

Review Article

Emergency Thoracotomy. Indications, Surgical Technique and Results

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ARTICLE INFORMATION

Article history:

Received August 18, 2010

Accepted February 3, 2011

Keywords:

Penetrating heart wounds

Penetrating chest wounds

Emergency thoracotomy

A B S T R A C T

Emergency thoracotomy is a surgical technique that has been extended in the last few years, and is currently included in advanced cardiopulmonary resuscitation protocols. Despite its proven use in patients with penetrating heart wounds, it is often not used due to lack of knowledge of the technique. Currently, the increase in chest wounds due to violence, traffic accidents, crashes or suicides, and advances in extra-hospital medical care systems, has currently awakened new interest in this technique.

A review of emergency thoracotomy is presented in this article: indications, surgical technique, results, and its usefulness in the extra-hospital setting.

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Toracotomía de urgencia. Indicaciones, técnica quirúrgica y resultados

R E S U M E N

La toracotomía de urgencia es una técnica quirúrgica que se ha extendido considerablemente en los últimos años, y que se incluye en la actualidad dentro de los protocolos de reanimación cardio-pulmonar avanzada. A pesar de su contrastada utilidad en pacientes con heridas cardíacas penetrantes, en ocasiones no se utiliza por desconocimiento de la técnica, o de sus indicaciones. En la actualidad, el aumento de las lesiones torácicas por violencia, accidentes de tráfico, atropellos, o suicidios, y los avances en los sistemas de atención extrahospitalaria, han despertado nuevamente interés sobre esta técnica.

En este artículo se realiza una revisión de la toracotomía de urgencia: indicaciones, técnica quirúrgica, resultados, y su utilidad en ambiente extrahospitalario.

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Palabras clave:

Heridas cardíacas penetrantes

Heridas torácicas penetrantes

Toracotomía de urgencia

Introduction

The first thoracotomy performed to treat a penetrating cardiac injury was described by Ludwig Rehn in 1896,

an event that became one of the greatest milestones in the history of surgery. Although Rehn is referred to as the pioneer in almost all treatises on the history of medicine, the first surgeon who treated a cardiac tamponade was a Spaniard in 1801.¹ Emergency thoracotomy (ET) was initially

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described in 1874² as a resuscitation manoeuvre for performing open heart massage in cases of cardiopulmonary arrest (CPA). The technique, as it is currently known, was described in 1966 by Beall,³ which prompted its use despite disappointing neurological results. Moreover, the discovery of chest compressions⁴ and external defibrillation⁵ significantly decreased the use of the technique, relegating it to patients with cardiac injuries.⁶ In the second half of the 20th century, it garnered new interest thanks to its effectiveness in patients with open chest injuries, which were increasingly frequent due to the rise in social violence.³ Currently, it is normally applied according to each institution's criteria, and mainly in countries in which traumatic injuries are more frequent due to a greater degree of violence. In short, the current increase in trauma due to stab and firearm wounds, along with chest trauma from traffic accidents, pedestrian crashes and suicides, have once again aroused interest in ET, and its usefulness in certain clinical situations that threaten the patient's life. We propose a revision of the ET: indications, surgical technique, results and its usefulness in the prehospital environment, instead of performing an emergency transfer.

Objectives of Emergency Thoracotomy

The objectives of ET are: decompression of cardiac tamponade (CT), control of acute haemorrhage (intrathoracic or cardiac), control of bronchopleural fistulae, direct cardiac massage and occlusion of the descending thoracic aorta (for control of acute abdominal haemorrhages).

