Revista Mexicana de Anestesiología

CLINICAL CASE
Vol. 31. No. 3 July-September 2008
pp 215-218

Lower Extremity Acute Compartment Syndrome at Lumbar Spine Surgery in Knee-Chest-Position. A Clinical Case

Mª Esperanza Moriano-Béjar, MD;* Ignacio Zearreta-Letamendia, MD;* Edurne Lopetegui-Auzmendi, MD;* Iñaki Roa-Martínez, MD;* Mª Jesús Madina-Albisua, MD;** Ángel Berain-Arzalus, MD*

* Assistant Medic.
** Head of Service.

Servicio de Anestesia y Reanimación
Hospital de Zumárraga, Guipúzcoa. País Vasco. España.

Reprints request:
Mª Esperanza Moriano Béjar
Servicio de Anestesia y Reanimación
Hospital de Zumárraga
Guipúzcoa Núm. 20700, España
Teléfono: 34 677 302 093
Correo electrónico:
mariaesperanza.morianobejar@osakidetza.net

Received for publication: 17-04-08
Accepted for publication: 18-07-08

SUMMARY

In the last years the number of perioperative complications due to patiens´ positions has increased. Surgical procedure are longer and de positions less physiological. Compartmental syndromes due to this reason are not common, and due to genupectoral position (knee-chest position) are unusual. However, this possibility must be considered in order to be able to do an early diagnosis and the treatment as soon as possible because of the seriousness of this syndrome and avoid irreversible tisular damage and the after-effects originated. A case of bilateral compartment syndrome of lower limbs in a female patient who was submitted to an artrodesis of lumbar spine by channel stenosis. The operation was performed in genupectoral position during seven hours with elastic bandaging in the legs. The patient developed secondary rabdomyolysis to the compartmental syndrome and a paralysis of external popliteo ciatic nerve as a sequel.

Key words: Rabdomyolysis, compartment syndrome, knee-chest position, fasciotomy, elastic bendages.

RESUMEN

En los últimos años ha aumentado el número de complicaciones en el peroperatorio debidas a las posiciones de los pacientes. Las intervenciones quirúrgicas son más largas y las posiciones menos fisiológicas. Los síndromes compartimentales por esta causa son poco frecuentes y por la posición genupectoral son excepcionales. Sin embargo, conviene tener presente que pueden ocurrir para hacer el diagnóstico precoz e iniciar el tratamiento lo antes posible dado la gravedad del síndrome y así evitar el daño tisular irreversible y las secuelas que se derivan de ello. Comunicamos un caso de síndrome compartimental bilateral de extremidades inferiores en una paciente que fue sometida a una artrodesis de columna lumbar por estenosis de canal. La intervención se realizó en posición genupectoral durante siete horas con vendajes elásticos en las piernas. La paciente desarrolló una rabdomiólisis secundaria al síndrome compartimental y como secuela parálisis del nervio ciático poplíteo externo.

Palabras clave: *Rabdomiólisis, síndrome compartimental, posición genupectoral, fasciotomía, vendajes compresivos.*

A CLINICAL CASE

We present the case of a 56-year old female patient, weighing 100 kg (222 pounds) and 1.72-meter tall, with arterial hypertension record, NIDDM (non-insulin dependent diabetes mellitus) and hypercholesterolemia. The patient had no toxic habits and was under treatment with ramiprimil (tritace), metformin, simvastatine, ketazolam and tranxilium. The laboratory analysis (hemogram %blood count%, electrolytes, renal function, glucose, coagulation tests) and exploration at the pre-operative period were normal, with the exception of ECG (electrocardiogram), which showed a His Left Bundle Branch Block (HLBBB) without re-polarization disorders. The patient was programmed for laminectomy and arthrodesis due to L2-L4 lumbar canal stenosis.

It was monitored ECG, AP (arterial pressure), pulse-oximetry, entropy, and 24-hour diuresis.

The induction was carried out through 2 µg of midazolam, 200 ìg of fentanyl, 200 mg of propofol, and 10 mg of cisatracurium. The patient is intubated with a #8.5-ringed endotracheal tube. The patient's legs were bandaged with elastic bandages and it was placed in modified «Mahometan» (genupectoral, knee-chest) position (in prone decubitus position %face down%, flexing hips from the trunk at 90º, and knees from the thighs at 90º too) (Figure 1). It was used habitual protectors to prevent lesions on the supporting areas. The anesthetic maintenance was performed by propofol and remifentanyl though perfusion, and fentanyl and cisatracurium bolus.

