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ORIGINAL ARTICLE

Trauma teams: global reality and implementation in a developing country. Narrative description

Equipos de trauma: realidad mundial e implementación en un país en desarrollo. Descripción narrative

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Abstract

Introduction. Trauma is one of the entities with the highest morbidity and mortality in the world. Teams specialized in trauma patient care are called «trauma teams». These teams arose from the need to provide timely multidisciplinary treatment to individuals with severe injuries in war; however, with time they moved to the civilian arena, generating a positive impact in terms of care times, mortality and morbidity. The objective of this study was to describe the process of development of trauma teams worldwide and the experience in our institution in southwestern Colombia.

Methods. A search of the PUBMED database was carried out, which included systematic reviews, meta-analyses, Cochrane reviews, clinical trials, and case series.

Results. Forty-one studies were included for this narrative review, and it was observed that the length of stay in the ER, the time of transfer to surgery, mortality and complications associated with trauma were lower when trauma teams are implemented.

Discussion. The design of a horizontal care and assessment system for a patient with severe trauma produces a positive impact in terms of care times, mortality and morbidity. It is necessary to establish operational parameters in high and medium complexity health institutions in our country to implement such work teams.

Keywords: trauma centers; wounds and injuries; multiple trauma; trauma severity indices; advanced trauma life support care; hospital rapid response team; patient care team.

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Resumen

Introducción. El trauma es una de las entidades con mayor morbimortalidad en el mundo. Los equipos especializados en la atención del paciente traumatizado son llamados «equipos de trauma». Dichos equipos surgieron de la necesidad de brindar tratamiento oportuno multidisciplinario a individuos con heridas que condicionan gran severidad en la guerra; sin embargo, con el paso del tiempo se trasladaron al ámbito civil, generando un impacto positivo en términos de tiempos de atención, mortalidad y morbilidad. El objetivo de este estudio fue describir el proceso de desarrollo de los equipos de trauma a nivel mundial y la experiencia en nuestra institución en el suroccidente colombiano.

Métodos. Se realizó una búsqueda en la base de datos PUBMED, que incluyó revisiones sistemáticas, metaanálisis, revisiones de Cochrane, ensayos clínicos y series de casos.

Resultados. Se incluyeron 41 estudios para esta revisión narrativa, y se observó que el tiempo de permanencia en Emergencias, el tiempo de traslado a cirugía, la mortalidad y las complicaciones asociadas al trauma fueron menores cuando se implementan equipos de trauma.

Discusión. El diseño de un sistema de atención y valoración horizontal de un paciente con traumatismos severos produce un impacto positivo en términos de tiempos de atención, mortalidad y morbilidad. Se hace necesario establecer los parámetros operativos necesarios en las instituciones de salud de alta y mediana complejidad en nuestro país para implementar dichos equipos de trabajo.

Palabras clave: centros de trauma; heridas y traumatismos; índices de gravedad del trauma; atención de apoyo vital avanzado en trauma; equipo hospitalario de respuesta rápida; grupo de atención al paciente.

Introduction

According to the report "Injuries and Violence" issued by the World Health Organization, 10% of deaths worldwide are due to trauma, being within the first 10 causes of death and contributing 5.8 million deaths per year[1,2]. The main secondary causes of death due to external injuries are car accidents (24%), suicide (16%), falls (14%), and homicides (10%)[2]. According to the Situation Analysis in Health in Colombia (ASIS) in 2016, external injuries were the fourth cause of death in the Colombian population, causing 16.4% of deaths, with a high burden of disease both short and long term[3].

The management of the polytrauma patient is a great challenge, and given its impact on morbidity and mortality, during the War World I, the first teams of trauma care were created[4]. Those teams were focused on the management of the patient wounded in combat, to provide the immediate attention required to safeguard life, seeking to attend and transfer patients as soon as possible, to centers of greater complexity for its definitive care[4]. Subsequently, the trauma teams were transferred to the civil sphere, and nowadays, they are a fundamental part of world reference centers in the management of polytrauma patients. Several studies have shown the impact of the formation of trauma teams, decreasing attention times, morbidity and mortality[4-6].

The purpose of this article is to perform a narrative review about experiences and development of these teams worldwide and describe the experience in southwestern Colombia.

