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Research Article

Place of Atropine and Vasoactive Drugs in Hemodynamic and Rhythmic Complications of Cervical Spine Trauma

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Abstract

Objectives: The aim of this work is to demonstrate the importance of the earliest atropine's introduction and vasoactive drugs as preventive therapy for the occurrence of hemodynamic and rhythmic complications, which most often severely hamper the prognosis of cervical spine trauma patients.

Patients and Methods: Exhaustive descriptive-type study with prospective collection, carried out over a period of three and a half years at the level of several structures of the Tlemcen University Hospital, namely medico-surgical emergencies, multipurpose resuscitation and neurosurgery departments. It focuses on cervical spine trauma patients treated from the scene of the accident to the neurosurgery and/or medico-surgical intensive care unit at Tlemcen University Hospital. All were admitted for cervical spine trauma, whatever the level reached, whatever the mechanism of the accident, whatever the treatment decision, with or without neurological lesions, with or without signs of seriousness on admission and over 16 years of age.

Results: The initial management in intensive care and in a dechocking unit for vegetative disorders was indicated on admission in 25% of patients. Cardiac arrest recovered in three patients on admission to medico-surgical emergencies. An injection of Atropine® on admission was performed in 18.75% of patients, but also vasoconstrictor drugs in 15.62%. A combination of vasoactive drugs and Atropine® were required in 7.81% of our patients; 33 of them had hemodynamic disturbances and 20 were in collapse requiring the use of vasoconstrictor drugs.

Conclusion: Our study allowed us to study and analyze the main hemodynamic and rhythmic changes occurring during cervical spine trauma. Survival was 7 ± 3.71 days for the patients who had bradycardia, and 29 ± 6.13 days for those who had kept a normal heart rhythm (P = 0.000). Maintaining a stable heart rate and hemodynamic state upon admission remains the primary care physician's priority in order to increase the chances of survival for this type of patient.

Keywords: Cervical Spine Trauma; Neurogenic Shock; Atropine; Vasoactive Drugs; Hemodynamic Complications

Introduction

Trauma to the cervical spine is a disabling pathology through motor deficit and the sphincter disorders it causes, but also fatal, through respiratory and/or hemodynamic disorders [1], hence the need for early and effective resuscitation.

Neurogenic shock (NC) is rare, though it is a serious complication (14% of spinal injuries, all levels combined), making its diagnosis valuable from the pre-hospital phase [2]. It is of vital prognostic value and corresponds to the association of bradycardia and arterial hypotension caused by spinal cord injury [2].

Their orthopedic and surgical management vary from one case to another and must obey the requirements of this type of surgery, namely an urgent release of the medullary canal and the lifting of any neurological compression according to the radio clinical results and neurological classification.

Our main objective is to study the predictive value of hemodynamic and rhythmic complications linked to cervical spine trauma on the prognosis of these patients, besides the place of the introduction of atropine and vasoactive agents in our therapeutic conduct.

Patients and Methods

Our research work carry out an exhaustive descriptive type of study with prospective collection, carried out over a period of three and a half years extending from July 2013 to December 2016 at the level of several structures at the University Hospital Center of Tlemcen, including medical and surgical emergency services, multi-purpose resuscitation and neurosurgery.

It emphasizes on the cervical spine trauma patients treated from the scene of the accident to the neurosurgery and/or medico-surgical resuscitation departments at the University Hospital Center, where, all admitted for cervical spine trauma, whether superior (C0-C2) or inferior (C3-C7) or mixed, whatever the mechanism of the accident, whatever the therapeutic decision (surgical or orthopedic), with or without neurological lesions, with or without signs of seriousness on admission and over 16 years of age.

We excluded from our study all subjects with other associated traumatic spinal injuries, namely dorsal, lumbar and/or sacral.

Results

Initial care in intensive care and in a deconstruction unit for neurovegetative disorders or in the context of multiple trauma was indicated on admission in 25% of patients, including 20 patients in multipurpose resuscitation and 12 in the deconstruction unit medico-surgical emergencies of Tlemcen.

