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RESEARCH

Emergency interventions for air medical services trauma victims

Intervenções de emergência realizadas nas vítimas de trauma de um serviço aeromédico

Intervenciones de emergencia realizadas en las víctimas de trauma de un servicio aéreo médico

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ABSTRACT

Objective: to analyze emergency interventions for air medical services trauma victims, considering the time at the scene of trauma and the severity of the victims. **Method**: This was a descriptive, correlational and quantitative study, conducted from October of 2014 to December of 2015. Six nurses participated, completing an instrument containing emergency interventions performed in the care of victims after the occurrence of trauma. The sample consisted of 97 treatments. **Results**: Among the 97 for whom care was provided, peripheral venipuncture was performed in 97.94% of the cases; immobilization, including a backboard, was used in 89.70% of cases. The most commonly used medications were dipyrone in 44.33%, and ondansetron in 76.29%. The time on the scene showed significance with the severity of the victims. The Glasgow Coma scores were inversely related to time on the scene. **Conclusion**: Further studies are necessary, focused on care protocols for trauma victims
Descriptors: Emergency Medical Services; Wounds and Injuries; Aerospace Medicine; Nursing; Emergency Nursing.

RESUMO

Objetivo: analisar as intervenções de emergência realizadas nas vítimas de trauma de um serviço aeromédico, considerando o tempo na cena do trauma e a gravidade das vítimas. **Método**: estudo quantitativo correlacional descritivo realizado no período de outubro de 2014 a dezembro de 2015. Seis enfermeiros participaram do preenchimento de um instrumento contendo as intervenções de emergência executadas nos atendimentos às vítimas após a ocorrência de trauma. A amostra constitui-se de 97 atendimentos. **Resultado**: foram realizados 97 atendimentos, com destaque para a punção venosa periférica, realizada em 97,94% dos casos; imobilizações, tendo a prancha rígida sido utilizada em 89,70% dos atendimentos. Medicamentos mais utilizados foram Dipirona 44,33% e Ondansetrona 76,29%. Houve significância entre a gravidade das vítimas e tempo em cena. Os escores na Escala de Coma de Glasgow estão inversamente relacionados ao tempo em cena. **Conclusão**: sugerem-se estudos voltados para protocolos de cuidados para uma melhor abordagem do traumatizado.
Descritores: Serviços Médicos de Emergência; Ferimentos e Lesões; Medicina Aeroespacial; Enfermagem; Enfermagem em Emergência.

RESUMEN

Objetivo: analizar las intervenciones de emergencia realizadas en las víctimas de trauma de un servicio aéreo médico, considerando el tiempo en el escenario del trauma y la gravedad de las víctimas. **Método**: estudio cuantitativo correlacional descriptivo realizado en el periodo de octubre de 2014 a diciembre de 2015. Seis enfermeros participaron de un instrumento debidamente llenado, conteniendo las intervenciones de emergencia ejecutadas en la atención a las víctimas después de la incidencia de trauma. La muestra se constituye de 97 procedimientos. **Resultado**: fueron realizados 97 procedimientos de atención médica, con destaque para la punción venosa periférica, realizada en el 97,94% de los casos; inmovilizaciones, la

camilla rígida ha sido utilizada en el 89,70% de los procedimientos. Los medicamentos más utilizados fueron Dipirona 44,33% y Ondansetrona 76,29%. Hubo una significancia entre la gravedad de las víctimas y el tiempo en escena. **Conclusión**: se sugieren estudios direccionados a protocolos de cuidados para un mejor abordaje del traumatizado.
Descriptores: Servicios Médicos de Urgencia; Heridas y Traumatismos; Medicina Aeroespacial; Enfermería; Enfermería de Urgencia.

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INTRODUCTION

Assessment is the basis for all care and transport decisions regarding the trauma patient. The first goal is to determine the current condition of the patient, including respiratory, circulatory and neurological systems. Conditions that threaten life should be quickly assessed and emergency interventions and resuscitation should be initiated. Any other conditions that require attention must be identified and treated before transfer[1].