Cardiac Tamponade

Cardiac tamponade is the accumulation of blood (with sudden deterioration) or other fluids (more insidious) in the pericardial cavity, which causes diastolic dysfunction with decreased cardiac output and blood pressure (BP). The most frequent causes of acute CT are acute aorta dissection, left ventricular (LV) free wall rupture, traumatic rupture of the aorta and cardiac injuries. Diagnosis is always based on clinical findings. Beck's triad (jugular venous distention, decreased BP and muffled heart sounds)⁷ and Kussmaul's Sign or Paradoxical Pulse are non-specific signs that are difficult to evaluate in emergency situations. Low voltage tracings and pointed T-waves can be observed in the ECG by a pericardial rub. There are other non-specific but useful signs: psychomotor agitation, tachycardia, tachypnoea, hypotension, diaphoresis and cold extremities. It is essential that a CT not go unnoticed⁸ and should, therefore, always be considered in patients with chest trauma. In short, when faced with a CT situation, an ET is indicated for emergency pericardiotomy, haemopericardium drainage and examination of the epicardium.

Bronchovenous Air Embolism

Rupture of the pulmonary parenchyma and blood vessels may cause air emboli during intubation, promoting the entry of air into the coronary arteries. In these cases, ET facilitates

clamping the affected lung's hilum. Cardiac massage may promote the exit of air from the coronary arteries, although this tends to be a later finding.

Direct Cardiac Massage

This is performed with both hands and with the wrists together, avoiding pressure from the fingers, or with a hand directly in the LV.⁹ It is seldom used in open chest trauma and is ruled out in closed chest trauma and in non-traumatic CPA due to poorer results compared to chest compressions.⁴

Occlusion of the Descending Aorta

Finger occlusion of the descending aorta reduces infradiaphragmatic blood loss and improves heart and brain perfusion in cases where pericardiotomy does not improve patient haemodynamics.¹⁰ Total clamping of the aorta, widely used in various trauma protocols, is associated with poor outcomes,¹¹ although this does not preclude its use in certain situations.

Indications for Emergency Thoracotomy

ET is recommended in patients with penetrating cardiac injuries. By convention, a patient is considered to have a cardiac injury if they have a penetrating chest injury located between the right midclavicular line, the left anterior axillary line, below the clavicles and above the costal margins.

According to the practice guidelines of the American College of Surgeons Committee On Trauma (ACS COT) workgroup,¹² ET is indicated in patients with penetrating cardiac injuries who have some constant vital signs, provided that:

1. ET is performed shortly after the trauma in patients who have objective signs of life: pupillary response, spontaneous ventilation, carotid pulse, palpable blood pressure, movement of extremities and electrical activity in the ECG.
2. ET is performed in patients with penetrating chest injuries with no cardiac involvement, when it is not possible to discern whether or not there is cardiac damage. It is indicated in patients with injuries to the large abdominal vessels for occlusion of the descending thoracic aorta. In both cases, poor life expectancy is expected.

ET is not recommended for closed chest trauma due to poor neurological results, and is only performed in cases where the patient has vital signs and in those who have suffered a witnessed CPA. It has recently been suggested that the indications should be broadened to patients with open chest injuries who have been revived following a CPA, as long as this has occurred within 15 minutes. Furthermore, ET is indicated in patients with closed trauma and witnessed CPA as long as the CPA occurred in the last five minutes.¹⁰ In general, ET is contraindicated in patients with severe head trauma.

Surgical Technique

Anterolateral ET (Figure) is performed through an incision beginning at the sternum, continuing below the nipple and describing a curve towards the axilla (along the curvature of the ribs). The incision is firm and deep in order to reach deep layers with a single stroke. If the patient's clinical situation permits it, the fifth intercostal space is located by counting the ribs, although in extreme emergencies the incision is advanced to the pleura through the first intercostal space found (either the fourth or fifth). Access is always made above the costal margin of the lower rib for the chosen space to avoid damaging the neurovascular bundle. Not all bleeding points of the incision will be considered since the patient is at low output (or even cardiac arrest) and does not present a catastrophic haemorrhage risk.

The parietal pleura is sectioned (scalpel or scissors) and the lung is moved downwards to avoid lacerations. The pleurotomy is extended a few centimetres further than the ends of the skin incision allow. Finochietto spreaders are placed and the lung is searched for air leaks and haemorrhages, which are controlled using haemostatic clamps. If there are large air leaks or massive haemorrhaging, the entire pulmonary hilum is clamped directly with a clamp or manually. The lung is retracted (i.e., towards the table). The aorta is occluded if deemed necessary.