Trauma Teams Overview

Trauma teams are multidisciplinary groups whose objective is to provide an evaluation and timely management of polytrauma patients, provide timely resuscitation and prioritize management of those injuries that can threaten the life of the patient. They are usually composed of specialists in emergency medicine, anesthesiologists, surgeons, nurses, teams of the blood

bank and operating rooms, diagnostic images and logistical support[7,8].

Since the 1970s, the first legal guidelines lead the creation of current primary care protocols in trauma[9]. Despite this, only 20% of institutions have a trauma team to a hospital level[8,10].

There is a consensus that the resuscitation leader must be the specialist in emergency medicine or surgeon who attends the first call, supported by the anesthesiologist as an airway specialist, the nursing staff and the diagnostic imaging technician.

The team works following objectives and predefined roles for each member, addressed by the leader. Usually, the emergency medicine physician or the surgeon, is the one in charge of carrying out the initial assessment[7]. Similarly, they perform Focused Abdominal Sonography in Trauma (FAST) to determine the presence of any life-threatening injuries to the patient. The team also consists of two nurses, the first one in charge of vital signs monitoring and obtaining invasive blood pressure, when necessary, and the second is in charge of the preparation and supply of medications. Finally, the diagnostic images technician is in charge of taking the portable radiography equipment and to coordinate with the radiology unit for reading them[7].

It is important not to overload the number of people who respond to the trauma call; studies have shown that a large group does not improve team function, nor does it have a positive impact on outcomes of patients[11].

Studies have shown that the implementation of a trauma team improves outcomes in trauma patients in terms of mortality and morbidity[12-16]. This impact is especially appreciated in those patients with severe trauma. Petrie et al showed that patients with a revised trauma score (RTS) greater than 12 present better results with activation of a trauma team versus care provided by non-specialist personnel in trauma[17]. Cornwell et al recorded the time it took for a trauma patient to be taken from the emergency room to the operating room, to the Intensive Care Unit or to the observation room after the formation of a trauma team, finding a decrease from 84 to 52 minutes, from 197 to 118 minutes, and from 300 to 140 minutes, respectively, all with $p < 0.01$[18].

Likewise, Gerardo et al conducted a comparative study, before and after implementation of the trauma code in a level 1 trauma center, where they found a decrease in the overall mortality from 6% to 4%, and when patients were analyzed with an Injury Severity Score (ISS) greater than 25 points, it was observed a reduction in mortality from 30.2% to 22%[19]. Furthermore, it has been shown that when the activation of the trauma team is performed the care of patients with high rates of severity trauma (ISS> 15), travel time from the emergency room to surgery is less (170 versus 534 minutes, respectively), which in turn leads to a decrease in mortality and complications associated with trauma[20].

The presence of experienced surgeons in trauma has managed to reduce the hospital emergency room length of stay for trauma patients, both blunt and penetrating injuries. In addition, for the specific case of penetrating trauma, a decrease time for surgical interventions was achieved[21].

Criteria for trauma code activation

Different trauma groups have organized their trauma code activation protocols based on their own experiences or institutional protocols[7,12,15,22]; however, each activation criterion must be defined, and ideally validated, before its incorporation into the institutional protocol, with the objective of optimizing resources and identifying patients requiring intervention, without generating an over or under classification of patients[22,23].

The trauma center staff should be aware of the patient's clinical conditions at the trauma site through continuous information, issued by the prehospital care staff, in real time[12,24]. It works in that way in developed and more advanced health systems, where the communication system with prehospital health personnel is well structured, unlike our environment, where pre-hospital care systems usually are not articulated effectively with hospital care.

Franklin et al[25] based on prehospital variables, performed an analysis of 6976 trauma patients and

documented that patients presenting with hypotension at scene and managed to arrive with signs of life to level 1 trauma centers, had a mortality of 12%, compared to a mortality of 32% of patients who became hypotensive during their stay in the emergency department, without having presented hypotension in the prehospital area. Given these results, they conclude that prehospital hypotension remains a valid indicator for activation of trauma teams, including the presence of hypotension during the stay in the emergency department.