Anesthesia time was of 7 hours and 30 minutes. Five liters of crystalloids and 500 mL of colloids were perfused. The diuresis was of 2,100 cc. The bleeding was of about 2 liters (the 36.35% of the total blood volume). Hb went from 12.9 g/dL in the pre-operative period to 8.2 g/dL. Therefore, the patient was transfunded three-hematite concentrates. During the last hours of the intervention, anesthesia need increased; therefore, several bolus of 1 to 2 ìg/kg of fentanyl were needed up to reach a total dose of 2.2 µg (22 mg/kg). There was no arterial hypotension at any moment.

At the end of the surgery, the patient woke up and she was transferred to the Unit of Reanimation, where she entered in conscious condition, oriented, breathing normally, with good skin and mucosa coloration, edemas in surgical supporting areas, and hard pain in both leg calves (Figures 2 y 3). She was removed leg bandages, and both leg calves tumefaction and paleness is observed. Pain increased along with flexion movements and pressure. There was a decrease in distal sensibility in left leg (0/5 in L5 and 0/5 in S1) and in right leg (3/5 in L5 and 2/5 in S1). Dorsalis pedis pulse was present. An analytical test and a Doppler Echo were required in order to discard DVT (Deep Vein Thrombosis). The urine began to become dark; therefore, it was suspected rhabdomyolysis.

There were no DVT (Deep Venous Thrombosis) criteria in the results, despite of the fact that the (popliteal and posterior

Figure 2. Swelling and edema of the left lower limb after surgery.

Figure 1. «Mahometan» (genupectoral, knee-chest) position (in prone decubitus position face down, flexing hips from the trunk at 90°, and knees from the thighs at 90° too)

Figure 3. Swelling and edema of the right lower limb after surgery.

tibial) veins were collapsed by the edema. The KPC isoenzymes in 7,790 U/L; K+ 6.37 mEq/L, creatinine, 1.25 mg/dL, and gasometry showed metabolic acidosis. This fact confirmed rhabdomyolysis diagnostic. A treatment consisting of osmotic diuretics (20% mannitol, 5 g/hour), 35 mEq/hour of bicarbonate, serum therapy and morphine sulfate was administered.

After six hours, the edema is more remarked in the left leg, and there was a decrease in bilateral sensibility and paresthesias; besides this, there was distal pulses presence. The KPC isoenzymes of 57,640 U/L; creatinine, 1.58 mg/dL; K+, 4.24 mEq/L, had decreased metabolic acidosis and creatinine clearing was of 46 mL/hour. The pressure at the antero-external and posterior compartments of the left leg was of 50 mmHg.

Bilateral fasciotomy was performed. In the left leg antero-external compartment, the muscle presented a violet coloration and decrease in contractility. The rest of the muscle was in a good condition.

The following day, the KPC had decreased, but the renal function kept on getting worse until reaching creatinine figures of 3.65 mg/dL on the sixth post-operative day, while KPC was of 18,000 U/L on that day.

The fasciotomy evolved favorably. The muscle presented good color except from the left leg antero-external compartment, where there were like-necrosis patches. There was a good distal perfusion, but there was mobility diminution. On the eleventh day, the CPK was of 304 U/L and creatinine in 2.46 mg/dL.

On the post-operative twenty-second day, the patient was admitted to rehabilitation, presenting 0/5 strength loss in common peroneal nerves and extensor muscles of the left leg feet, sciatic nerve hypoesthesia in the popliteal fossa, and difficult and reaper-like bent locomotion.

One month after the spine arthrodesis, the fascia was closed and an autograft of the anterior face of the thigh practiced.

After one moth and 26 days, the patient was discharged in order to keep on receiving ambulatory rehabilitation under diagnostic of paralysis of the left external popliteal sciatic nerve.

DISCUSSION

Compartment syndrome is a probable and serious complication that may appear during or after surgery. Compartment pressures over 45 mm of Hg for more than 4 hours are associated to irreversible muscular harm[1] and pressures higher than 30 mm of Hg predispose to compartment syndrome[2]. What really matters is not the absolute value, but the relationship between intra-compartment syndrome and MAP (maximum arterial pressure); i.e., perfusion pressure[3]. When the interstitial pressure inside a close anatomical space is higher than perfusion pressure, a compartment syndrome is produced[4]. It is necessary a 30-mmHg.pressure in order to keep cell metabolism in the normal muscle, and of 40 mm of Hg in traumatized muscles[5]. This perfusion pressure decrease occludes local circulation and initially affects vein drainage, and the arterial drainage, producing neuromuscular ischemic lesions in a few hours[6].

