

Sepsis and lower limb fractures in road traffic accidents

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Abstract: Mortality in road traffic accident, even if is slightly decreasing in most countries due to incremental advances in car safety and better prevention programs, is still a significant cause of death. The purpose of this article was to determine whether the lower limb fractures are a determining factor in the development of sepsis and multiorgan failure in road traffic accidents. Material and methods. Retrospective, descriptive study on 82 consecutive cases of clinical expertises and 100 cases of autopsy reports for road traffic accidents. Two parameters, Sev_In and Sev_Tot were build to assess the severity of the septic process. Results. By analyzing the mean value of neutrophil, leucocyte count, and cerebral, cardiac, hepatic, renal and ICD markers for multiorgan failure in the presence of lower limb fractures we could not establish any statistically significant correlations. The evolution of leucocytes leads to a significant inequality of the variance of the Sev_Tot parameter, with both an increase and a decrease in leucocyte count during hospitalization being associated with a significant increased severity compared to a relative unmodified value of this parameter. Conclusion. Lower limb fractures are not a determining factor in neither the development of a septic process as they do not contribute significantly to the mortality in road traffic accidents. Their contribution to severity scores in these circumstances should therefore be limited, and mortality due specifically to lower limb fractures should be regarded as incidental. The development of sepsis in road traffic accidents is independent upon the presence of lower limb fractures, being caused rather by another traumatic lesions produced in the same context.

Key Words: sepsis, road traffic accidents, multi organ failure, lower limb fractures.

Mortality in road traffic accident, even if is slightly decreasing in most countries due to incremental advances in car safety and better prevention programs, is still a significant cause of death. Moreover, many deaths associated with road traffic accidents are preventable or cannot be explained as simply being caused by the severity of the trauma[1].

Sepsis is a major cause of morbidity and mortality worldwide, being the first cause of death in non-coronary intensive therapy units and amongst the ten most frequent causes of death overall[2].

An exact definition of sepsis and associated

syndromes is extremely difficult due to a high etiological heterogeneity, a high number of medical specialities diagnosing and treating with this medical issue, and so on. Classically sepsis was defined as the presence or possible presence of an infection associated with a systemic inflammatory response. The systemic inflammatory response is characterised by the associations of at least two of the following: temperature of above 38 or below 36 degrees Celsius, HR>90b/min (or PaCO₂<32 torr) and leucocytes above 12000/mm³ or below 4000/mm³ or more than 10% immature leucocytes[3].

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In trauma sepsis is associated with an increased severity of the traumatic injury, increased resource allocation[4] and mortality[5]. Presence of diabetes, cardiac disease, immunodeficiency, and other chronic pathologies are known to increase the severity of the sepsis acquired in a traumatic context[4].

The purpose of this article was to determine whether the lower limb fractures are a determining factor in the development of sepsis and multiorgan failure in road traffic accidents.

Material and methods

From the archives of the National Institute of Legal Medicine were selected 82 consecutive cases of clinical expertises (CE) and 100 cases of autopsy (AR) reports for road traffic accidents. Data was included in a SPSS database. In order to quantify the severity of trauma we have build two parameters:

1. Sev_in (initial severity), which was obtained by quantifying the severity of the initial lesions. Minor lesions like bruises, abrasions, were excluded. Generally, a severity index of below 10 was awarded for lesions with minor lethal potential, 20 points were given for lesions wich may lead to death if left untreated and 40 points were awarded for lesions leading to death in minutes. The score was computed by mutiplying the number of lesions of a certain severity with that severity and adding the results.

2. Sev_Tot – this parameter measures the severity of the lesions according to the number of days of hospitalization. The severity ranges from 0 to 100 and the score is quantified as follows: for clinical legal medicine cases (non-lethal) the severity ranges from 0 to 40 and is directly proportionate with the number of hospitalization days and for lethal cases

the severity ranges from 41 to 100 and is indirectly proportionate with the number of hospitalization days.

Results

Most patients were male (104 cases, 57.14%), with a mean age of 46.09, greater in CR (48.78) than CE (42.80).

The sev_in parameter had a mean value of 34.93, significantly higher in AR group (54.17) compared to the CE group (11.48), with a F value of 145.056, significant at a p<0.0001. The sev_tot parameter had a mean value of 54.14, higher in AR group (91.51) than in CE group (9.17). The difference is statistically significant as revealed by the ANOVA test, which gave an F value of 2054.781, significant at a p<0.0001.(See Figure 1 for details).