Dehli et al published in 2011 the evaluation of performance to detect surgeries o emergency procedures (need of orotracheal intubation, chest tube, hemostatic surgery in abdomen or pelvis with packing, thoracotomy, or primary stabilization of fractures with external fixation, showed an over-activation of 71% and an under-activation of 32% when assessed the ISS as an standard reference equal or greater than 15 points, data that is not very different when used as a standard reference for the need of emergency procedures, with over-activation of 71% and under-activation of 21%[26].

Lehmann et al[27] in 2007, made a validation of trauma activation criteria at the Madigan Army Medical Center in United States, and found that with the current application of the trauma code activation criteria there is an over-classification of 51% and a under-classification of 1%, and mortality of 0% and 7%, respectively. The presence of hypotension, respiratory distress and penetrating trauma to the torso were independently associated with the need for and emergency intervention.

In 2009, Kouzminova et al[28] analyzed the effectiveness of the activation of trauma code at two level 1 trauma centers, and found a statistically significant difference ($p < 0.0001$) between activation of major versus minor trauma in intubated patient in the emergency service (9.2% versus 0.1%), transfer to surgery rooms (12.1% versus 2.3%), admission to intensive care unit (17.6% versus 2%), admission for evaluation and neurological observation (11.6% versus 5.9%), discharge from the emergency department (18.7% versus 66%), death in the emergency department (2.6% versus 0%), and death during hospitalization (6.3% versus 0.1%), among others.

In 2010, Trudi Davis et al[29] conducted a prospective evaluation study and during 12 months they collected information from 1144 activations of trauma code, of which 41% were full activation (all trauma teams involving departments of emergency, surgery, anesthesiology, diagnostic imaging and others), and 52% were activation for consultations by the trauma group (involving only departments of emergency and surgery). At the institution where the study was conducted, the activation trauma code involved variables such as vital signs and major injuries, leaving as criteria for activation of trauma consultation the trauma kinematics variables and those patients without changes in vital signs or from major injuries. This operating model showed a sensitivity of 83%, 68% specificity, 3% under-classification and over-classification of 27%, with no evidence of deaths in the under-classification group of patients. Based on these results it was shown a relative reduction of almost 50% and of 33% absolute reduction, compared to the criteria of the American College of Surgeons for activation of trauma code[30].

Trauma in the world and in Colombia

Traumatic injuries carry 11% of the global death rate and represent 10% of the burden of disease associated with traumatic injuries events around the world[31]. Similarly, when the burden of disability and trauma-related mortality are analyzed globally, low- and middle-income countries, like Colombia, contribute 90% of this statistic. It is also relevant that is up to 6 times higher the probability of death of a trauma patient in low- and middle-income countries compared to high-income countries, reflecting the poor quality in terms of management and care of the trauma patient in these regions[32].

In Colombia, the main cause of death reported by DANE (Administrative Department of National Statistics) corresponds to ischemic heart disease, followed by cerebrovascular diseases, chronic respiratory diseases and, fourth, by injuries of external cause. Based on the information extracted

from DANE for year 2018, there were a total of 228,156 deaths, of which 27,669 (12.1%) were violent. The counties with the highest number of violent deaths registered were Antioquia (16.8%), Valle del Cauca (14.4%), and Bogotá (9.4%)[33].

Trauma team at the institution

Currently our Valle del Cauca county has few institutions with trauma teams, two of which are institutions of level III complexity and level 1 trauma centers, according to the international classification[34]. Additionally, these institutions keep records of trauma to obtain statistics that allows to know the operation of its services[35-38]. In 2016 Ordoñez et al studied the distribution of trauma in the city, based on records of these two institutions, and collected a population of 17,431 patients, of which 67% were men and the age group most affected was between 18 and 35 years old, with an average of 30 years. The most prevalent mechanisms of trauma were falls from height (37%), traffic accidents (12%), and injuries due to violence (24%); of the latter, firearm injuries were 35%, stab wounds 35.5%, and burns 10%. They also reported an overall mortality of this population of 2.5%, according to the injury severity score, ISS <15 points, 0.3%; ISS 15-24, 34%; ISS> 25, 64%[37,38].

In our institution, the trauma team was formed on September 1, 2015. This work team is made up of a specialist in Emergency Medicine, who is the leader of resuscitation and who has as the main role directing the patient's approach and performing the FAST. In parallel, the surgeon goes to the shock room when the trauma code is activated and is who, according to the hemodynamic, ultrasonographic and/or imaging findings, takes the surgical conduct of the patient.

