PERSISTENT INFLAMMATORY SYNDROME IN A POLYTRAUMA PATIENT- PREDICTIVE FACTOR FOR COMPLICATIONS- CASE PRESENTATION

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ABSTRACT
POLYTRAUMA REPRESENTS A MAJOR CAUSE OF MORBIDITY OF MORTALITY IN MODERN TRAUMATOLOGY. ALTHOUGH NO UNIFIED DEFINITION HAS BEEN DEVELOPED YET, THE MAIN PHYSIOPATHOLOGIC CHARACTERISTIC OF POLYTRAUMA HAS BEEN IDENTIFIED : THE SYSTEMIC INFLAMMATORY RESPONSE SYNDROME (SIRS), WHICH MAY HAVE A FAVORABLE OUTCOME, OR IT CAN EVOLVE UP TO MULTIPLE SYSTEM AND ORGAN FAILURE (MSOF) OR EVEN DEATH. THE INFLAMMATORY STATUS CAN BE DESCRIBED USING BIOCHEMICAL MARKERS AND ITS DURATION AND INTENSITY DEPENDS ON THE OUTCOME OF EACH OF THE ASSOCIATED INJURIES. THIS PAPER PRESENTS A CASE OF A POLYTRAUMA PATIENT WITH A PERSISTENT INFLAMMATORY SYNDROME WHO DEVELOPED MAJOR LOCAL COMPLICATIONS, INCLUDING SEPTIC ONES, THUS DEMONSTRATING THE VALUE OF PROPER MONITORING AND MULTIDISCIPLINARY APPROACH OF POLYTRAUMA

KEY WORDS: POLYTRAUMA, BIOCHEMICAL MARKERS, DAMAGE CONTROL

CLINICAL CASE

INTRODUCTION

Several definitions have been proposed for polytrauma; in 2002, Trentz [6] introduced two major elements as crucial for a multiple injury to be considered a polytrauma:

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[6] Trentz O. Polytrauma: pathophysiology, priorities, and management.In: Ruedi TP, Murphy WM, editors. AO principles of fracture management. Stuttgart: Thieme; 2000. p. 661–73

- ISS >17, and
- The association of injuries determines a sequential systemic traumatic reactions that may lead to dysfunction (up to complete failure) of vital organs/ systems which had not been directly injured, meaning that this reaction affects target organs WITHOUT them having been primarily affected by trauma.

Pape [7],[8] and his team considered the following as relevant parameters for defining a polytrauma:

a. ISS > 15 and
b. Abbreviated Injury Score (AIS) > 3 in at least two body regions , and
c. at least one of the following: - hypotension (systolic blood pressure SBP <90 mm HB) OR unconsciousness [GCS score ≤8], OR acidosis [Base Excess BE ≤- 6.0], OR coagulopathy [PTT ≥ 40 seconds or INR ≥ 1.4] OR age [>70 years]).

Regardless of the defining, the common thing for polytrauma is represented by the hyper-inflammatory status (SIRS), with duration and intensity depending on the balance between the initial trauma and the therapeutic intervention, and consistently determined by the pre-traumatic status of the patient[9],[10]

The elements defining SIRS are

1. Tachycardia , with HR> 90/ min
2. Tachypnea, with RR> 20 min, with decreased PaCO2< 32 mmHG
3. Body temperature >38 grd C or <35 grd C
4. Leucocytosis >12.000/mm3 or leucopenia< 4000/mm3, or immature granulocytes ≥10%[11]

The main goal of the treatment in initial stages of polytrauma is survival of the patient, so basic resuscitative interventions addressed to vital injuries are performed, then injuries requiring urgent treatment are approached, while the rest of the injuries are treated when the status of the patient is stable enough so as not to produce a reactivation of SIRS. This principle, called "damage control "ensures the patient stabilization with minimal systemic impact and avoids the "second hit" phenomenon

MATERIAL AND METHOD

The patient, 24 yrs old, sustained a traffic accident 10 days before arriving to our hospital; while riding a motorcycle he drove into a lighting pole. Severely injured, he was taken to the county hospital where he was immediately operated for ruptured subclavian artery (which was restored using a vascular prosthesis), ruptured spleen (splenectomy) and liver (hepatoraphy)

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[7] Harwood PJ, Giannoudis PV, Probst C, Van Griensven M, Krettek C, Pape HC. Polytrauma study group of the german trauma society. Which AIS based scoring system is the best predictor of outcome in orthopaedic blunt trauma patients? J Trauma 2006;60(2):334–40.

