

# Management of acute compartment syndrome: case report

*Manejo da síndrome compartimental aguda: relato de caso*

*Manejo del síndrome compartimental agudo: informe de caso*

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**ABSTRACT: Introduction:** Acute compartment syndrome (ACS) is defined as any increase in interstitial pressure within the bony-fascial compartment and consists of an adverse event in the intraoperative period, resulting from surgical positioning. **Objective:** To report a case of fasciotomy in the lower limbs after ACS. **Method:** Case report registered in a large public teaching hospital, with a highly complex care profile. Results: Patient underwent videolaparoscopic surgery to remove endometriosis, having remained in the gynecological position for 9 hours, developing ACS in the immediate postoperative period (IPO). The patient underwent decompressive fasciotomy to treat ACS in the second postoperative period, and nine other surgical approaches to continue treatment. She remained hospitalized for 45 days. **Conclusion:** The training of nursing professionals, knowledge about surgical patient safety and teamwork throughout the anesthetic-surgical procedure are essential for reducing adverse events and quickly identifying and treating complications. **Keywords:** Perioperative care. Fasciotomy. Patient positioning. Debridement. Nursing.

**RESUMO: Introdução:** A síndrome compartimental aguda (SCA) é definida como qualquer elevação na pressão intersticial dentro do compartimento ósseo-fascial, e consiste em um evento adverso no período intraoperatório, decorrente do posicionamento cirúrgico. **Objetivo:** Relatar um caso de fasciotomia em membros inferiores após SCA. **Método:** Relato de caso registrado em um hospital escola público de grande porte, com perfil assistencial de alta complexidade. **Resultados:** Paciente submetida à cirurgia videolaparoscópica para remoção de endometriose, tendo permanecido 9 horas em posição ginecológica, desenvolvendo SCA, no pós-operatório imediato (POI). A paciente foi submetida à fasciotomia descompressiva, para o tratamento da SCA no segundo pós-operatório (PO), e outras nove abordagens cirúrgicas, para a continuidade do tratamento. Ela permaneceu hospitalizada por 45 dias. **Conclusão:** O treinamento dos profissionais de Enfermagem, o conhecimento acerca da segurança do paciente cirúrgico e o trabalho em equipe durante todo o procedimento anestésico-cirúrgico são essenciais para a diminuição dos eventos adversos e a rápida identificação e tratamento de complicações.

**Palavras-chave:** Assistência perioperatória. Fasciotomia. Posicionamento do paciente. Desbridamento. Enfermagem.

**RESUMEN: Introducción:** El síndrome compartimental agudo (SCA) se define como cualquier aumento de la presión intersticial dentro del compartimento ósseo-fascial y consiste en un evento adverso en el período intraoperatorio, resultante de la posición quirúrgica. **Objetivo:** Reportar un caso de fasciotomía en los miembros inferiores después de un SCA. **Método:** Informe de caso registrado en un gran hospital público de enseñanza, con un perfil de atención de alta complejidad. **Resultados:** La paciente se sometió a una cirugía videolaparoscópica para extirpar la endometriosis, permaneciendo en posición ginecológica durante 9 horas, desarrollando SCA en el período postoperatorio inmediato (POI). La paciente se sometió a una fasciotomía descompresiva para tratar el SCA en el segundo período postoperatorio, y a otros nueve abordajes quirúrgicos para continuar el tratamiento. Permaneció hospitalizada durante 45 días. **Conclusión:** La formación de profesionales de enfermería, el conocimiento sobre la seguridad del paciente quirúrgico y el trabajo en equipo durante todo el procedimiento anestésico-quirúrgico son esenciales para reducir los eventos adversos y para identificar y tratar rápidamente las complicaciones.

**Palabras clave:** Atención perioperativa. Fasciotomía. Posicionamiento del paciente. Desbridamiento. Enfermería.

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## INTRODUCTION

Acute compartment syndrome (ACS) is defined as any increase in interstitial pressure within the bone-fascial compartment<sup>1</sup>. It affects 3.1 per 100 thousand inhabitants<sup>2</sup> and occurs because of different causes, the most common being traumatic injury, corresponding to 70% of cases<sup>3</sup>. Its risk factors include male sex, age under 30 years, well-developed muscles due to physical activities and fracture of the proximal tibia or diaphyseal<sup>1-4</sup>.