Compartment syndrome emerges from very diverse causes. The most frequent reasons are traumatisms and vascular repercussion after a prolonged ischemia period, and less frequently in surgeries in the lithotomy position[7,9]. Clinically, this syndrome is characterized by pain, eritema, edema, and hypoesthesia of the nerves in the affected area. If early diagnostic is performed and an early fasciotomy carried out too, permanent harm can be avoided. If the treatment is delayed, it will be produced a serious rhabdomyolysis, permanent neurologic deficit, and even death.

The diagnostic is clinically carried out, even though we can measure intra-compartment pressure with a needle and a manometer, or with an arterial catheter and a pressure transducer when we do not count on a specific device to measure that pressure[5,10]. Legs should not be elevated because this fact make perfusion pressure decrease.

Once the patient has been diagnosed, and the difference between the intra-compartment pressure and the mean arterial pressure is less than 30 mm of Hg[11], fasciotomy is the recommended treatment, the sooner the better. If a rhabdomyolysis has already set on due to the muscle destruction and necrosis, it will be performed a treatment to protect the renal function. The accumulation of liquids in the harmed muscle interstitial space and the obstruction generated by myoglobin result in renal hypoperfusion. In order to prevent ARI (acute renal insufficiency), it should be performed an aggressive reposition through 1.5 L/h crystalloids, being very careful that the cardiac output keep over 300 mL/h, alkalinizing urine with mEq/h of sodium bicarbonate in order to favor the track of the cylinders in the renal ducts. When volemia is restored, the diuresis treatment with 5-10 g/h of mannitol diuretics should begin[6]. The use of mannitol and sodium bicarbonate is very controversial at present[12,13]. It does not seem that this drug may present beneficial effects in patients with light increases of KPC, but it could be useful when the levels of KPC are about son ≥ 30,000 UI/L.

Compartment syndrome of lower extremities due to chest-knee position is very unusual. This position is frequently used for lumbar spine surgery in order to correct lumbar lordosis, facilitating spine access and decreasing pressure over the lumbar epidural plexus and, therefore, minimizing intra-operative bleeding.

In a study carried out by Warner *et al*[14] on 499,214 patients who were subjected to surgical interventions, these authors found that 173 of them developed compartment syndrome. None of these syndromes was due to chest-knee position. Nevertheless, these researchers found that there was an effect from lithotomy position, in dorsal decubitus and, in lower proportion, in supine decubitus.

In our literature review, we found twelve cases of compartment syndrome in lower extremities in patients who had been operated on lumbar spine in chest-knee position[15,19]. However, we think that there might be more imperceptible

cases because pain may be suppressed by opiate analgesia. Moreover, the motor and sensorial deficits may be confused with syndromes before the surgery or we may think that they were produced by root lesions during surgery.

In a study carried out by Jourdan *et al*[20] on 173 patients, who were analyzed KPC in anesthetic induction at 6-8 hours after induction, subjected to surgery in different positions, they concluded that KPC rise after surgery in chest-knee position is constant, but it is not higher than the increase that occurs after abdominal or thoracic surgery. They proved that this fact has no relationship with either age or sex. There is a relationship between KCP increase and the intervention length. These authors do not believe that position might be the cause, but a wrong patient's positioning. It would be important to discuss the role of anesthetics, intra-operative hypotension, alcoholism, and some unknown neuromuscular diseases over these issues. These researchers do not recommend practicing controlled hypotension in this position.

Bryan *et al*[22] found, in their study, that in 90/90 chest-knee position, there was a relationship between the patient's weight and the anterior compartment pressure. The aforementioned relationship was not present either in the other compartments or in the prone decubitus and 45/45 positions. Regarding the role of compressive bandages on lower extremities during the development of compartment syndrome, we have found three references that describe lower extremity compartment syndrome due to the excessive pressure produced by elastic bandages on four patients subjected to varicose vein surgery[22], and on three quadriplegic patients[5,23].

CONCLUSIONS

The patient was morbidly obese (BMI %Body Mass Index% of 33.80 kg/m^2), and she stayed in knee-chest position over seven hours with elastic bandages on lower extremities. All of these factors might have determined the compartment syndrome. However, several patients under the same conditions do not develop this type of complication. We agree with Jourdan *et al*[20] in the fact that perhaps the mentioned position is not the only cause for the problem, but the patient may have not been properly placed or there are other non-studied factors.

We recommend not using compressive bandages. Besides this, we should take into account, to establish the accurate treatment very quickly, that the patient may develop this syndrome when this position is employed in prolonged surgery.