The prehospital care, in Brazil, is organized into two modes: Basic Life Support (BLS) and Advanced Life Support (ALS). The BLS consists of the preservation of life, without invasive procedures, in which persons trained in first aid provide care, working under medical supervision. In ALS, the procedures are more invasive and complex, and therefore the care is performed exclusively by physicians and nurses. Thus, nursing practice is focused on direct care of the critically ill patients, and the team members must remain capable and qualified for work in this health segment[2].

Helicopters are considered type E transport. They are rotorcraft used for inter-hospital transport of patients and rescue actions, equipped with medical equipment approved by the Department of Civil Aviation. The care provided by the flight crew is always considered to be ALS[3].

Aeromedical transport in Brazil had its first recorded operation in 1950, in the northern region of Belém, in Pará, with the creation of the Search and Rescue Service- SRS (Serviço de Busca e Salvamento - SAR). In 1988, the Emergency Rescue Team - ERT (Grupo de Socorro de Emergência - GSE), in Rio de Janeiro, continued this trend, impacting the Brazilian air medical service[4].

In Santa Catarina, the air medical service began in December of 2005, in a partnership between the Mobile Emergency Medical Services (Serviço Móvel de Urgência - SAMU) and the Federal Highway Police (Polícia Rodoviária Federal - PRF) by using the aircraft, Patrol 1. However, in January of 2010, this service obtained a new partnership, which continues today, between the SAMU and the Military firefighter corps of the State of Santa Catarina (Corpo de Bombeiros Militar do Estado de Santa Catarina - CBMSC) with a squirrel helicopter model, named Archangel 1[5].

This is the reference service in the state of Santa Catarina, as it is the only one with ALS staff, namely a crew consisting of a physician and nurse on board, with advanced equipment and life support materials.

Air transport requires a team with knowledge of flight physiology and changes that may occur with the patient, which is the basis for specific skills for care provision in the aerospace environment, both in fixed-wing aircraft (airplanes), and in the rotary wing aircraft (helicopters)[6].

These changes to which patients are exposed during the flight are called stress factors of flight, namely: hypoxia, dysbarism, humidity temperature, vibration, noise, accelerative and gravitational forces, luminosity, musculoskeletal overload, flight fatigue, and time zone changes[7-9].

Therefore, nursing interventions should be adapted to the conditions imposed by the aerospace environment[10]. The main concerns for assessment and care of patients with trauma are as follows, in order of priority: airway, ventilation and oxygenation, control of bleeding, perfusion, and neurological function. This sequence allows for oxygenation of the body and the ability for red blood cells to deliver oxygen to the tissues. Patient transport to the hospital depends on the rapid identification of injuries that can be fatal. Only essential procedures needed for sustaining life must be provided in the scene[1].

The aeromedical service of Santa Catarina, by means of the Archangel aircraft, reached the mark of 4,249 events occurred from January 20, 2010 to February 2, 2016. Among these, 2,095 (49.30%) were related to trauma (traffic accident, injury from firearm, drowning, poisoning, among others). Thus, it is necessary to enhance our understanding on trauma occurrences and emergency interventions provided by the air medical service team to trauma patients[5].Thus, the present study has as its research questions: What are the emergency interventions for aeromedical service trauma patients in Santa Catarina? What is the relationship of the time on site and the severity of trauma patients treated by this service? Then, the objective was to analyze the procedures performed for trauma patients in an aeromedical service, considering the time spent at the trauma site and the severity of patients.

METHOD

Ethical aspects

The study was approved by the Ethics and Research Committee of the Federal University of Santa Catarina. The ethical aspects followed Resolution 196/96 of the National Health Council (NHC)[11].