The diagnosis of ACS is based on clinical examination and confirmed by measuring intracompartmental pressure (ICP). ACS is characterized by an absolute ICP above 30 mmHg<sup>4</sup> or a difference of less than 30-40 mmHg between diastolic blood pressure and ICP, indicating impaired blood flow to the tissues<sup>5</sup>. It is considered a diagnostic and therapeutic emergency, given the risk of numerous complications, such as infection, nerve damage, delayed fracture healing and non-union of fractures<sup>1-4</sup>.

Hypertension in the muscle compartment impairs local microcirculation, leading to cellular anoxia and increased capillary permeability, giving rise to local edema<sup>1</sup>. This process takes place in a compartment surrounded by rigid structures, which do not expand, resulting in insufficient tissue perfusion and anoxia of the nerves and muscles that make up the compartment.

ACS occurs as a result of an increase in the volume of compartmental fluid or a decrease in compartmental space. If left untreated, a positive feedback loop occurs, with continued cellular swelling and interstitial edema, resulting in further elevations in ICP<sup>5</sup>. When it develops after surgical procedures, ACS is considered a complication that will result in unforeseen events for both the patient and the institution, one of which is prolonged hospitalization<sup>6</sup>.

Fasciotomy is the gold standard treatment for ACS. It consists in a surgical procedure in which the muscle fascia is cut to relieve pressure and treat circulatory loss, preventing tissue necrosis. However, if performed late, it can evolve into a local or systemic inflammatory response, disseminated intravascular coagulation and multiorgan failure, resulting from the release of large quantities of muscle necrosis products into the bloodstream<sup>7</sup>.

As this is an infrequent diagnosis and given the importance of preventing surgical complications, it is essential in perioperative nursing care that studies on adverse events (AE) in surgical centers (SC) are reported, discussed and disseminated in our area. Only through the dissemination of knowledge about the management of ACS cases, with a deeper understanding of its causes and consequences and

the identification of signs and symptoms, can the necessary care aimed at surgical patients be proposed.

## OBJECTIVE

To report a case of fasciotomy in the lower limbs (LL) after ACS.

## METHOD

This is a case report that occurred in a large public teaching hospital, with a highly complex care profile, which has 306 beds and 11 operating rooms, and which performs, on average, 800 surgical procedures per month. This study was organized in accordance with the recommendations of the Revised Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines, from the Equator Network.

Data collection from medical records was carried out using an instrument proposed by the authors, containing: age, marital status, profession, weight, height, body mass index (BMI), comorbidities, family history, type of surgical procedure performed, anesthesia used, intraoperative positioning, surgical procedure time, length of hospital stay in days. For the interview, a script was created in order to learn about the patient's history and confirm the data collected in the medical record.

The photographic records were taken with an iPhone10<sup>®</sup>, after registered authorization to disseminate the images for the purpose of teaching and research, signed by the patient. To this end, an informed consent form was signed.

The project was submitted to the Research Ethics Committee (CEP) of the Faculdade de Medicina do ABC (FMABC), in compliance with Resolution No. 466/12, of Brazil's National Health Council<sup>8</sup>, and was approved, according to Approval No. 4.440.115

## CASE DESCRIPTION

Female patient, 35 years old, 72 kg, white, married, born in São Paulo, administrative assistant, former smoker (12 years), who was admitted for elective surgery, via laparoscopy, for the treatment of deep infiltrative endometriosis, with the objective of performing the excision of endometriosis foci in the posterior compartment of the uterus, by videolaparoscopy and rectosigmoidectomy, with mechanical end-to-end colorectal anastomosis. Upon admission to the SC, a protocol

was applied to prevent venous thromboembolism, identifying low risk, not adhered to prophylaxis by the medical team, as it did not meet the score for the use of prophylactic enoxaparin sodium. She underwent general anesthesia combined with epidural block and indwelling bladder catheterization. She was positioned in a gynecological position with homemade cushions like sheets and pyramidal foam on the head, upper limbs (UL), LL, abdomen and chest. The procedure lasted approximately 9 hours. No evaluation or change in positioning was recorded, nor were any changes or complications during the anesthetic-surgical procedure.