There are two nurses as part of the team, one of them has the role of applying medications, assist in vascular access, and support the specialist in performing procedures. In turn, the other nurse verifies roles, withdraws personnel who is not perfoming any intervention, and supports the mobilization en bloc. In addition, there are 3 nurses assistants, one of them in charge of registering the code of trauma, and a respiratory therapist for airway support.

There are also Emergency Medicine residents and interns, who are in the resuscitation room providing support during the trauma code. Each one of the team members have assigned roles, which are described in a table located in the resuscitation unit in the emergency department (Figure).

Regarding the trauma team activation criteria, it is worth to mention that they arise from expert consensus[39]. In our institution, activation of the trauma code is performed with the fulfillment of at least one of the activation criteria (Table) and requires calling to a telephone extension designated for this purpose. Activation implies call to trauma and emergency surgery, portable diagnostic imaging equipment, blood bank, surgery rooms, logistical support services and security guards, who go to the resuscitation room for intervention (Figure). In the same way there is a telephone extension for transfusion package request. Once the type of injury is established, the patient is stabilized and defined his/her destination, the trauma code is closed.

Since the beginning of the trauma team in our institution on September 1, 2015, until September 25, 2019, has been treated 1305 patients; 85% were men, with an average age of 28 years. Approximately 45% were victims of penetrating trauma and the majority presented severe trauma, with a median ISS of 19 (range 11-26). Of these patients 47% required surgical intervention by emergency and trauma surgery department, and 66% underwent computed tomography of trauma. Mortality was 13%.

Conclusions

Design of a care and assessment system for patients with severe trauma produces a positive impact, in terms of care times, mortality and morbidity. Therefore, it is necessary to set the required parameters in high and medium complexity institutions in our country, to implement these work teams, in order to offer the best opportunities to our patients in emergency rooms, as well as to coordinate the mechanisms between prehospital

systems and hospitals of low and medium complexity, in order to expand the scope of these multidisciplinary groups, favoring that more patients benefit from such structured care, such as the one provided by trauma teams.

Compliance with ethical standards

Informed consent: The Institutional Ethics Committee approved the design and methodology of the study. This study is a review of the literature and registry of retrospective trauma, and as such there is no need for an informed consent.

Conflict of interest: The study authors declare no conflicts of interest.

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Author's contribution:
Conception and design of the study, acquisition of data and writing: Francisco Luis Uribe, Sandra Milena Carvajal. Analysis and interpretation of data, writing, critical review and final approval of the manuscript: Nicolás Felipe Torres, Luis Alfonso Bustamante, Alberto Federico García.