The pericardium has a colour between ochre and pearly white under normal circumstances, and blue-violet for cases

of haemorrhaging. It should always be opened even when injuries are doubtful. The incision is made 1cm above and parallel to the phrenic nerve (and extended in the craniocaudal direction), ideally with the prior touch of a scalpel and extended with scissors. If there is a cardiac injury, an undetermined amount of blood will appear in the surgical field. "Arterial" blood indicates rupture of the aorta or injuries in the pulmonary veins, left atrium or left ventricle. "Venous" blood indicates lesions in right side cavities, pulmonary artery or vena cava.

Whenever the severity of the patient's condition permits, silk sutures are recommended for resuspension of the pericardium before examination of the heart. Possibilities: incised or anfractuous injuries in cardiac cavities and/or coronary arteries, coronary air embolism, laceration of large vessels. If there are no abnormalities, the surgeon should not overlook the possibility of a contralateral haemopneumothorax.

Bleeding epicardial injuries that do not involve coronary arteries should be immediately finger occluded. Sometimes clots on the surface may mask underlying injuries, especially in the right ventricle (RV) (lower pressure chamber). The epicardium suture can be performed with any type of suture, including a skin stapler, a fast and effective measure that also avoids accidental punctures, especially useful in potentially infected patients.¹³ Regardless, risky manoeuvres should be avoided in patients with potential risk of infection. In addition, CT evacuation and injury occlusion are often sufficient for stabilising the injured patient. A Foley catheter

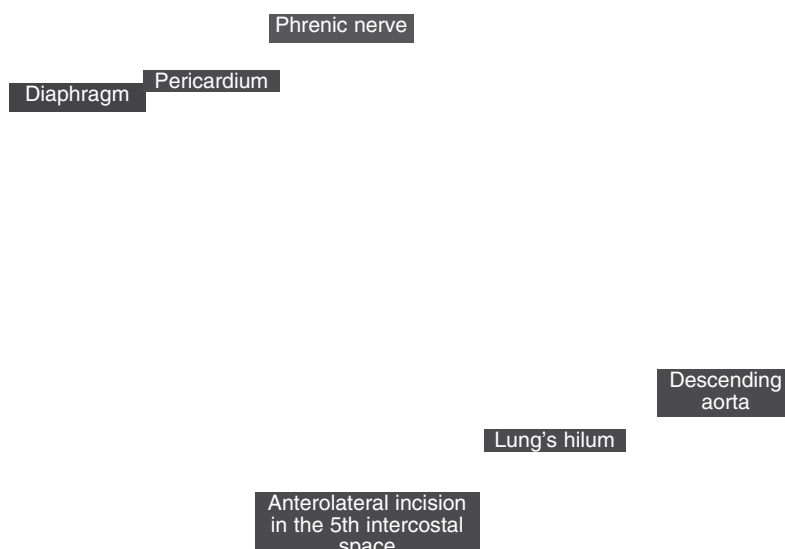


Figure 1 – Structures involved in the anterolateral incision in emergency thoracotomy.

can be used inside the wound occluding the defect after filling the balloon. When faced with a cardiac injury with coronary artery involvement, it is recommended to perform a suture that passes through the myocardium below the artery to avoid its occlusion, using U sutures supported by Teflon.

In the event that this is performed outside the hospital, transporting the patient would be preferable, occluding the injury with a finger instead of fruitless attempts at suture, which may cause tearing.