[8] Pape HC, Lefering R, Butcher N, Peitzman A, Leene L, Marzi I, Lichte Ph, Josten, C, Bouillon B, Schmucker U, Stahel Ph, Giannoudis P, Balogh Z. The definition of polytrauma revisited: An international consensus process and proposal of the new 'Berlin definition' Journal of Trauma and Acute Care Surgery November 2014 - Volume 77 - Issue 5 - p 780–786

[9] Butcher N, Balogh ZS. The practicality of including the systemic inflammatory response syndrome in the definition of polytrauma: Experience of a level one trauma centre; Injury, Volume 44, January 2013,Issue 1, Pages 12–17Giannoudis PV: Current concepts of the inflammatory response after major trauma: An update. *Injury* 2003;34:397- 404

[10] Giannoudis PV, Hildebrand F, Pape HC. Inflammatory serum markers in patients with multiple trauma. J Bone Joint Surg (Br) 2004;86-B:313–23

[11] Ciriello, Vincenzo et al. Biomarkers predicting sepsis in polytrauma patients: Current evidence Injury; 2013 , Volume 44 , Issue 12 , 1680 – 1692

Figure 1- Polytrauma patient with MSOF, 10 days after the accident

Afterwards, the status of the patient worsened, with progressive renal failure and pulmonary dysfunction (Acute Respiratory Distress Syndrome), evolving to Multiple System Organ Failure (MSOF).

Due to the extreme severity of the injuries and their negative outcome, the patient was sent to a Level 1 Trauma Center.

When arriving to our hospital, the patient (Figure 1) was haemodinamically unstable, intubated and anuric; multidisciplinary clinical evaluation was performed, followed by blood and urinary analysis , X rays and CT scan, revealing :

- Severe cerebral trauma with cerebral hemorrhage
- Bilateral rib fractures with bilateral haemo-pneumothorax and bilateral pleurostomy
- Right femoral fracture temporarily stabilized with cast (Figure 2 a,b), with a pre-patellar contaminated wound

a b c

Figure 2 – Right femoral fracture (a) with contaminated pre-patellar wound (b)

Left humeral fracture temporarily stabilized with cast (Figure 3 a, b) with the subclavian artery permeable (Figure 3 c)

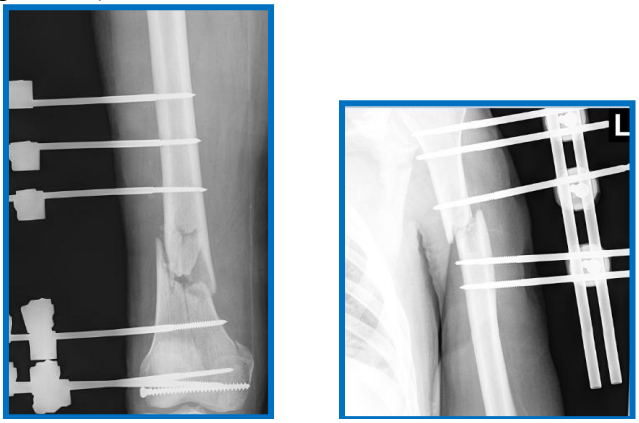
a b c

Figure 3- Left humeral fracture – X ray (a) and clinical aspect (b); incision for subclavian graft (c)

Blood analysis revealed severe inflammation- leucocytes 19.400x1000/µL, trombocytopenia (69000/mm3), hiperkalemia (6.71 mmol/l), anaemia (7.2g% Hb), acute renal failure (creatinine 4.21 mg/dl, urea 84 mg/dl, CK > 20000U/l, ESR 60mm/h