REFERENCES

1. Matsen FA, Winsquist RA, Kingrnire RB. Diagnosis and management of compartiment syndromes. J Bone Joint Surg Am 1980;62:286-291.
2. Rorabeck CH. The treatment of compartment syndromes of the leg. J Bone Joint Surg Br 1984;66:93-97.
3. Meyer RS, White KK, Smith JM, Groppo ER, Mubarak SJ, Hargens AR. Intramuscular and blood pressures in the legs positioned in the hemilithotomy position: clarification of risk factor for well-leg acute compartment syndrome. J Bone Joint Sur Am 2002;84A:1829-1835.
4. Mendieta JM, Rubio J, Elías M, Company R. Bilateral compartment syndrome after surgical reperfusion in chronic ischemia of lower extremities. Rev Anestesiol Reanim 2004;51:155-157.
5. Vogel LC, Lubicky JP. Case report: lower extremity compartment syndrome in an adolescent with spinal cord injury. The Journal Spinal Cord Medicine 2001;24:278-283.
6. Madrazo DM, Uña OR, Redondo CFJ, Criado JA. Ischemic rhabdomyolysis and acute renal failure. Rev Esp Anestesiol Reanim 2007;54:425-435.
7. Muret J, Farhat F, Jair C. Rhadomyolyse après intervención prolongée en position de lithotomie. Ann Fr Anesth Réanim 1994;13:262-265.
8. PertekJP, Coissard A, Hubert J, Meistelman C. Rhadomyolyse et syndrome des loges après position de lithotomie: évolution favorable après traitement conservateur. Cahiers d´Anesthésiologie 1997;45: 59-62.
9. Zappa L, Sugarbaker P. Compartment syndrome of the leg associated with lithotomy position for cytireductive surgery. J Surg Oncol 2007;96:619-623.
10. Salcido R, Lepre S. Compartment syndrome: Wound care considerations. Skin & Wound Care 2007;20:559-565.
11. Klenerman L. The evolution of the compartment syndrome since 1948 as recorded in the JBJS. J Bon & Joint Surg 2007;89B:1280-1282.
12. Russell T. Acute renal failure related to rhabdomyolysis: Pathophysiology, diagnosis, and collaborative management. Nephrology Nursing J 2000;27:567-576.
13. Brown C, Rhee P, Chan L, Evans K, Demetriades D, Velmahos G. Preventing renal failure in patiens with rhabdomyolysis: do bicarbonate and mannitol make a difference? J Trauma 2004;56:1191-1196.
14. Warner ME, LaMaster LM, Thoeming AK, Shirk MME, Warner MA. Compartment syndromes in surgical patients. Anesthesiology 2001;94:705-708.
15. Díaz OO, Pizaña DA, Chávez SJM, Morales CI. Rhabdomyolysis in post-operative period of spinal cord surgery: A five-case report. Ac Med Gpo Ang 2005;3:141-148.
16. Aschoff A, Steiner-Milz H, Steiner HH. Lower limb compartment syndrome following lumbar disectomy in knee-chest position. Neurosurg Rev 1990;13:155-159.
17. Geisler FH, Laich DT, Goldflies M, Sherpard A. Anterior tibial compartment syndrome as a positioning complication of the prone-sitting position for lumbar surgery. Neurosurgery 1993;33:1117 (letter).
18. Cortes-Franco S, Pacheco AEM, Martel D, Millán-Corada AM, Spreafico M, Ginovés M. Compartment syndrome in lower extremities after lumbar schwannoma surgery at genupectoral position. Neuro-surgery. 2007;18:56-59.
19. Gupta R, Batra S, Chandra R, Sharma VK. Compartment syndrome with acute renal failure: a rare complication of spinal surgery in kee-chest position. Spine 2008;33:272-274.
20. Jourdan C, Convert J, Terrier A, Tixier S, Bouchet C, Montarry M. Etude compare des CPK au cours de la chirurgie du rachis en position génupectorale. Cahiers d´anesthésiologie 1992;40:87-90.
21. Leek BT, Meyer RS, Wiemann JM, Cutuk A, Macias BR, Hargens AR. The effect of kneeling during spine surgery on leg intramuscular pressure. J Bone Joint Surg Am 2007;89:1941-1947.
22. Danner R, Partanen K, Partanen J, Kettunen K. Iatrogenic compartment syndrome. A follow-up of four cases by elastic bandage. Clin Neurol Neurosurg 1989;91:37-43.
23. Jacobs DG, O'Brien KB, Kurt B, Miles WS. Unilateral lowerextremity compartment syndrome in the quadriplegic patient: A possible association with the use of elastic bandages. The Journal of Trauma, Injury, Infection and Critical Care 1999;46:343-345.