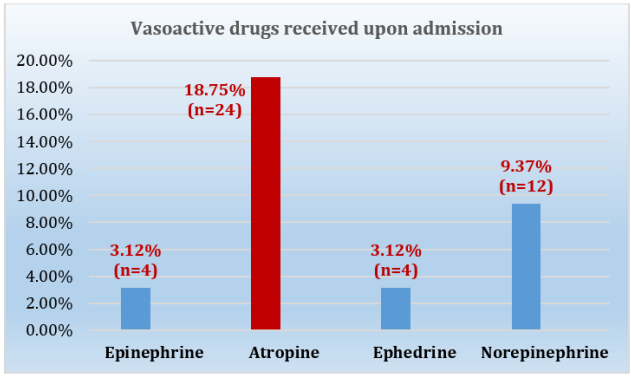
Cardiac arrest recovered in three patients on admission to medico-surgical emergencies.

Six central venous catheters were placed in the dechocking room (4 femoral ports/2 internal jugulars).

An injection of Atropine® on admission was performed in 18.75% of patients, but also vasoconstrictor drugs in 15.62% of patients (Histogram 1).

Four patients had borderline bradycardia, for which they were not put on Atropine®.

A combination of vasoactive drugs and Atropine® was required in 7.81% of our patients.



Histogram 1: Vasoactive drugs received. On admission to medical and surgical emergencies of Tlemcen.

Respiratory distress was present in 38 patients, including 14 with abdominal breathing type and 18 with thoraco-abdominal swing type. Six cases of respiratory pauses were treated on admission.

Thirty-three patients had hemodynamic disturbances, 20 of them were in collapse requiring the use of vasoconstrictor drugs from the start. Seven cases of thermal disturbances and three cases of swallowing disturbances were also recorded.

Bradycardia (<50 beats/min) was recorded in 21.87% of our patients influencing the evolution of our study population, which concluded to a significant link between the presence of bradycardia on admission and the evolution of our patients (P = 0.001) (Table 1).

In addition, a precarious hemodynamic state on admission was noted in 26.56% of our wounded (n = 34). The bivariate analysis studying the association between the presence of hemodynamic disturbances at baseline and the course shows a statistically very significant link between the fall in blood pressure and one death in cervical spine trauma (P = 0.000). (Table 1).

The need to use vasopressor drugs was recorded in 26.56% of our patients (n = 34) with a predominance of fatal outcome, which allowed us to determine the existence of a statistically very significant link between the use of resuscitation products and the evolution of cervical trauma patients in this study population (P = 0.000) (Table 1).

	Evolution					
	Improvement	**Aggravation**	**Death**	**Stablity**	**Total**	**P-Value**
Bradycardia						
No	25	4	22	49	100	0,001
Yes	3	0	17	8	28	
Hemodynamic disorders						
No	24	2	18	50	94	0,000
Yes	4	2	21	7	34	
Vasopressor Drugs						
No	26	3	16	49	94	0,000
Yes	2	1	23	8	34	
Total	28	4	39	57	128	

Table 1: Severity criteria and evolution.

It is 7 ± 3.71 days for patients who had bradycardia, and 29 ± 6.13 days for those who had kept a normal heart rhythm (P = 0.000) (Figure 1).

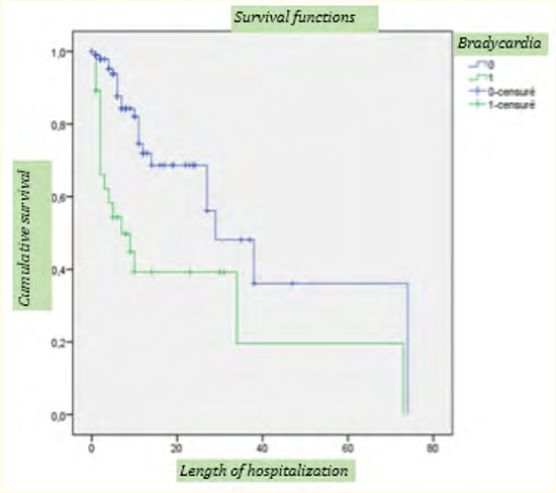


Figure 1: Graphical representation of survival depending on the existence of a Bradycardia.