Design, study setting and period

This was a descriptive, correlational, quantitative study, conducted from October of 2014 to December of 2015, in the Airfield Operations Battalion (Batalhão de Operações Aéreas - BOA) of the state of Santa Catarina (SC), in Florianopolis. The service offers a model helicopter AS 350B Squirrel with ALS

equipment, crewed by a pilot, co-pilot, nurse, physician and an operating crewmember. The six nurses from the aeromedical service participated, completing an instrument containing the emergency interventions performed during the care of trauma victims.

Population and sample

To calculate the sample, a survey of the number of responses with the Squirrel AS 350B aircraft in the period from September 1, 2011 to August 31, 2012 was conducted, accounting for 772 occurrences. Among these, 313 were regarding patients with some kind of trauma; of these, 130 adults survived and were treated, rescued and transported[4]. The SestatNet, a computer program for teaching statistics via the internet, was used to calculate the sample size[12].

This research was conducted with a representative and sequential sample, calculated with a margin of error ± 5, and a 95% confidence level, which resulted in 97 trauma patients treated. It was a non-probabilistic, or convenience sample.

Inclusion and exclusion criteria

Inclusion criteria were any treated trauma patient (injuries, suicides, violence, vehicle collisions, pedestrian accidents, drownings, falls, electric shock, venomous animal bites, exogenous poisoning and burns), with age greater than or equal to 16 years, both sexes, who were rescued, treated and transported by the ALS helicopter AS 350B Squirrel of the SAMU/BOA service within the period of daytime activities. The exclusion criterion was the occurrence of death before the patient was inside the helicopter, as well as events in which there was no rescue and care at the accident site.

Data analysis and statistics

Data were uploaded into an electronic spreadsheet of the Excel® 2007 software. The descriptive statistical analysis presented the absolute and relative frequencies of the procedures performed during prehospital care. The time variable was considered as the time at the site (between arrival of the aircraft at the trauma scene and its departure, with the victim inside the helicopter). The patient's level of consciousness was studied using the Glasgow Coma Scale (GCS), which determines brain function and can predict the survival of the victim. The association between the discrete quantitative variables, time at the scene and the GCS score, was verified using the *Spearman* correlation.

RESULTS

In terms of respiratory interventions, a mask with an oxygen reservoir bag was the most used resource to administer oxygen, for 34 patients (34.02%), followed by oxygen by nasal cannula, used in 21 patients (21.65%), and endotracheal tube in 21 patients (21.65%).

Regarding the circulatory interventions, nine patients received care for cardiac arrest (9.28%). Of the cases treated, 60 patients (61.85%) did not experience bleeding. Of the 37 patients with bleeding episodes, 36 (37.11%) required compression dressings and direct compression, and in three patients (3.09%) a tourniquet had to be used.

Peripheral venipuncture for volume replacement or medication was the most common procedure, performed in 95 patients (97.94%). Fluid therapy with 0.9% saline solution was used in 84 patients (86.60%), followed by Lactated Ringer's, used in 39 patients (40.21%), and a hypertonic solution of 20% sodium chloride (NaCl) used in four patients (4.12%).

Regarding tube insertion, in 79 patients (81.44%) no insertion of any tube was required; 11 patients (11.34%) required orogastric tube insertion, and seven patients (7.22%) required an indwelling urinary catheter.

Immobilization was necessary and frequent, especially the use of a backboard in 87 cases (89.70%), and a cervical collar in 69 patients (71.13%), as shown in Table 1.