Overall sepsis was identified in 32 cases, of which 23 (71.85%) had an respiratory point of origin, five (15.6%) had a cerebral point of origin, three had a cutaneous point of origin and one had a cutaneous point of origin. The point of origin in septic processes is highly associated with the Sev_Tot parameter (ANOVA, F=8.011, p=0.001), and is not associated with Sev_In parameter (ANOVA, F=2.285, p=0.101). See Table 1 for details.

Sev_Tot is significantly correlated with a decreased value of neutrophil count at admission (Pearson=-0.420, significant at a p=0.05).

Sev_In is significantly associated with the presence of pelvic fractures whilst Sev_Tot is significantly associated with the presence of femoral and foot fractures (See Table 2 for details).

Cerebral trauma is significantly more frequent in cases with associated pelvis fractures (Pearson Chi2=6.024, p=0.013) but the Cramer test does not

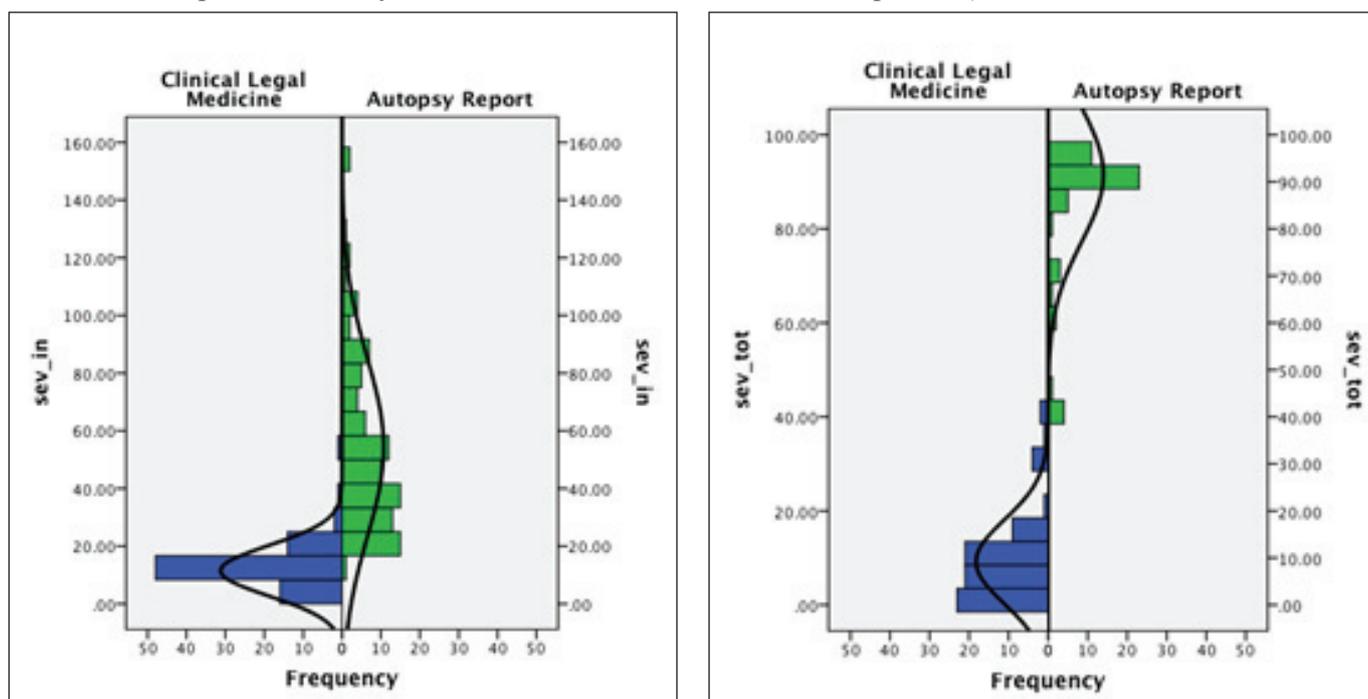


Figure 1. Sev_In and Sev_Tot values and distribution in CE and AR groups

Table 1. Mean Sev_In and Sev_Tot depending upon the site of origin

Point of origin	Mean Sev_In	Mean Sev_Tot	No
Pulmonary	41.9	79.3	23
Cerebral	52.2	95.2	1
Digestive	17.33	40	3
Cutaneous	65	97	5
Total	40.42	78.68	32