Discussion

Cervical spinal cord injury can cause significant changes in pulse, blood pressure, cardiac output, and heart rate. This is linked to the sympatholytic caused by cervical spinal cord injury. The optimal mean arterial pressure for maintaining spinal cord infusion is not known.

In our study, volume resuscitation was performed according to the patients' blood pressure levels and their heart rate. Crystalloids then colloids (SSI 9 ‰ and Plasmagel®) were infused according to the severity of the arterial hypotension. The use of vasopressors was reserved for collapse and atropine was the rule for any bradycardia-accompanying trauma to the cervical spine.

Mc KINLEY and DEVIVO [3,4] consider that cardiovascular dysfunctions represent the main causes of morbidity and mortality in the acute and chronic stages of cervical spinal cord injuries. According to GARSHICK., *et al.* [5], they contribute 40.5% of deaths in this type of injured person.

The more pronounced hypotension following complete injury to the cervical cord [6], results in decreased perfusion of the lat-

ter and an increased risk of secondary ischemic injury [7]. A good replacement of the fluid is therefore considered necessary to improve the action of vasopressors, before initiating them [8].

According to PIEPMEIER., *et al*. [9,10], patients with severe cervical cord lesions are more prone to hemodynamic and cardiac abnormalities within 1 to 2 weeks after injury. Indeed, several authors have declared the existence of a link between these cardiovascular disorders and the completeness or incompleteness of the motor deficit.

LEHMANN., *et al*. [9] found hypotension in 68% of patients with spinal cord injury with complete cervical cord injury and no hypotension in incomplete cervical or thoracolumbar cord injury.

Later, LEVI., *et al*. [11] supported the studies by LEHMANN., *et al*. and reported that patients with complete motor deficit are 5.5 times more likely to have systolic blood pressure (SBP) <90 mm Hg on admission than patients with incomplete motor function.

In our study, an injection of Atropine on admission was performed in 24 patients (18.75%) but also vasoconstrictor drugs in 20 patients (15.62%) according to the following distribution: Norepinephrine (9.37%), Ephedrine (3.12%) and Epinephrine (3.12%). However, the use of vasoactive drugs was doubly important (35%) in the HABBAB series [12], usually following failure of filling when there was bleeding. 42.85% of cases, which required vasopressor agents, died.

These rates remain low compared to those in the literature, if we refer to a previous retrospective cohort-type study conducted by TOMOO., *et al*. [13]. It was performed on 131 patients (2005-2011) who received vasopressors of any type to maintain blood pressure in the neurocritical care unit of a level 1 trauma center.

As unexpected as it may sound, these researchers reported that dopamine was the most commonly used vasopressor (48.0%), followed by Phenylephrine (45.0%), Norepinephrine (5.0%), Epinephrine (1.5%) and Vasopressin (0.5%). Their use is not without risk since logistic regression analysis has shown that vasopressors are associated with increased complications in patients with spinal cord injury (for example, ventricular tachycardia, troponin elevation, ($P < 0.001$).

The difference spotted can be explained by the non-availability of certain pressing agents in the intensive care services of Tlemcen during the call (including Neosynephrine®), the prescription habits of each specialist doctor and the cardiovascular profile and hemodynamics of the patient.

LEHMANN., *et al*. [9] also studied the presence of bradycardia, hypotension and cardiac arrest, as well as the need for therapy with Atropine and a pressing agent according to the severity of the cervical spine trauma, and not by the level in the cervical spine. This team of researchers found that 71% of patients with severe cervical spine trauma who had Frankel "A" and "B" scores had bradycardia <45 beats/min.

In addition, 68% of patients with severe cervical trauma were hypotensive and 35% required vasopressor therapy. Cardiac arrest in 16% of them [14].

PIEPMEIER., *et al*. [10] also examined cervical spinal cord injuries according to the severity of the Frankel score, and placed a strong emphasis on bradycardia-type complications. Patients in this study were stratified by the level of cervical lesions, with C1 to C4 considered high and C5 to C7 low. Contrary to the literature, they found no difference between groups with regard to bradycardia, cardiac arrest and the need for pressers [10].