After the anesthetic-surgical procedure, the patient was taken to the postanesthesia care unit (PACU), where she remained for 3 hours, presenting the first reports of pain complaints in LL, with intensity 10, according to a numerical scale, already in the first hour of PACU.

In the immediate postoperative period (IPO), in the hospitalization unit, she reported pain level 10, being medicated for pain but without improvement. The physical examination, carried out by the inpatient unit nurse, revealed pallor, sweating, impaired capillary refilling, edema and calf stiffness, in addition to a progressive increase in pain.

The nurse identified the possibility of an ACS and made telephone contact with the surgery team to share the physical examination and the suggestion to refer the patient to the imaging diagnostic service. After agreement from the surgical team, the patient underwent Doppler ultrasound of LL, which confirmed bilateral ACS.

After 21 hours of IPO, the patient underwent decompressive fasciotomy (DF) on her calves, with double incisions to release the four compartments. An enlarged incision was made in the skin, covering the subcutaneous tissue up to the muscle fascia, in its entirety, including all compartments that were involved, with the purpose of relieving compressed tissues and increasing muscle volume capacity, immediately reducing intracompartmental pressure and reestablishing adequate blood circulation.

The nurse who identified the ACS, as well as the stoma nurse, monitored the patient's dressings weekly, throughout the entire hospitalization period (45 days) and sequentially in the outpatient clinic of the service in question, totaling 15 months of postoperative (PO) treatment in the service's outpatient clinic.

## RESULTS

The patient was hospitalized for elective laparoscopic surgery to treat deep infiltrative endometriosis. Endometriosis

is a chronic inflammatory gynecological condition, often painful, characterized by the presence of tissue similar to the uterine lining (endometrium) outside the uterus, occurring mainly in the: pelvic peritoneum, rectovaginal septum, ovary, uterosacral ligament, rectum or colon<sup>9,10</sup>. Ectopic tissue can form lesions in these areas, causing chronic pain and other debilitating symptoms. Endometriosis has broad and widespread repercussions on women's health, which may have physical and/or mental consequences<sup>9</sup>.

## Diagnosis of acute compartment syndrome

ACS is characterized by an increase in pressure in this compartment, reducing capillary perfusion to below the basic level for tissue effectiveness, leading to microcirculation obstruction. Muscle fascia is inelastic; therefore, it makes it difficult to dissipate this increased pressure within the muscle compartment. If there is a delay in diagnosing and performing DF, ischemia generated by vessel obstruction may lead to permanent neuromuscular deficit<sup>7</sup>.

## Treatment of acute compartment syndrome

The patient was again referred to the SC (7 hours after ACS diagnosis) and underwent bilateral DF, with double incisions, to release the four compartments, as shown in Figure 1.

Sequential dressing changes after DF were performed in the SC and sometimes required other associated procedures.

A second DF was necessary, two days after the first, due to the evolution of the wound, with secretion draining. Despite reporting improvement in pain in one of the limbs, the patient remained with paresthesia and a feeling of heaviness in both limbs. Figure 2 shows the appearance of the lesion with the presence of sloughing after the second DF.

Four days after the second DF, the patient underwent DF enlargement, developing pain and edema in the lower limbs. Despite the improvement in dorsiflexion movement in the right foot and recovery of sensitivity in the left lower limb (LLL), she showed difficulty in dorsiflexion, decreased strength and lack of sensitivity. She was again referred to the SC, on the sixth and eighth day PO, for new expansions of the DF, associated with debridement of necrotizing fasciitis. On the 12th day PO, another surgical approach was necessary, performing lateral and medial DF. In LLL, the incision was enlarged to 30 cm, in the right lower limb (RLL), approximately 15 cm, with the implantation of an epidural catheter at the L3-L4 level, to relieve pain. After 14 days PO, surgical



**Figure 1.** Bilateral decompressive fasciotomy.



**Figure 2.** Sloughing after the second debridement procedure.

debridement was performed, with approximation dressing and placement of a Penrose drain in RLL and vacuum dressing in LLL, as shown in Figure 3.

Vacuum dressing changes were carried out on the 20th and 26th days PO of DF, and on the last change, the surgical wound was also sutured in the RLL, obtaining significant improvement of the lesions, after debridement and dressing changes (Figure 4).