Review of Literature

Material and Methods

To analyse the results of published ETs, a literature search on MedLine was performed using the following key words: penetrating heart injuries, penetrating chest trauma, penetrating cardiac injuries, emergency department thoracotomy, urgent thoracotomy, resuscitative thoracotomy, neurologic outcomes. Articles were excluded that related to combat wounds, ETs not performed in the hospital emergency department recovery rooms and those with series of less than 70 interventions. A total of 30 articles were found. To assess the study of total survival and survival depending on whether the chest trauma was open or closed, 21 articles were selected that analysed both variables (open and closed trauma)¹⁴⁻³⁴ (Table 1). Articles were selected that clearly analysed cardiac injuries that were penetrating

(12 articles)^{20,27,29,31,33-40} (Table 2). We calculated total survival, survival according to main cause of injury (stab or gunshot wound), survival according to the number of injuries (single or multiple), the presence or absence of signs of life (SOL) on arrival: pupillary response, spontaneous ventilation, carotid pulse, blood pressure, movement in the extremities and/or electrical activity in the monitor. Survival in patients with concomitant abdominal and large vessel injuries was also analysed as well as the most frequent location of heart injuries (Table 4).

Results

In the articles analysed, 5986 patients subjected to ET are described, of which 431 (7.2%) survived. Twenty-seven patients (0.4%) suffered neurological abnormalities at the time of discharge. The survival rate for penetrating chest trauma was 10.1% (398 patients out of 3937) and 1.7% (36 patients out of 2049) for closed chest trauma (Table 1). Total survival for patients with penetrating cardiac injuries subjected to ET was 12.5% (229 patients out of 1832). Depending on the injury mechanism (stab or gunshot wound), survival was 28.5% and 7.9%, respectively (Table 2). Taking into account the number of injuries, 23.9% survived with single injuries and 6.1% survived with multiple injuries. Given the presence of SOL when evaluating the patient, survival in the group of patients with SOL was 33.2%, compared to 8.1% observed in the group of patients without SOL subjected to ET (Table 4). The survival of patients with cardiac injuries associated with injuries in

Table 1 – Total Survival in Patients Operated on for Emergency Thoracotomy.

Reference	Year	Survival of Patients Subjected to ET		Patients With Neurological Involvement	Survival for Penetrating Chest Trauma		Survival for Closed Chest Trauma	
		n/ET	%	n	n/ET	%	n/ET	%
Matttox ¹⁴	1974	11/106	10.3	0	8/87	9.1	3/19	15.7
Moore ¹⁵	1979	12/146	8.2	4	11/98	11.2	1/48	2
Baker ¹⁶	1980	32/168	0.1	2	31/108	28.7	1/60	2
Cogbill ¹⁷	1983	16/400	4	4	15/205	7.3	1/195	0.5
Shimazu ¹⁸	1983	6/267	2.2	2	4/50	8	4/217	1.8
Danne ¹⁹	1984	10/89	11.2	1	10/60	16.6	0/29	0
Matttox ²⁰	1985	50/119	42	0	50/119	42	1/3	33.3
Feliciano ²¹	1986	28/335	8.3	1	25/280	8.9	3/53	5.6
Ordog ²²	1987	6/80	7.5	1	5/64	7.8	2/16	12.5
Baxter ²³	1988	29/632	4.5	0	22/313	7	7/319	2.1
Clevenger ²⁴	1988	3/72	4.1	0	3/41	7.3	0/31	0
Hoyt ²⁵	1989	33/113	29.2	0	33/74	44.5	0/39	0
Esposito ²⁶	1991	2/112	1.7	1	1/24	4.1	1/88	1.1
Ivatury ²⁷	1991	16/163	9.8	0	16/134	11.9	0/29	0
Lorenz ²⁸	1992	41/424	9.6	4	37/231	16	3/193	1.5
Durham ²⁹	1992	32/389	8.2	0	32/318	10	0/69	0
Mazzorana ³⁰	1994	10/273	3.6	0	10/252	3.9	0/21	0
Velmahos ³¹	1995	43/855	5	0	42/679	6.1	1/176	0.5
Brown ³²	1996	4/160	2.5	0	4/149	2.6	0/11	0
Branney ³³	1998	41/ 868	4.7	7	33/483	6.8	8/385	2
Asensio ³⁴	1998	6/215	2.7	0	6/167	3.5	0/48	0
Total		431/5986		27	398/3937		36/2049	
Mean, %			7.2	0.4		10.1		1.7

Number of patients with neurological involvement at discharge and survival taking into account whether the chest trauma was open or closed. Three patients had combined injuries.