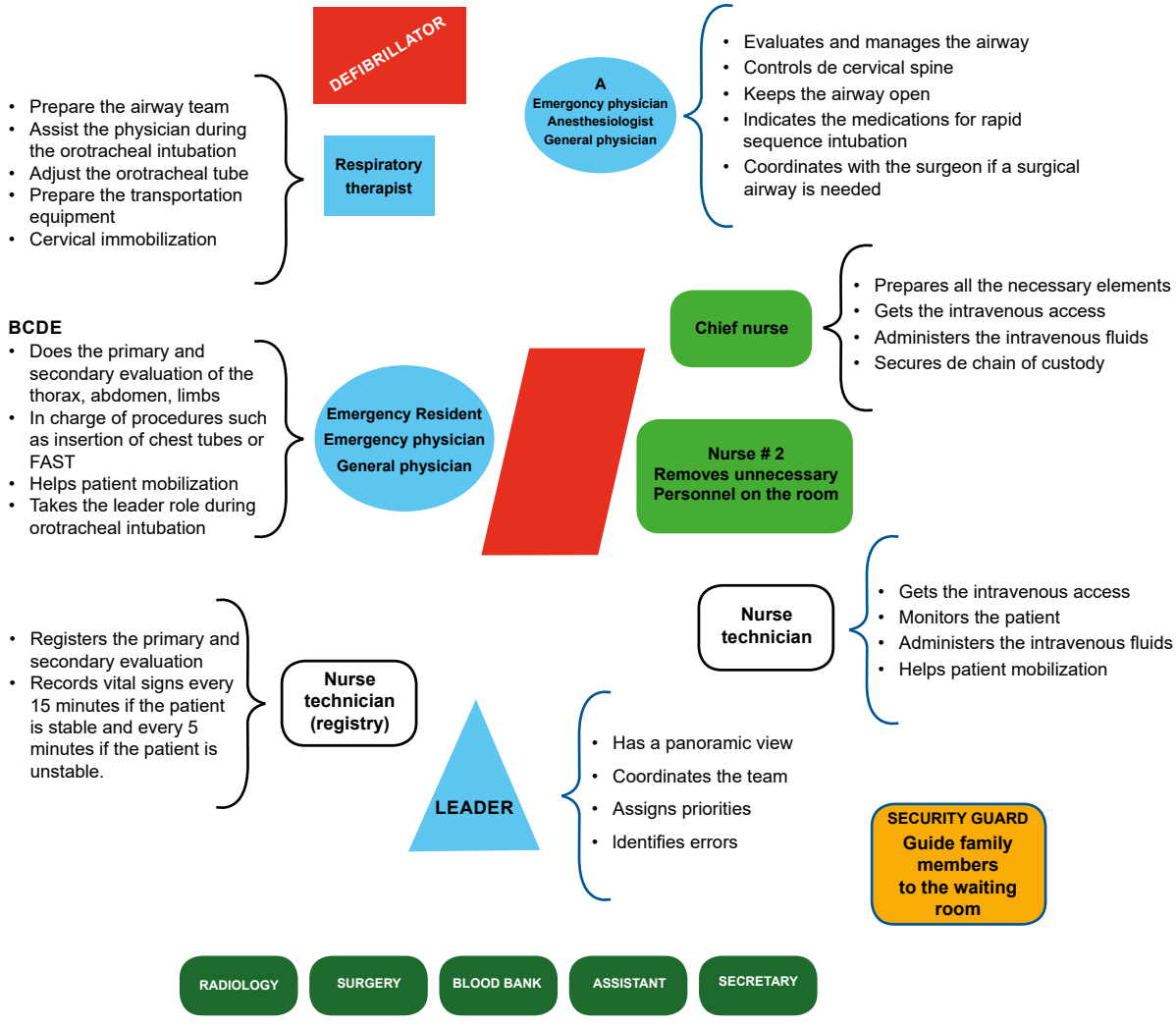

Figure. Organization of the trauma team. Clínica Fundación Valle del Lili, Cali, Colombia.

Table. Trauma Team Activation criteria. Clínica Fundación Valle del Lili, Cali, Colombia.

Trauma code activation criteria
Intubated patient
Dyspnea or respiratory failure
Hypotension - Systolic blood pressure (SBP) less than 90 mmHg
Glasgow coma scale lower than 9
Penetrating trauma to torso
Traumatic amputation
Unstable pelvic fracture
Patient previously operated on for trauma surgery
Multiple victims (2 or more at the same time)
At the discretion of who activates it