On the 33rd PO day of DF, partial closure of the medial LLL wound was performed, with elastic suture of the lateral wound. The last procedure was performed on the 40th PO day, with debridement of the lesion, creation of an elastic suture and primary closure of the wound on the left leg. Figure 5 demonstrates the closure performed on the LLL wound.

The patient was discharged from hospital after 45 days of treatment, with continuing outpatient treatment.

## DISCUSSION

The global challenge, launched by the World Alliance for Patient Safety, of the World Health Organization (WHO), between 2007 and 2008, determined the basis for beginning to discuss safety in surgery<sup>11-13</sup>. The Brazilian Ministry of Health launched the “Safe Surgery Saves Lives” campaign, which aimed to encourage managers of hospital institutions, as well as health professionals, to mobilize efforts to create standards of surgical practices that promote safety in surgery<sup>11</sup>. The concept of “safe surgery” involves measures adopted to reduce the risk of AE, which can occur before, during and after operations<sup>11</sup>.

The WHO defines AE as any incident that results in harm to the patient<sup>12</sup>. The WHO assumes that 230 million surgeries are performed worldwide per year, with the occurrence of 7 million AEs — with 1 million patients dying<sup>12</sup>. It is estimated that there is potential for avoidance in half of the cases, in which surgery leads to injury — data that encourages the need to adopt systematic practices for safe patient care in the perioperative period<sup>12</sup>.

ACS is one of the preventable complications, through the implementation of protocols established for patient safety, improving assessment, as well as total care, according to the needs of each patient, guiding planning and promoting care<sup>14</sup>.

In Brazil, research carried out on surgical AE reinforces the need to evaluate indicators of surgical care. The study revealed that 26.2% of patients suffered more than one AE

during hospitalization and suggests that managers, surgeons and nursing team professionals evaluate the care process with the aim of proposing continuous improvement measures, given the avoidability of surgical AE<sup>12</sup>.

This understanding allows us to affirm that ACS — and many other AE — can be avoided when the available tools are applied appropriately. Adequate care management, carried out by nurses and the team in the operating room, combined with effective communication between surgeons, anesthesiologists and the nursing team, can minimize the risks of AE, including those related to patient positioning<sup>15,16</sup>.

Providing surgical positioning to minimize possible complications is the responsibility of the surgical team. Being considered nursing care, it must be directed to each patient, respecting their physiology and ensuring body alignment<sup>15,17</sup>.

Safe and comfortable positioning is a priority in surgery; therefore, ensuring that each operating room team member is aware of the scope of potential positioning issues will prevent

AE. Regarding adequate patient positioning, the Association of Perioperative Registered Nurses (AORN) recommends planning the surgical position, evaluating risks, needs and requirements, in addition to determining the regular intervals at which the patient's position should be reviewed<sup>15</sup>.

Perioperative nurses are the voices of patients and advocate best positioning practices; They are responsible for transmitting trust and ensuring the best possible care, protecting



**Figure 3.** Surgical wound with vacuum dressing — left lower limb.



**Figure 4.** Surgical wound before debridement (left) and after debridement (right).



**Figure 5.** Surgical wound with elastic suture at the distal end.

patients from injuries and possible litigation, should a post-operative injury occur<sup>18</sup>. Training and competency verification ensure that the perioperative staff understands how to correctly position patients while receiving information about positioning and procedures<sup>18</sup>.

The lithotomy position, used during the patient's first surgery in this study, is used for procedures that require transperineal access to the retropubic area; however, if the procedure is prolonged, there is a high incidence of LL compartment syndrome<sup>16</sup>. With the legs bent over the torso, compression of the thigh muscles can cause edema; As the muscle fasciae are not elastic, any edema puts more pressure on the muscle tissue, reducing perfusion and increasing ischemia — which can lead to necrosis<sup>16</sup>.

In surgical procedures, this risk may be greater depending on the patient's positioning and the prolonged surgery time<sup>19</sup>. The arterial perfusion pressure caused by the elevation of the LL above the level of the heart increases the pressure of the local compartment, caused by direct compression from the leggings and the weight of the limb on these supports<sup>20</sup>. In the case reported in this study, the surgery lasted 9 hours, with the patient unable to move her LL — which remained positioned in leggings due to the gynecological positioning<sup>20</sup>.