Table 2 – Survival of Penetrating Cardiac Injuries.

Reference	Year	Total		According to Mechanism, %	
		n/ET	%	Stabbing	Gunshot
Rohman ³⁵	1983	24/91	26.4	31.6	16.1
Mattox ²⁰	1985	50/119	42	59	22.2
Ivatury ³⁶	1987	28/118	23.7	16.3	3.9
Ivaturi ²⁷	1991	12/56	21.5	24.5	4.7
Durham ²⁹	1992	18/135	13.3	17.8	7.8
Henderson ³⁷	1994	6/122	4.9	-	-
Velmahos ³¹	1995	13/108	12	8.3	4.5
Asensio ³⁴	1998	10/71	14.1	65	16
Branney ³³	1998	33/483	7	14	4
Tyburski ³⁸	2000	12/152	8	20	0
Molina ³⁹	2008	8/94	8.5	33.3	4.9
Seamon ⁴⁰	2009	15/283	5.3	24.2	2.8
Total		229/1832			
Mean, %			12.5	28.5	7.9

Total survival for patients operated on for emergency thoracotomy due to penetrating cardiac injuries, and depending on injury mechanism (stabbing or gunshot wound). Series with less than 70 patients were excluded, as well as those that did not specify whether or not the injuries were penetrating.
ET indicates emergency thoracotomy.

large vessels and abdominal injuries was 8.4% and 16.2%, respectively. Cardiac injuries were most frequently located in the LV, with a mean of 32.3%, followed by RV (30.8%) and atria (17.4%) (Table 4).

Discussion

Overall, the analysis of the literature suggests that the U.S. has the most experience in this type of procedure (probably due to its higher rate of violence), and that the patient profile is that of a young male with multiple gunshot wounds.^{37,39} This resuscitation manoeuvre is not well established in

the rest of the world and there are few centres that have performed this procedure. This situation may be due to a lower legal tolerance towards gun ownership,⁴¹ or due to a greater lack of initiative in situations of extreme severity, or perhaps to the lack of preparation of physicians who work in emergency departments. Moreover, the heterogeneity of clinical indications of hospitals regarding their use makes it difficult to obtain a consensus in this regard.¹² The general belief is that this is an aggressive and desperate manoeuvre with poor results, which may cause the patient to go into a vegetative state. This situation does not correspond with reality, as has been observed in the analysis of selected series. ET has an overall survival of 7.2%, which is even greater in patients with penetrating chest trauma (one in ten survive) when compared to closed chest trauma (1.7%), and only 0.4% of patients have severe neurological abnormalities at discharge (Table 1).

Penetrating cardiac injuries are the most studied in the literature, perhaps because they are the most striking or because this type of injury leaves no doubt that ET needs to be performed. Overall results are better (12.5% survival rate), with puncture wounds due to knives having better prognosis (one in every four patients survive) when compared to gunshot wounds, which tend to be more harmful in its trajectory and have a mortality higher than 80%. Similarly, multiple injuries have a mortality approaching 85%, regardless of the type of weapon used, compared to single injuries in which almost 25% of patients survive (Table 2, Table 3).

Contrary to expectations, the most affected cardiac cavity was the LV followed by the RV (32.3% and 30.8%, respectively), although with minimal differences. This result may be attributed to the fact that the location depends on the type of weapon, the trajectory and the number of impacts, which varied significantly in all series and was not always analysed. On the other hand, if the penetrating cardiac injuries were associated with injuries to the large vessels, survival was lower (8.4%). This variable, as well as the results of concomitant abdominal injuries (with a 16% survival rate),

Table 3 – Survival for Penetrating Cardiac Injuries According to the Number of Injuries and Presence of Signs of Life.