However, a study conducted by BILELLO., *et al*. [15] between December 1, 1993 and October 31, 2001, found a significant difference between the high and low injury groups and the need for vasopressor products and cardioversion ($P = 0.02$).

Furthermore, our paramedical teams of Tlemcen University Hospital observed an aggravation of bradycardia in 54.76% of our patients who were intubated and sedated at the time of treatment, particularly during tracheal aspirations. FRANKEL., *et al*. (16) had previously described this phenomenon in the study published in "The Lancet" in December 1975. These researchers had reported bradycardia and, in some cases, cardiac arrest during aspiration of patients with traumatic neck injury, probably secondary to autonomic activity predominantly parasympathetic.

In the two other studies, LEVI and VALE [11,17], dynamic provision of hemodynamic support to maintain adequate perfusion and blood pressure has been shown to improve patient mortality rates and neurologic outcomes with cervical spine trauma.

PLOUMIS., *et al*. [18] were also interested in vasopressor support after cervical spine trauma by carrying out several studies on this subject. Indeed, a documentary search in English was carried out using the Medline (1950 to April 2008) and Embase (1974 to July 2009) databases.

The search strategy included the following terms: acute spinal cord injury, hypotension, treatment of hypertension, vasopressors, cardiovascular abnormalities, spinal shock, and cardiogenic shock.

In addition, the Cochrane Trials Register and the Cochrane Database of Systematic Reviews were searched in the updated register for the first trimester of 2009.

All the works agree that the need to use atropine and/or vasopressors is the rule in cases of cervical spine trauma with complete motor impairment and in the presence of cardiovascular disorders, and the Consortium on spinal cord medicine [19] recently published guidelines that guide clinicians in the hemodynamic management of patients with this type of lesion. In fact, inadequate treatment of neurogenic shock can lead to further ischemic damage to an already compromised nervous system (secondary injury) [20].

One of the 39 deaths recorded in our study had ischemic stroke because of her spinal cord injury. This joins with what recent studies have reported on alarming evidence demonstrating an increased risk of ischemic stroke after spinal cord injury [21]. Therefore, aggressive treatment with fluids and vasopressors, and appropriate invasive monitoring (arterial and central venous), is essential [22].

VALE., *et al*. [23] determined over 40 years ago based on an experimental study of spinal cord injury in animals, that the highest degree of edema and vascular congestion in spinal cord was between the 3rd and 5th day after the trauma.

Recovery is also closely dependent on well-conducted initial therapy. Indeed, in a retrospective study conducted by DUCKER., *et al*. [24], on patients with spinal cord involvement receiving appropriate medical treatment, including vasopressor, and surgery; quadriplegic patients had a motor neurological recovery rate of up to 15% while patients with incomplete motor impairment had a motor recovery rate of 80% on average.

This once again proves the repercussions of the completeness or not of the cervical spinal cord injury on neurological recovery.

At the end of our research, these various study results lead us to conclude that the use of atropine and vasopressors in a trauma patient of the cervical spine is necessary especially if the spinal cord involvement is severe, extensive and complete.

In our study, patients with cardiovascular disorders at baseline had a significantly greater requirement for vasopressor agents (P = 0.000) and Atropine (P = 0.000), including colloid infusions, compared to patients admitted without signs of gravity. This difference can affect the allocation of resources in intensive care units.

Conclusion

Neurogenic shock remains a dangerous complication, although it is not frequent, which makes its diagnosis essential as soon as there is a cervical spinal cord injury. It is life threatening due to the association of bradycardia and vasoplegia with cervical trauma.

We also infer that bradycardia and hypotensive patients require more intensive monitoring after cervical spinal cord injury because they are more likely to progress fatally, regardless of age or concomitant injuries.

The occurrence of these hemodynamic and rhythmic complications must be anticipated, hence the interest of the skills of medical and paramedical staff, but also of technical staff, in order to optimize the efficiency of intensive care and the chances of survival of these patients. Resuscitation, implemented early, should make it possible to reduce the mortality and morbidity of cervical spine trauma patients.

Conflict of Interest

The authors have stated that there is no conflict of interest.

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