References

1. World Health Organization. The top 10 causes of death. WHO. 2017. Consult: may 7 2020. Available: http://www.who.int/mediacentre/factsheets/fs310/en/
2. World Health Organization. Injuries and violence. The facts 2014. Consult: may 7 2020. Available: https://apps.who.int/iris/bitstream/handle/10665/149798/9789241508018_eng.pdf
3. Ministerio de Salud y Proteccion Social. Análisis de Situación de Salud (ASIS) Colombia, 2016. Asis 2016. 2016:1-163 Consult: may 7 2020. Available: https://www.minsalud.gov.co
4. Celso B, Tepas J, Langland-Orban B, Pracht E, Papa L, Lottenberg L, et al. A systematic review and meta-analysis comparing outcome of severely injured patients treated in trauma centers following the establishment of trauma systems. J Trauma Acute Care Surg. 2006;60:371-8. https://doi.org/10.1097/01.ta.0000197916.99629.eb
5. West JG, Trunkey DD, Lim RC. Systems of trauma care. A study of two counties. Arch Surg. 1979;114:455-60. https://doi.org/10.1001/archsurg.1979.01370280109016
6. West JG, Cales RH, Gazzaniga AB. Impact of regionalization. The Orange County experience. Arch Surg. 1983;118:740-4. http:/doi.org/10.1001/archsurg.1983.01390060058013
7. Tiel Groenestege-Kreb D, Van Maarseveen O, Leenen L. Trauma team. Br J Anaesth. 2014;113:258-265. https://doi.org/10.1093/bja/aeu236
8. Georgiou A, Lockey DJ. The performance and assessment of hospital trauma teams. Scand J Trauma Resusc Emerg Med. 2010;18:66. https://doi.org/10.1186/1757-7241-18-66
9. Shah MN. The formation of the emergency medical services system. Am J Public Health. 2006;96:414-23. https://doi.org/10.2105/AJPH.2004.048793
10. Wong K, Petchell J. Trauma teams in Australia: a national survey. ANZ J Surg. 2003;73:819-25. https://doi.org/10.1046/j.1445-2197.2003.02782.x
11. Driscoll PA, Vincent CA. Variation in trauma resuscitation and its effect on patient outcome. Injury. 1992;23:111-5. https://doi.org/10.1016/0020-1383(92)90044-s
12. Adedeji OA, Driscoll PA. The trauma team - A system of initial trauma care. Postgrad Med J. 1996;72:587-93. https://doi.org/10.1136/pgmj.72.852.587
13. Hart N, Dasgupta S, Williams EW, Williams-Johnson J. Twenty-four hour trauma team at the University Hospital of the West Indies, Kingston, Jamaica--the time is now. West Indian Med J. 2012;61:211-3. https://doi.org/10.7727/wimj.2012.043
14. Gerardo CJ, Glickman SW, Vaslef SN, Chandra A, Pietrobon R, Cairns CB. The rapid impact on mortality rates of a dedicated care team including trauma and emergency physicians at an Academic Medical Center. J Emerg Med. 2011;40:586-91. https://doi.org/10.1016/j.jemermed.2009.08.056
15. Wuthisuthimethawee P. Trauma team activation criteria in managing trauma patients at an emergency room in Thailand. Eur J Trauma Emerg Surg. 2017;43:53-7. https://doi.org/10.1007/s00068-015-0624-7
16. Cherry RA, King TS, Carney DE, Bryant P, Cooney RN. Trauma team activation and the impact on mortality. J Trauma Inj Infect Crit Care. 2007;63:326-30. https://doi.org/10.1097/TA.0b013e31811eaad1
17. Petrie D, Lane P, Stewart TC. An evaluation of patient outcomes comparing trauma team activated versus trauma team not activated using TRISS analysis. Trauma and Injury Severity Score. J Trauma. 1996;41:870-5. https://doi.org/10.1097/00005373-199611000-00020
18. Cornwell E, Chang C, Phillips J, Campbell K. Enhanced trauma program commitment at a level i trauma center. Effect on the process and outcome of care. Arch Surg. 2003;138:838-43. https://doi.org/10.1001/archsurg.138.8.838
19. Illescas-Fernández GJ. Escalas e índices de severidad en trauma. Trauma. 2003;6:88-94. http://www.medigraphic.com/pdfs/trauma/tm-2003/tm033c.pdf.
20. Wang CH, Hsiao KY, Shih HM, Tsai YH, Chen IC. The role of trauma team activation by emergency physicians on outcomes in severe trauma patients. J Acute Med. 2014;4:1-5. https://doi.org/10.1016/j.jacme.2013.10.006
21. Khetarpal S, Steinbrunn B, McGonigal M, Stafford R, Ney A, Kalb D, et al. Trauma faculty and trauma team activation: impact on trauma system function and patient outcome. J Trauma. 1999;47:576-81. https://doi.org/10.1097/00005373-199909000-00028
22. Smith J, Caldwell E, Sugrue M. Difference in trauma team activation criteria between hospitals within the same region. Emerg Med Australas. 2005;17:480-7. https://doi.org/10.1111/j.1742-6723.2005.00780.x