Reference	Year	According to No. of Injuries, %		According to SOL, %	
		Single	Multiple	Present	Absent
Rohman ³⁵	1983	36	17	32	0
Mattox ²⁰	1985	-	-	-	-
Ivatury ³⁶	1987	-	-	73	29
Ivaturi ²⁷	1991	20.7	4.8	33.3	18.6
Durham ²⁹	1992	-	-	-	-
Henderson ³⁷	1994	-	-	41.6	0.9
Velmahos ³¹	1995	16	0.2	5.9	0.7
Asensio ³⁴	1998	-	-	69	9.9
Branney ³³	1998	-	-	12	2
Tyburski ³⁸	2000	49	12	27	12
Molina ³⁹	2008	17.6	2.2	33.3	3.8
Seamon ⁴⁰	2009	4.5	0.7	5.7	4.8
Mean, %		23.9	6.1	33.2	8.1

Survival of patients subjected to emergency thoracotomy, taking into account the number of injuries (single or multiple) and the presence or absence of signs of life (SOL) upon arrival at the emergency department. Series with less than 70 patients were excluded as well as those that did not specify whether or not the injuries were penetrating.

Table 4 – Survival of Emergency Thoracotomy in Patients with Injuries Associated With Large Vessels and Abdomen

Author	Year	Survival of Patients With Associated Injuries, %		Most Frequent Location of Penetrating Cardiac Injuries, %		
		Abdominal	Large vessels	RV	LV	Atria
Rohman ³⁵	1983	44.4	-	36	25	8.3
Mattox ²⁰	1985	-	-	-	-	-
Ivatury ³⁶	1987	-	-	-	-	-
Ivaturi ²⁷	1991	0	-	27.5	34.4	29.3
Durham ²⁹	1992	6.3	14.1	28.1	59.2	0
Henderson ³⁷	1994	-	6	18.2 ^a	18.5 ^a	16.6 ^a
Velmahos ³¹	1995	6.8	-	-	-	-
Asensio ³⁴	1998	-	-	24.5	37.1	12.3
Branney ³³	1998	7.3	2.7	-	-	-
Tyburski ³⁸	2000	-	10	50	32	50
Molina ³⁹	2008	-	-	24	20	9
Seamon ⁴⁰	2009	-	3.4	38.2	32.5	13.8
Mean, %		16.2	8.4	30.8	32.3	17.4

Most frequent location of penetrating cardiac injuries (in some cases there are multiple cardiac injuries).

ET indicates emergency thoracotomy; LV, left ventricle; RV, right ventricle.

^aSome patients were not subjected to ET.

was not analysed by most authors and therefore these results should be considered with caution. A more detailed study of the series published by Rohman et al³⁵ (with 44% survival in cardiac injuries with associated abdominal injuries) reveals a group with joint injuries in the diaphragm and abdomen with no indication of the number of patients with exclusively abdominal injuries. If this study is excluded, we would have a 5.1% survival rate, similar to other previously published studies^{27,42} in which the survival of exclusively abdominal wounds is between 4% and 4.5% (Table 4). Purely penetrating chest injuries were difficult to analyse in this review because they were not reported in most series.

In general, almost all authors agree that a penetrating injury (with no cardiac involvement) or with involvement of large vessels, in which a transfer is performed quickly, allows for relative haemodynamic stability and a subsequent thoracotomy in the operating room with appropriate care and asepsis.

One of the most important variables in patient prognosis is the presence or absence of SOL during the examination (Table 3). In the series analysed, the survival rate for those with SOL was 33.2% (one in three), compared to those with no SOL (8.1% survival). This difference depends significantly on the time elapsed between the accident and the ET. The rapid assessment of patient severity by medical personnel or law enforcement, and the subsequent immediate transfer, seem to play a crucial role in the final outcome. One should take into account that it takes some time to perform the diagnosis and understand the severity of the situation. For example, Beck's Triad,⁷ presumably of great value in the first assessment, is rarely observed in patients in acute situations when caused by CT.⁴³ Moreover, initial medical care often uses "flooding" colloids, which rapidly increase patient blood volume, facilitating an increase in pressures and masking the actual haemodynamic situation. External compressions are not effective for haemorrhage, tamponade and tension pneumothorax, and do not achieve an increase

