54	0.53	0.13	2.22	0.30
Other	4	44.4	5	55.6	9				
Side									
Right	12	37.5	20	62.5	32	1.33	0.48	3.67	0.32
Left	8	25.8	23	74.2	31				
Type of surgery									
BK	19	31.7	41	68.3	60	0.93	0.08	10.86	0.95
Syme	1	33.3	2	66.7	3				
Torniquete									
Yes	7	20.6	27	79.4	34	0.32	0.11	0.97	0.04
No	13	44.8	16	55.2	29				
Type of IV fluid									
Ringer	18	31.6	39	68.4	57	0.92	0.16	5.51	0.93
Saline	2	33,3	4	66.7	6				
Transfusion		.							
Yes	8	47.1	9	52.9	17	2.52	0.79	8.02	0.11
No	12	26.1	34	73.9	46				
PNC									
Yes	15	27.8	39	72.2	54	0.31	0.07	1.30	0.10
No	5	55.6	4	44.4	9				
CEP									
Yes	14	33.3	28	66.7	42	1.25	0.39	3.92	0.47
No	6	28.6	15	71.4	21				
AMK									
Yes	2	15.4	11	84.6	13	0.32	0.06	1.62	0.14
No	18	36.0	32	64.0	50				
GMC									
Yes	11	35.5	20	64.5	31	1.41	0.48	4.08	0.36
No	9	28.1	23	71.9	32				
PNC-AMK									
Yes	1	16.7	5	83.3	6	0.4	0.04	3.67	0.37
No	19	33.3	38	66.7	57				
PNC-AG									
Yes	3	27.3	8	72.7	11	0.77	0.18	3.28	0.51
No	17	32.7	35	67.3	52				

BK = below knee; Syme: technique of foot amputation; PNC: penicillin; CEP: cephalosporin; AMK: amikacin; GMC: gentamycin; AG: aminoglycoside

and mortality,[16-20] it is important to be more selective in their use. One should consider the hemodynamic information and metabolic impact of anemia using arterial blood gases as a parameter.

Another incidental finding was a trend towards a decreased risk of surgical site infection (SSI) when the preoperative antimicrobial prophylaxis regimen included penicillin and amikacin, but not gentamycin. Aminoglycosides in trauma patients have a higher risk of renal dysfunction, because of associated shock. However, they are frequently used in an orthopedic scenario in the setting of complex open fractures. The decreased risk of SSI was not statistically significant. This was most likely due to the low number of subjects in some of the subgroups. However, these findings should be addressed in further studies.

This was a descriptive and retrospective study with a small sample size and small subgroups. Unfortunately, the small size does not allow for inference analysis and the subject would benefit from further study to validate these findings. It is notable that there was no follow up of renal function and a lack of blood gases to evaluate the oxygenation and acid-base status of this population. Another finding from this study was the low adherence to clinical guidelines, as evidenced by the lack of deep vein thrombosis prophylaxis and tetanus immunization in this patient population. This highlights elements of real clinical practice that occasionally are forgotten in cases of serious trauma or surgical emergencies.

These data introduce some working hypothesis that we felt would be important to evaluate through well-designed controlled clinical trials:

- Blood transfusion in patients with landmine injuries to the lower extremity should be restricted to acute anemia or blood loss that is greater than 1500 cc, to reduce the associated infection risk.
- Early antimicrobial therapy, including the use of crystalline penicillin and amikacin, is associated with a lower risk of SSI in patients with landmine injuries to the lower extremity. The risk of SSI is higher when penicillin and amikacin are not utilized, or when penicillin is replaced by a first generation cephalosporin or amikacin is not used, and when a pneumatic tourniquet is used.

In conclusion, spinal anesthesia is a safe technique that can be used when military personnel suffer landmine injuries to the lower extremities. Despite the fact that this is a problem affecting a young adult population, deep vein thrombosis and pulmonary embolism are still at risk and prophylaxis should be administered.[21-24] Additionally, adjustments in procedure should be made to guarantee the administration of tetanus prophylaxis. Blood transfusion restriction is a measure that might be beneficial as well. Early antimicrobial therapy, with a unified scheme, might be beneficial in the prevention of infection in this group of patients.

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