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Department of Maxillofacial and Oral Surgery, Medical University of Lublin

ANNA GAWĘDA

The analysis of C-reactive concentration in patients with maxillofacial fractures

The C-reactive protein (CRP) is a constant component of the organism, it is present in blood serum in trace amounts of both healthy people and animals in physiological conditions (1, 2). Macrophage stimulation caused by tissue damage is a necessary condition for CRP synthesis (3, 4, 5). These cells produce pro-inflammatory cytokines which induce the expression of the APR gene. Interleukin 6 (IL-6) is the most important factor that stimulates CRP synthesis as well as all other acute phase proteins (5, 6). Interleukin 1 (IL-1) and tumor necrosis factor (TNF-α) stimulate macrophages, monocytes, fibroblasts, endothelium cells and others to produce IL-6 (6, 7, 8). CRP in the organism performs a defensive and reparative role (2, 3, 9, 10). This protein acts like an opsonin by joining with antigens and pathogen structure ligands and hastening their phagocytosis. CRP attaches to Fcγ receptors of human monocytes, neutrophils and other leucocytic system cells activating them. Cell stimulation results in a varied effector response, e.g. in the cytotoxic effect, phagocytosis, oxygen explosion or in the release of inflammatory mediators. C-reactive protein complexes with corresponding ligands activate the complement cascade mainly on the classical pathway (similarly to the antigen-antibody complexes).

As a result of the inflammatory stimulation the C-reactive protein appears in the plasma already 2 hours after the trauma and it reaches its peak 48–72 hours after the injury. In non-complicated cases it returns to norm after 6–7 days (7, 9). CRP as a prognostic is a reliable exponent of the regularity of ossification and reparative processes. In the conditions of correct bone fusion its value is low; it rises, however, when the healing is interrupted by a bacterial infection. Fractures of the facial skeleton are in danger of infections with saprophytous and pathological bacterial flora present in the oral cavity. The perioperative anti-inflammatory prophylaxis which is routinely administered may be terminated when plasma CRP level normalizes. This way the patient avoids a prolonged antibiotics therapy and its side-effects (12).

The evaluation of the C-reactive protein changes in patients with zygomatico-maxillo-orbital fractures and the usefulness of systematic monitoring of acute phase protein levels in maxillofacial surgery were the aims of the work.

MATERIAL AND METHODS

The measurements involved 23 patients with maxillofacial fractures and the analyzed size of the injuries was within medium, most often encountered in hospital practice. Inflammation was not observed in any of the patients pre-operatively. During the hospitalization period all patients received antibiotics as prophylaxis, mainly from the cephalosporin group. Patients with malnutrition,

endocrinological, immunological ailments and with hepatocellular or cardiovascular system damage were excluded from the measurements. CRP concentration was determined both after trauma and the operative procedure in equal periods of time of 3, 5, 7, 9 and 17 days after the trauma, as well as in the cases of inflammatory complications. The immunoenzymatic method was used to determine CRP concentration. The Mann-Whitney statistical test was used to evaluate the significance of the differences. According to this method regular CRP concentration values in the plasma of healthy people do not exceed 10 mg/l.

RESULTS AND DISCUSSION

In the course of the acute phase response in patients with maxillofacial fractures, it can be observed that CRP reached a value of 10.7 mg/l as a result of the trauma. The operative procedure of osteosynthesis triggered another peak in the protein value, equal to 11.8 mg/l.

The normalization of CRP was observed on the 5th and 9th day post trauma. Another acute phase reaction was visible in patients who had inflammatory complications during bone healing. CRP increased to a value of 14 mg/l (Fig. 1).

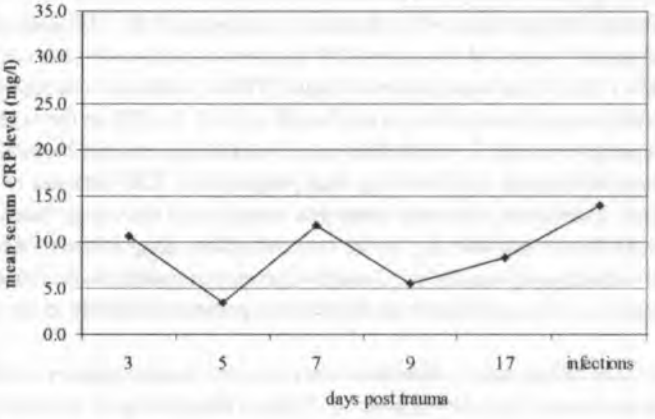

Fig. 1. Graphical representation of the average CRP levels in case of fractures (3rd day – trauma, 7th day – osteosynthesis procedure)