An AE like ACS is not easy to diagnose. This difficulty is accentuated during the intraoperative period and during anesthetic recovery, as anesthesia and residual anesthetic hide the symptoms of this syndrome<sup>21</sup>. In the case presented, the patient was diagnosed at the IPO, which led to relatively quick intervention.

Rapid diagnosis and immediate interventions are essential to minimize complications, such as paralysis, sensory deficits, multiple organ failure or limb amputation<sup>5</sup>. In this case, the intervention carried out, bilateral DF, took place the day after the diagnosis of ACS.

Tissue hypoxia and the consequent muscle necrosis, due to the high pressure within the compartments, require rapid action, with decompressive surgical intervention being the one that provides the most satisfactory results, compared to non-surgical treatment. DF is the surgery of choice for these cases<sup>22</sup>, presenting a high risk of developing infections, due to the fact that the surgical wound is kept open and its closure is progressive, with prolonged healing<sup>23,24</sup>.

In the present case, the patient required nine anesthetic-surgical procedures, involving expansion of the fasciotomy, debridement and dressing changes, which prolonged her stay at the institution by 6 weeks.

After applying different dressings to the patient, negative pressure wound therapy (NPWT) was implemented. NPWT is a broad term used to describe a unique and versatile system

that helps optimize wound healing by applying subatmospheric pressure to help reduce inflammatory exudate and promote granulation tissue<sup>25</sup>. It can be used to treat acute and chronic wounds, from open fasciotomy wounds and diabetic foot ulcers to closed surgical incisions<sup>25</sup>.

NPWT has undergone significant evolution since the first recorded application of this concept in the 19th century<sup>26</sup>. The description of this procedure was made by Argenta and Morykwas, in an article published in 1997, in which they reported a type of system that comprises a porous compress dressing over which a device to achieve a subatmospheric pressure of 125 mmHg below ambient pressure<sup>26,28</sup>.

This technique is mainly used to treat complex wounds that do not heal or are at risk of not healing. It has benefits, such as controlling the drainage of secretions and reducing local edema, in addition to promoting the development of granulation tissue<sup>27</sup>, thus reducing healing time and, consequently, hospitalization time. It also reduces the chances of major complications — as was the case with the patient presented<sup>27</sup>.

Although available evidence shows ambiguous results for wound healing, this wound care system has been widely implemented in closed wounds prone to dehiscence or infection secondary to exudate and localized inflammation<sup>26,28</sup>. This system has wide acceptance and is routinely implemented for open wounds, such as open fractures, fasciotomies, ulcers and infected wounds. It is usually performed in the operating room, as wounds generally require debridement and washing in a sterile environment<sup>26</sup>.

NPWT provided a positive result in the patient's treatment, improving granulation tissue and reducing exudation from the lesion. The involvement of the surgical and nursing teams was essential for the evolution of the wound, the minimization of complications and, consequently, the patient's discharge.

It is expected that reports of surgical AE cases will be published in a timely manner, to help with prevention and guidance in similar cases.

## CONCLUSION

ACS can be considered an AE in the intraoperative period, which may be due to surgical positioning. Good training of nursing professionals, commitment and teamwork throughout the anesthetic-surgical procedure are essential for reducing AE.

Adequate surgical positioning, with risk assessment, in addition to monitoring the patient's position throughout the procedure are factors that facilitate the taking of the

indicated corrective measures and assist in the implementation of interventions and repositioning when necessary.

In the case presented, the speed in identifying the ACS, as well as the knowledge and safety of the professionals when managing the case, were the difference in nursing care in the PO period — which may have minimized more serious complications in the patient studied.

It is necessary to disseminate knowledge about surgical patient safety and implement training programs for professionals who work in perioperative care, aiming to prevent AE and take rapid action after identifying complications related to this period.

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## CONFLICT OF INTERESTS

Nothing to declare.

## AUTHORS' CONTRIBUTIONS

SGL: Project administration, Formal analysis, Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing, Supervision, Validation, Visualization. CRFI: Project administration, Formal analysis, Methodology, Writing – original draft, Writing – review & editing, Supervision, Validation, Visualization. SDM: Formal analysis, Methodology, Writing – original draft, Writing – review & editing, Visualization. LLS: Conceptualization, Data curation, Investigation, Methodology. SSR: Conceptualization, Data curation, Investigation, Methodology.

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