23. Rehn M, Lossius HM, Tjosevik KE, Vetrhus M, Østebø O, Eken T and the Rogaland Trauma System Study Collaborating Group. Efficacy of a two-tiered trauma team activation protocol in a Norwegian trauma centre. Br J Surg. 2012;99:199-208. https://doi.org/10.1002/bjs.7794
24. Driscoll PA. Trauma: today's problems, tomorrow's answers. Injury. 1992;23:151-8. https://doi.org/10.1016/S0020-1383(05)80033-6
25. Franklin GA, Boaz PW, Spain DA, Lukan JK, Carrillo EH, Richardson JD. Prehospital hypotension as a valid indicator of trauma team activation. J Trauma. 2000;48:1034-9. https://doi.org/10.1097/00005373-200006000-00006
26. Dehli T, Fredriksen K, Osbakk SA, Bartnes K. Evaluation of a university hospital trauma team activation protocol. Scand J Trauma Resusc Emerg Med. 2011;19:18. https://doi.org/10.1186/1757-7241-19-18
27. Lehmann RK, Arthurs ZM, Cuadrado DG, Casey LE, Beekley AC, Martin MJ. Trauma team activation: simplified criteria safely reduces overtriage. Am J Surg. 2007;193:630-5. https://doi.org/10.1016/j.amjsurg.2007.01.017
28. Kouzminova N, Shatney C, Palm E, McCullough M, Sherck J. The efficacy of a two-tiered trauma activation system at a level I trauma center. J Trauma. 2009;67:829-33. https://doi.org/10.1097/TA.0b013e3181b57b6d
29. Davis T, Dinh M, Roncal S, Byrne C, Petchell J, Leonard E, Stack A. Prospective evaluation of a two-tiered trauma activation protocol in an Australian major trauma referral hospital. Injury. 2010;41:470-4. https://doi.org/10.1016/j.injury.2010.01.003
30. Centers for Disease Control and Prevention. Guidelines for field triage of injured patients. Recommendations of the National Expert Panel on field triage. Centres Dis Control Prev MMWR. 2012;61:1-21. https://doi.org/10.1542/peds.2009-0257
31. Aboutanos MB, Mora F, Rodas E, Salamea J, Ochoa-Parra M, Salgado E, et al. Ratification of IATSIC/WHO's guidelines for essential trauma care assessment in the South American region. World J Surg. 2010;34:2735-44. https://doi.org/10.1007/s00268-010-0716-9
32. LaGrone L, Riggle K, Joshipura M, Quansah R, Reynolds T, Sherr K, Mock C. Uptake of the World Health Organization's trauma care guidelines: a systematic review. Bull World Health Organ. 2016;94:585-98C. https://doi.org/10.2471/BLT.15.162214
33. DANE. Defunciones no fetales 2018 preliminar. Consult: may 12 2020. Available: https://www.dane.gov.co/ index.php/estadisticas-por-tema/salud/nacimientos-y-defunciones/defunciones-no-fetales/defunciones-no-fetales-2018
34. Trauma Center Levels Explained - American Trauma Society. Consult: may 22 2020. Available: http://www.amtrauma.org/?page=traumalevels.
35. Ordóñez CA, Pino LF, Tejada JW, Badiel M, Loaiza JH, Mata LV, Aboutanos MB. Experiencia en dos hospitals de tercer nivel de atención del suroccidente de Colombia en la aplicación del Registro Internacional de Trauma de la Sociedad Panamericana de Trauma. Rev Col Bras Cir. 2012;39:255-61. https://doi.org/10.1590/s0100-69912012000400003
36. Gelvez S, Ordoñez CA, Badiel M, Ramirez O, Pino LF, Garcia AF, et al. Evaluación de las escalas ISS y NISS en trauma penetrante grave. Rev Colomb Cir. 2009;24: 229-35.
37. Uribe A, Ordoñez CA, Badiel M, Tejada JW, Loaiza JH, Pino LF, Aboutanos MB. Tendencia del trauma en dos hospitales nivel IV en Cali, Colombia. Reporte preliminar en la plataforma del registro de la Sociedad Panamericana de Trauma (SPT/RT). Panam J Trauma, Crit Care Emerg Surg. 2012;1:175-181.
38. Ordoñez CA, Morales M, Rojas-Mirquez JC, Bonilla-Escobar FJ, Badiel M, Arana Miñán F, et al. Registro de Trauma de la Sociedad Panamericana de Trauma: Un año de experiencia en dos hospitales en el suroccidente colombiano. Colomb Med. 2016;47:148-54.
39. Aristizábal D, González G, Suárez JF, Roldán P. Factores asociados al trauma fatal en motociclistas en Medellín, 2005-2008. Biomédica. 2012;32:112-24. https://doi.org/10.7705/biomedica.v32i1.603