in pressure in the intrathoracic cavity for severe chest injuries. Infusion with adrenaline bolus will only enhance inotropism in healthy hearts, increasing systemic pressures and promoting haemorrhage. It has been shown that survival of patients with penetrating chest injuries improves if the patient is transferred immediately, instead of attempting stabilisation at the scene of the accident.⁴⁴ A recent study shows that mortality is higher in patients transferred by external emergency medical personnel compared to those transferred by police or firefighters, who presumably made no attempt at stabilisation.⁴⁵ Moreover, some studies have demonstrated that the average time in minutes needed to travel the distance between the scene of the accident and the hospital for patients who survive was half (five minutes) that of those patients who died,^{29,39} although another published study did not reach the same conclusions.³³

In short, the use of ET and its potential usefulness (including cost/benefit) is an old debate in literature. Some authors believe that the low survival rate makes the cost unjustified, while others claim that no price is too high when trying to save a life.⁴⁵ Regardless, the analysis of published studies to date shows the effectiveness of ET when performed according to the practice guidelines of the American Surgery Society, for situations where the alternative is certain death.⁴²

On-Scene Emergency Thoracotomy

As we have shown, a crucial factor in survival is the reduction of time between the event and the ET, and therefore a thoracotomy would seem to make sense within current resuscitation techniques. The first prehospital ET was performed 15 years ago on a stabbing victim treated by a surgery resident who worked in an advanced life support ambulance. Given the agonising situation of the patient, the surgeon performed a thoracotomy, cleared the pleural clots, opened the pericardium, finger compressed the descending

aorta and thus saved the victim's life.⁴⁶ Years after this event, the first ET performed in Europe was reported⁴⁷ while the first ET performed in Spain was in 2006.

The use of on-scene ET is indicated in two situations: tension haemothorax and CT. It must be performed in the first five minutes after the event, extending to 10 minutes if intubation is one of the CPR manoeuvres.²⁹ Nevertheless, the age of the patient must be taken into account, along with their associated diseases, conditions at the scene of the event and the availability of necessary minimum resources. Performing resuscitation manoeuvres on patients with bleeding injuries may be harmful³⁹ since controlled hypotension produces less haemorrhaging and facilitates coagulation. Aggressive CPR, with excessive fluids and inotropic and/or vasopressor drugs, will cause increases in BP and blood volume, but may also cause rapid blood loss.⁴⁸ It is likely that under situations of haemorrhage due to penetrating chest trauma, performing an ET presents a clear benefit over the excessive use of fluid infusions.⁴⁸

The technique does not differ much from that described previously, although certain conditions must be present: there is no favourable or sterile environment, the most appropriate materials are not available and the medical personnel located on site do not have the minimum experience necessary. The procedure must never be attempted with the victim on the ground. The patient must be placed on the stretcher where the patient will stay in the supine decubitus position with the left hemithorax properly positioned. Before starting, the hospital should be advised about the manoeuvre to be performed, and certain functions will be assigned to each of the medical personnel present. Unless there is a sound diagnosis of CT or tension haemothorax, rapid transport is recommended avoiding fruitless stabilisation manoeuvres as much as possible. If carried out, urgent transfer once again becomes a priority, especially in the event of non-sutured penetrating injuries in which the doctor's fingers occlude the haemorrhage.

Conclusions

In summary, there are variables that clearly affect the prognosis of patients subjected to ET:

- Knife wounds and penetrating injuries have better prognoses than those caused by firearms^{37,39,40} and non-penetrating injuries,^{39,42} respectively.
- Multiple injuries have greater mortality.³⁸
- Survival is greater for cardiac injuries compared to chest injuries. Abdominal injuries have a worse prognosis.⁴²
- The presence of SOL^{39,42}, and the time between CPA and the start of ET influences survival.⁴⁹
- The presence of CT³⁸ and the absence of other injuries in the large vessels⁵⁰ improve the prognosis.
- Immediate transport increases chances of survival.^{29,39}

Conflict of Interest

The author declares that he has no conflict of interest.

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