Table 1 – Emergency interventions performed in trauma patients, assisted by air medical service from October of 2014 to December of 2015, Florianopolis, Santa Catarina, Brazil

Procedures	n	%
Respiratory		
Did not require oxygen therapy	20	20.62
Oxygen by nasal cannula	21	21.65
Mask with oxygen reservoir bag	33	34.02
Endotracheal tube	21	21.65
Cricoidectomy	02	2.06
Circulatory		
No bleeding	60	61.85
Cardiopulmonary resuscitation	09	9.28
Compression dressing and direct compression	36	37.11
Tourniquet	3	3.09
Venous access		
Not needed	2	2.06
Peripheral venipuncture	95	97.94
Central venipuncture	-	-
Volume replacement		
Not needed	4	4.12
Saline solution	84	86.60
Lactated Ringer's Solution	39	40.21
Hypertonic sodium chloride	4	4.12
Tube insertion		
Not needed	79	81.44
Orogastric tube insertion	11	11.34
Nasogastric tube insertion	4	4.12
Indwelling urinary catheter	7	7.22
Immobilization		
Not needed	3	3.09
Cervical collar	69	71.13
Backboard	87	89.70
Splint	39	40.21
Kendrick Extrication Device – K.E.D.	3	3.09
Femoral traction splint.- FTS	5	5.15

With regard to the use of sedative and analgesic medications, dipyrone was administered in 43 patients (44.33%) and tenoxicam in 41 patients (42.27%). The antiemetic most often used was ondansetron, administered in 74 cases (76.29%), as demonstrated in Table 2.

Referring to the time variations on the scene related to GCS scores, 38 patients (39.17%) scored 13-15 on the GCS, with time on the scene between 21 and 40 minutes. Ten patients had a GCS score from 3-8 and the longest time on the scene; for five patients (5.15%), the time on the scene was 41-60 minutes, and for five patients it was greater than 61 minutes (Table 3).

To verify the association between the variables, time on the scene and assessment with GCS, Spearman's correlation using the raw scores was performed. The test result showed a significant correlation, with inversely proportional values, namely, greater GCS scores showed less time on the scene, and vice versa (r = -0.202470 and p value = 0.0233564).

Table 2 – Sedation/analgesia and antiemetics used for trauma patients requiring the aeromedical service from October of 2014 to December of 2015, Florianopolis, Santa Catarina, Brazil

Purpose	n	%
Sedation and analgesia		
Not needed	20	20.62
Dipyrone	43	44.33
Tenoxicam	41	42.27
Midazolam	23	23.71
Fentanyl	18	18.56
Morphine	17	17.53
Others	18	18.56
Antiemetic		
Not needed	20	20.62
Ondansetron	74	76.29
Metoclopramide	03	3.09
Dimenhydrinate	03	3.09

Table 3 – Air medical services time on the scene (in minutes), according to the Glasgow Coma Scale (GCS), from October of 2014 to December of 2015, Florianopolis, Santa Catarina

	Glasgow Coma Scale Score			
Time on the scene	15-13 n (%)	12-9 n (%)	8-3 n (%)	Total n (%)
≤ 20 min	20 (20.62)	- (-)	- (-)	20 (20.62)
21-40 min	38 (39.17)	2 (2.06)	8 (8.25)	48 (49.48)
41-60 min	16 (16.49)	2 (2.06)	5(5.15)	23 (23.71)
≥ 61 min	1 (1.03)	- (-)	5 (5.15)	6 (6.19)

DISCUSSION

Regarding the procedures, especially the advanced respiratory support, the endotracheal intubation in the prehospital environment after traumatic brain injury is controversial. A study conducted in the United States, with 200 patients, showed that in severe traumatic brain injury, endotracheal intubation was associated with a higher mortality rate, septic shock and increased length of stay in the intensive care unit, when compared to the use of the oxygen mask[13].

A patent airway is the first priority in the treatment and rehabilitation of trauma patients. An artificial airway is used when manual techniques fail to maintain an airway free of anatomical obstructions. Tracheal intubation is the best method for enabling ventilation with 100% oxygen, eliminating the need to keep the mask adjusted perfectly to the face, significantly reducing the risk of aspiration, facilitating deep tracheal suctioning, preventing gastric insufflation, and enabling an additional route for medication administration[1].

Other emergency interventions to be undertaken in the aerospace environment include cardiac and respiratory monitoring, pulse oximetry, and oxygen administration by mask to all patients with spontaneous breathing, due to hypoxia resulting from the altitude[14-15]. This hypoxia is defined as a reduced supply of oxygen to the tissues, necessary for cell metabolism.