Due to the severity of the injuries, immediate treatment was started, with the following primary, urgent goals:

- Compensate hypoxia and anemia- blood transfusion was immediately administered
- Restore renal function- dialysis was indicated and started
- Sustain pulmonary function
- Stabilize the femoral fracture, since this is unanimously considered a resuscitative procedure. Because the patient was considered a borderline type, Damage Control procedure was chosen, so closed reduction and stabilization with ExFix was the method of choice (Figure 4 a)



a b

Figure 4 – Fracture stabilization using the Damage Control method- ExFix: femoral fracture (a), humeral fracture (b)

Post-operative outcome was favorable, with a slow improvement of inflammatory tests. Figure 5 shows the variations of leucocytes, and creatinine, not using the absolute values, but the percentages compared to the average normal ones (leucocytes 4-9x1000/µL, AST 14-50U/L, creatinine=0.7-1.4 mg/dl)

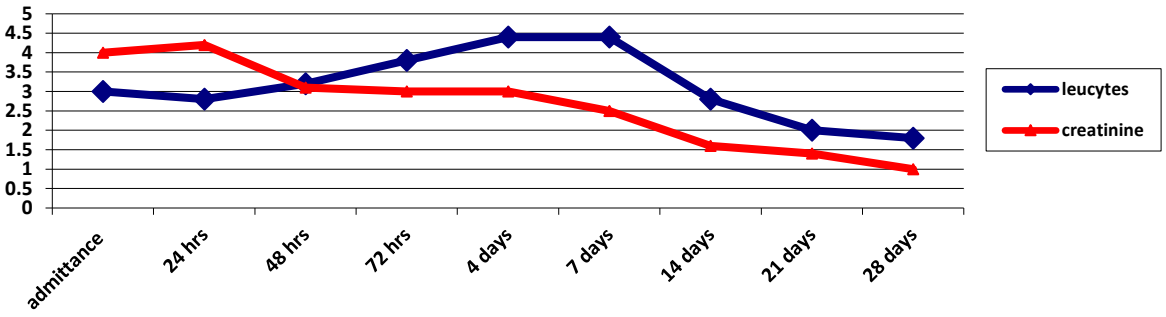


Figure 5 - Variations of anemia, creatinine and urinary flow

The humeral fracture was operated 3 days after the femoral one also following the Damage Control principles and an ExFix was inserted (Figure 4 b). The general status slowly improved; dialysis was continued for 10 days and, 14 days after admittance, the patient was extubated; reevaluation revealed left hemiparesis , as a consequence of the initial severe trauma with cerebral hemorrhage. He remained in the ICU 3 weeks after extubationg and was transferred to a Medical Rehabilitation service.

After 3 weeks in this service, the patient developed an acute septic syndrome, due to pericarditis with tamponade; he was urgently transferred from recovery to cardio-vascular surgery, where pericardiotomy was performed; due to persistent fever (up 39 grd) associated with respiratory dysfunction, he was transferred back to our hospital.

Clinical and CT evaluation revealed bilateral pleural fluid, pericarditis with infected hemopericard and mediastinitis; a Methiclino Resistant St. Aureus (MRSA) was isolated in the hemoculture, as well as in the pleural effusion. Due to the respiratory insufficiency, surgery was urgently performed, with left pleural excision and right pleurostomy , followed by sustained general treatment (including antibio-therapy)

The outcome was slow and difficult , with progressive pulmonary improvement. As for the fractures, definitive stabilization of the femoral fracture was delayed up to 10 months. An acute respiratory infection (considered as communitarian) appeared 4 months after definitive fixation and 2 weeks after that , acute infection with St.aureus appeared in the femoral fracture site, which had no other signs of infection or inflammation so far (at almost 1 year after trauma).

Considering this complicated evolution of this patient, a retrospective analysis was performed in his medical records in order to identify any potential biochemical elements which could be correlated with this long term complications.