Table 2. Mean Sev_In and Sev_Tot depending upon the type of lower limb fracture

Lower Limb Fracture	Sev_In Mean		F	Sig	Sev_Tot Mean		F	Sig
	No	Yes			No	Yes		
Pelvis	32.6	44.39	4.009	0.047	51.59	65.89	3.261	0.073
Femur	33	43.35	2.944	0.088	51.31	67.88	4.206	0.042
Tibia+peroneus	34.36	35.78	0.087	0.768	58.48	48.73	2.415	0.122
Foot	35.48	18.03	1.589	0.209	55.65	18	4.570	0.034

confirm the presence of a correlation between these two parameters (Cramer=0.245, $p=0.014$). Similar values were obtained when associating femoral fractures and cerebral trauma (significant value of Pearson Chi2, with a p value of 0.035, but no correlation, with a Cramer=0.528 and a $p=0.035$), and when associating femoral fractures with respiratory insufficiency (significant value of Pearson Chi2=6.354, $p=0.011$, with a Cramer=0.252, $p=0.012$).

Other associations did not prove to be significant. Cerebral involvement was identified in 51 cases (28.02%) and is associated with a significant increase in severity, with sev_tot parameter having a mean value of 91 in cases with and 40.16 in cases without it (ANOVA, $F=71.298$, $p<0.001$). Respiratory consequences consisted most often in acute pulmonary edema in 31 cases (17.13%), followed by bronhopneumonia in 20 cases, and others in 21. Respiratory involvement was associated with a significant increase in severity, with sev_tot parameter having a mean value of 88 in cases with and 36 in cases without it (ANOVA, $F=92.168$, $p<0.001$).

By analyzing the mean value of neutrophil, leucocyte count, and cerebral, cardiac, hepatic, renal and ICD markers for multiorgan failure in presence of lower limb fractures we could not establish any statistically significant correlations.

The evolution of leucocytes leads to a significant inequality of the variance of the Sev_Tot parameter (Levene's test=5.782, significant at a $p=0.008$), with both an increase (mean of 86.19) and a decrease (mean equals 46) in leucocyte count during hospitalization, being associated with a significant increased severity compared to a relative unmodified value of this parameter (mean equals 25.71).

Discussions

Septic complications occur frequently in road traffic accidents, especially if are associated with a prolonged hospitalization, being an important cause of death to these patients[4, 6, 7]. The point of origin is either at the place of a traumatic lesions (most often in our study group this happened in cranio-cerebral trauma), or iatrogenic (most often in our study group this happened in mechanically ventilated patients, in which the point

of origin was respiratory). Other frequently cited iatrogenic points of origin are urogenital (caused by a prolonged use of urinary probes), and cutaneous, caused by pressure sores.

Sev_In parameter is less sensitive than Sev_Tot in assessing the differences between

the two study groups. Therefore the cause of death is more dependent upon the in-hospital evolution of the patients than the initial severity, especially in cases in which the severity is not sufficient enough to cause death in minutes-hours.

Sev_Tor parameter is also useful in detecting an increased risk of developing sepsis during hospitalization, with values over 46 being associated with an increased risk.

The presence of lower limb fractures is not associated with an increased risk for the development of sepsis, most likely because they are either closed or open but easily treatable. Most severe septic cases are those with a cerebral or gastrointestinal point of origin, which are often difficult to detect immediately in severely traumatized patients. Cerebral and respiratory trauma or consequences are the most likely immediate cause of death in hospitalized patients[8-10]. They are independent upon the presence of lower limb fractures. This results in accordance with other similar studies, which reveal cerebral, respiratory and septic consequences as being the most often identified negative prognostic factors in road traffic accidents[11-13].

Conclusions

Lower limb fractures are not a determining factor in neither the development of a septic process as they do not contribute significantly to the mortality in road traffic accidents. Their contribution to severity scores in these circumstances should therefore be limited, and mortality due specifically to lower limb fractures should be regarded as incidental.

The development of sepsis in road traffic accidents is independent upon the presence of lower limb fractures, being caused rather by another traumatic lesions produced in the same context.

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