In the atmosphere, four levels are identified that impose progressive degrees of hypoxia on the body, with consequent physiological changes according to the altitude. Little or no physiological change is observed between zero and 6,000 feet, except in cases of trauma, shock and pneumothorax. Without a compensatory mechanism, such as supplemental oxygen administration, the hemoglobin saturation, which is 98% at sea level, drops to 87% at 10,000 feet and 60% at 22,000 feet. Oxygen therapy is administered to patients with an increased risk of decompensation, as in cases of head injury, multiple trauma and severe burn[10,16].

These references corroborate the findings of this study, in which oxygen therapy with a mask with an oxygen reservoir bag was the most frequently used, followed by oxygen by nasal cannula, and endotracheal tube.

Fluid replacement in the prehospital environment for trauma patients remains controversial. Fluid therapy can reverse shock yet aggravate bleeding, increasing blood pressure and hemodilution. A study examined the effect of the volume of pre-hospital fluids on the shock index and blood transfusion, at the patient's arrival to emergency services. The conclusion showed that decision-making on fluid replacement is crucial and proved effective for up to one liter of volume, but it may be necessary to adapt to the situation of each patient[17].

Isotonic solutions of electrolytes, preferably heated, such as normal saline or Lactated Ringer's solution, are used for initial resuscitation and were the most commonly used in this study. These types of fluids provide intravascular transient expansion and further stabilize the vascular volume, replacing the loss of fluids into interstitial and intracellular spaces. An alternative initial fluid is a hypertonic saline solution, although the current literature does not show any advantage for survival[1]. In this study, it was used in four patients.

The rapid control of blood loss is one of the major goals in the care of trauma patients. Significant external bleeding must be investigated and controlled as directly as possible. Hemorrhage is the most common cause of shock in the trauma patient. The direct compression on the wound site increases extra luminal pressure, and thus reduces the transmural pressure (the difference of pressure inside and outside of the vessel), helping to reduce the bleeding. Even if the blood loss is not completely stopped, it can be decreased to the point at which the coagulation system can stop the bleeding.

Compression dressings can be used. The tourniquets, for example, control 80% or more of the external bleeding, occluding arterial blood flow, and is widely used by surgeons and orthopedic surgeons in the USA for many years with good results[1]. Although there a slight risk of part or all the limb having to be sacrificed, in choosing between losing a limb or saving the patient's life, the decision is to preserve life[1].

In this study, most patients (61.85%) showed no bleeding; however, in 37.11% of them, compression dressings and direct compression were necessary, while in three patients (3.09%), a tourniquet was used, as demonstrated by the literature.

During the pre-hospital call, the procedures performed influence the survival time of the victims, including: advanced respiratory procedures, external chest compressions, and use of medications related to cardiopulmonary resuscitation. In this study, patients received analgesic, sedative, and antiemetic medications, and dipyrone was administered in 43 patients (44.33%), followed by tenoxicam in 41 patients (42.27%). The treatment of pain in trauma patients involves both the physical pain as well as anxiety about the situation in which they find themselves. Sedatives control anxiety, and analgesics control the pain, especially morphine and fentanyl[1].

The most commonly used antiemetic was ondansetron, in 74 patients (76.29%). During the flight, antiemetics are used due to the action of gravitational, centrifugal and centripetal forces, present in several directions during transport by helicopters. Inside the helicopter, the patient in a lying position suffers from the phenomenon of motion sickness as he does not have a displacement reference, the vestibular system does not recognize linear movement or curves, which can cause nausea and vomiting and, depending on the degree of awareness, can lead to pulmonary aspiration.

Gastric distension must be alleviated or eliminated, prior to flight, by nasogastric tube, which must remain open. As the altitude increases, the gases contained in body cavities can expand, resulting in vomiting, and possible aspiration into the lungs[18-19].