Due to the fact that the key element of polytrauma is hyper-inflammation, the authors analyzed the inflammatory tests: leucocytes, ESR, fibrinogen, C Reactive Protein (CRP), available in the medical records of the patient in our hospital for the first admittance period. Figure 6 shows the graphic evolution of these tests (not in absolute values, but in percentages referring to the mean normal values of the laboratory in our hospital)

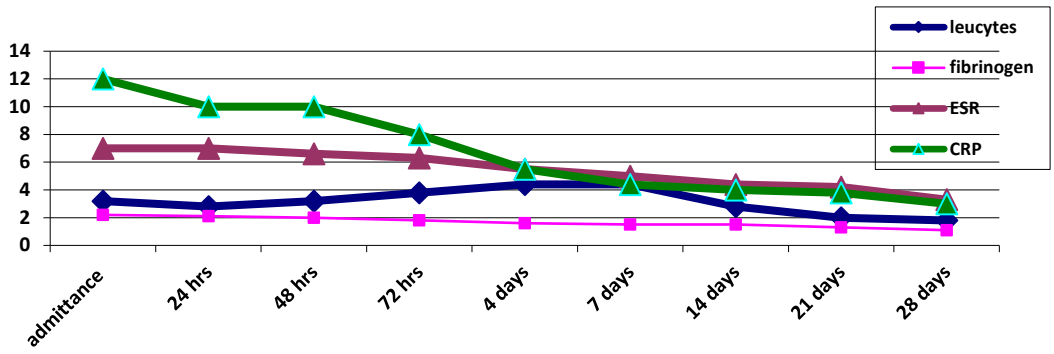


Figure 6- Inflammatory tests of the patient

RESULTS- DISCUSSION

The dynamics of the inflammatory tests showed a certain pattern: the initial values were extremely high compared to normal, revealing the severity of the inflammatory syndrome, consistent with the status of the patient. The fact that 10 days had already passed form trauma, this aspect suggests that the outcome of the injuries was in no way a favorable one; on the contrary, the patients status get worse within this time, with the final onset of MSOF, when he was sent to our hospital

The dynamics of the patient demonstrates that choosing the Damage Control procedure was beneficial for the patient, who did not perceive operations as a supplementary trauma, thus avoiding the " second hit" phenomenon.

After surgery the inflammatory tests continue to decrease, but they did not return to normal a long time; there was no other increase on this curve, but the fact that up to 3 weeks there were still abnormal values may suggest that the inflammation was persistent, despite all the therapeutic efforts. This can be explained by the fact that the possibilities of the organism to develop the counteractive system- CARS (*Compensatory Anti-inflammatory Response Syndrome*) were exhausted due to the long term between trauma and complete treatment.

The dynamics of the inflammatory markers showed a slow, but favorable tendency, reflecting the efficacy of the therapeutic measures, but the persistency of increased values for up to 3-4 weeks can definitely be correlated with the later complications

Inflammatory response in polytrauma has multiple components, the most important being: leucocytes (especially neutrophils, then macrophages), IL-1, IL-6, TNF-α, IL-10, IL-18, C3 and C5 (stimulating neutrophils), thromboxane, prostacycline (PG I2), CRP, Procalcitonine.[12],[13],[14]

The biochemical markers commonly used to evaluate this complex phenomenon are : leucocytes, fibrinogen, ESR and especially CRP- its' normal values are 0.3-1.7 mg/dl; although it does not give specific information, it is considered a consistent inflammatory marker. In our study, it showed the more accurate concordance between the inflammatory syndrome and the outcome of the patient.

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CONCLUSIONS

Polytrauma is characterized by severe injuries with increased morbidity and mortality; its' primary pathogenic mechanism is inflammation , which is responsible for activating other secondary damages in non-primarily traumatized systems and organs, thus leading to MSOF. Due to this fact, the inflammation tests are used in clinical practice in monitoring these patients and make therapeutic decisions. This case illustrates a potential connection between persistent inflammation and secondary complications, especially that the patient was protected by using the Damage Control procedures, which avoid the " second hit" phenomenon . Persistent inflammatory changes can be, in this case, related to the occurrence of secondary complications and the hypothesis of their predictive value worths validation through prospective randomized studies.