The influence that the primary and operative trauma exerted on the acute phase response was researched in the examined material. Based upon the results, it was concluded that in patients with the analyzed fractures the CRP level in plasma increases directly after the trauma and the operative procedure. A fracture and a dislocation of the zygomatic bone to the 'inside' or 'outside' in relation to the maxillary sinus occur under the impact of the blow. This is the cause of serious complications to the sight and mastication organs or an impediment of sensual functions and the aesthetic appearance of the face. Patients are qualified for operative procedures basing on the manifestation of one or more of the afore-mentioned symptoms. The C-reactive protein concentration analysis has demonstrated that zygomatico-maxillo-orbital fractures are characterized by a relatively low CRP concentration, both directly after trauma and after the operative procedure. The values affirmed in this case were slightly higher than the physiological norm. The acute phase reaction is faintly marked in the examined material in all measurements after trauma.

The reference of the own research results to the available published literature was not found. Results obtained by Iizuka et al. (9) in patients after single mandibular fractures depended on the

time that passed between the trauma and the examination. Within the time range of 12–84 hours after the injury the CRP concentration amounted on average 33.1 mg/l, and the decrease to about 11.5 mg/l occurred after 4 days. Another CRP concentration increase after the operative procedure appears in favour of another acute phase reaction caused by the tissue damage during the operation. In the research of Iizuka et al. (9) the mandibular osteosynthesis caused the mean CRP concentration to increase after 48 hours to 73.2 mg/l. The date of the procedure depended upon the time when the patient reported for hospitalization. This suggests that the time of performing the operative treatment has had a significant influence on the intensification of the acute phase reaction and on the obtained results.

Other authors who examined the C-reactive protein in different medicine disciplines, like Kallio et al. (10) have studied patients with solitary tibial fractures. CRP response depended on the kind of treatment – lower values were observed in patients treated conservatively than in operated cases. The highest values were usually recorded two days after the trauma. The operative treatment caused a CRP increase to 82.7–104.8 mg/l depending on the used operative method.

In own measurements the C-reactive protein values expressed in absolute numbers point to a certain tendency in the development of inflammatory states. Patients who reported due to early infections displayed a slight CRP concentration increase, which amounted to 14.0 mg/l on average. The low level depicted a smaller intensity of the infection and the applied treatment was bound with a local incision of abscess. The level of the C-reactive protein in the plasma was gradually normalized in the posttraumatic period in the course of a non-complicated bone fusion. Moreover, it was a useful laboratory test to evaluate the healing processes of the fracture, the course of the treatment and the early detection of complications in the form of infections and inflammatory states.

CONCLUSIONS

In cases of patients with zygomatico-maxillo-orbital fractures the CRP concentration increases directly after the trauma and the surgical procedure, but only to values slightly higher than the normal CRP level in blood serum. Then it undergoes a gradual normalization in the time after the trauma as well as in the course of non-complicated bone healing. The inflammatory complications are a cause of another CRP increase.

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SUMMARY

The C-reactive protein (CRP) is one of the most important defensive proteins that take part in the nonspecific immunity mechanism as a result of the acute phase response (APR). Bone fracture is the cause of a local inflammation and it stimulates the acute phase reaction, of which CRP production is the exponent. CRP reached a value of 10.7 mg/l as a result of the trauma and 11.8 mg/l after osteosynthesis. Another acute phase reaction was visible in patients who had inflammatory complications during bone healing, C-reactive protein increased to a value of 14 mg/l. C-reactive protein may have a prominent role in the monitoring of postoperative bone fusion, for it is a good exponent of the intensification of the local inflammatory reaction. Multiple concentration measurements enable the evaluation of the size of the acute phase reaction during the trauma, the osteosynthesis procedure as well as the jaw fracture healing.

Analiza stężenia białka C-reaktywnego u pacjentów ze złamaniami jarzmowo-szczękowo-oczodołowymi

Białko C-reaktywne (CRP) jest jednym z najważniejszych białek obronnych biorących udział w niespecyficznym odczynie immunologicznym, określanym jako reakcja ostrej fazy (ROF). Złamanie kości jest przyczyną miejscowego zapalenia, które stymuluje reakcję ostrej fazy i produkcję białka obronnego. CRP osiągnęło stężenie 10,7 mg/l w następstwie urazu oraz 11,8 mg/l po przeprowadzonym zabiegu osteosyntezy. Kolejna reakcja ostrej fazy była zauważalna u pacjentów, u których w trakcie gojenia kości wystąpiły powikłania zapalne, białko C-reaktywne podwyższyło się do wartości 14 mg/l. CRP może mieć znaczącą rolę w monitorowaniu pooperacyjnego zrostu kości, gdyż jest dobrym wskaźnikiem intensywności zakażenia. Wielokrotne pomiary określają wielkości reakcji ostrej fazy zarówno w następstwie urazu, zabiegu operacyjnego, jak i zrostu złamania.