In patients with suspected fracture of the skull base, a nasogastric tube is not an option, but orogastric tubes are used, due to the high risk of inaccurate placement during tube insertion[1]. The indwelling urinary catheter, in the aerospace environment, is inserted for better fluid control of the patient, preventing bladder distention due to altitude[18-19].

In this study, the majority of patients, 79 (81.44%), did not require tube insertion, but 11 patients (11.34%) had an orogastric tube inserted, and seven patients (7.22%) required an indwelling urinary catheter.

Immobilization, frequent in this research, is necessary both to minimize the possibility of further injury, as well as to reduce the level of pain. The head, neck, trunk and pelvis must be fixed, in a neutrally aligned position, in order to prevent any body movement that may result in spinal cord lesions[1]. In addition, this position facilitates the constant evaluation of the patient and minimizes the effects of gravitational forces resulting from the flight[14].

The time of call at the scene, and the GCS in this study showed that 38 (39.17%) patients had a GCS score of 13 - 15 points and a time on the scene of 21-40 minutes. The golden period is the critical time for care, and the recommended is eight to nine minutes between activation and arrival of the team to the crash site[1].

Research conducted to determine the effect of prehospital care time and different ALS interventions for trauma patients in Iran, showed that hospital mortality was more common in patients with severe injuries and longer periods of prehospital care. While the most seriously injured patients received ALS interventions and died, these interventions were associated with positive survival trends, when performed in locations distant from the trauma center[20].

Considering the pre-hospital transport, some studies have shown better results when emergency care is provided by air medical service in relation to the ground service. A study conducted in the USA, whose objective was to determine whether the mode of transport of adult trauma patients affected patient mortality, showed that the chances of death were 39% lower when transport occurred made by air service as compared to those transported by land[21].

Another study, conducted in Japan,[22] demonstrated that air transport may be associated with improved survival at time of hospital discharge, when compared to land rescue. Probably the combination of air rescue elements along with the high level of professional care is decisive in the survival of patients treated using this modality. Another study[23] points out that research studies that evaluated the survival of patients assisted by the air service had limitations in their samples and methods; however, invariably, to obtain any beneficial effect of aeromedical transport, a combination of speed, crew expertise, and willingness of reference centers to immediately refer patients is required.

From this perspective, the emergency interventions in the air medical services must be performed from the point of view of the need for implementing the procedures to prevent or correct physiological irregularities resulting from trauma. With regard to the results found in this study, even considering that the literature recommended a faster transport than the performance of procedures in the prehospital environment; this does not imply their contraindications. If the victim needs an early intervention and it is done promptly, it is considered a demonstration of the benefit obtained with pre-hospital care[24].

Study limitations

The limitations of this study are the unfamiliarity with the outcome of these patients (discharge, death and transfers) and the fact that we are dealing with a contextualized reality. Further

investigations are recommended with different populations to enable knowing the outcome of nursing interventions in the air medical services, and to compare the survival of patients regarding the air service in relation to ground transport services.

CONCLUSION

The procedures performed by the air medical services demonstrated the relevance of this type of care for trauma patients who required reduced time response, specific care for the environment, rapid transport, and definitive treatment in a shorter period.

Among the most common procedures, the oxygen mask with a reservoir bag was the most commonly used for respiratory care. Peripheral venipuncture for volume replacement or medications was the most frequent procedure, and saline was the most frequently used solution. The majority of victims did not present bleeding, but when necessary, a compression dressing, direct compression or tourniquet was used. Some tube insertions were necessary, and immobilization was common. Medications were administered in order to reduce pain and anxiety, and/or minimize effects of the aerospace environment.

A statistical significance between the severity of the victims and time on the scene was identified. Victims with better GCS scores had a lower time on the scene and vice versa, suggesting further studies related to prehospital team training to recognize the need for procedures for trauma victims, as well as the agility to meet the demands of their execution.

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