

THE VALUES OF SOME PLASMA COMPONENTS DURING THE EARLY PHASES OF FRACTURE HEALING IN MAN

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A study of plasma components during the early phases of fracture healing in man showed no specific changes except a change of C-reactive protein to positive and a slight but non-significant increase of the plasma hydroxyproline.

Key words: plasma components; fracture healing; calcium; alkaline phosphatase activity; plasma hydroxyproline; C-reactive protein

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As a part of the body's physiological reaction to fracture, alterations of some plasma components have been reported (Bruce & Strachan 1967, Herold et al. 1968, Gudmundson & Semb 1971 a, b). On the other hand classical papers state that plasma homeostasis prevents such a phenomenon occurring (Aegerter & Kirkpatrick 1968).

MATERIAL AND METHODS

Normal values for the plasma components in 13 healthy persons (6 male and 7 female) varying in age from 21 to 63 years (average 45.5 years) were measured. A total of 19 patients of both sexes (9 male and 10 female) with femoral or tibial fractures and an average age of 47.5 years (varying from 18 to 70) were included in this study. Blood samples were taken on days 3, 10, 20 and 30 after the fracture, for the determination of plasma hydroxyproline (Prockop & Underfriend 1960), calcium (Clark & Collip 1925), phosphate, alkaline phosphatase (King 1953), plasma proteins (biurate method) and C-reactive protein (precipitation in capillary tubes; Anderson & McCarty 1950).

RESULTS

All the results are shown in Table 1. The calcium level, alkaline phosphatase activity and plasma proteins did not change, while a small increase in the phosphatase level did not surpass normal values. In about half of the cases C-reactive protein was found positive. Plasma hydroxyproline did not show a significant elevation.

DISCUSSION

An increase in the alkaline phosphatase activity, calcium, and inorganic phosphorus has been found in the callus soon after a fracture (Bruce & Strachan 1967, Semb & Gudmundson 1969, Raekallio & Makinen 1969, Hekkelman 1970, Gudmundson & Semb 1971 a, b). Collagen is also produced at the fracture site and hydroxyproline values are found to be elevated (Stracher & Firschein 1967).

On the other hand, the metabolic response to fracture is not clear, and many

Table 1. Values of plasma components during the early phases of the healing of femoral and tibial fractures in man.

Plasma component	Normal values	Control	Days after fracture			
			3	10	20	30
Calcium	4.5–5.8 mEq/l	4.85±0.509	4.94±0.554	4.96±0.175	4.94±0.224	5.01±0.554
Phosphates	2–4 mg/100 ml	2.41±0.538	3.71±0.509	3.87±0.475	4.16±1.485	3.81±0.519
Alkaline phosphatase	3–13 units K.A.	8.61±2.75	7.50±5.39	9.49±2.09	8.04±5.98	8.63±3.19
Plasma hydroxyproline	8.3 mg/ml	11.32±2.45	14.69±3.95	14.69±2.52	14.95±3.49	12.68±1.35
Total proteins	6.8 g/100 ml	8.00±0.707	7.28±0.36	7.04±0.721	7.42±0.565	7.65±0.50
Albumin	4–5.7 g/100 ml	5.16±0.565	4.58±0.028	4.31±0.721	4.31±0.509	4.70±2.666
Globulin	1.5–3 g/100 ml	2.84±0.01	2.70±0.099	2.73±0.435	2.85±0.028	2.39±0.80

writers maintain that the plasma phosphatase activity and the calcium and phosphatase levels are not altered (Aegerter & Kirkpatrick 1968, Anderson 1967). In spite of these speculations, changes in these values have been noted in other experimental works (Studer 1965, Struck et al. 1970, Nilssen & Westlin 1972, Heinemann et al. 1973). Circulating hydroxyproline seems to increase also after a fracture (Klein 1966, Fazakas et al. 1969, Struck et al. 1970, Lyritis et al. 1975).

The response to fracture healing of the plasma proteins seems to be more specific, and a decrease in albumin with a simultaneous increase in the α_1 and α_2 globulins has been reported, this occurring between the 4th and 10th day after fracture (Studer 1965, Herold et al. 1968).

In the present series there is evidence that the homeostasis of the plasma components prevents most of them from showing a clear response to fracture, at least during the early phases of the phenomenon. Plasma hydroxyproline increases, but less noticeably than in similar experimental studies (Lyritis et al. 1975). A change of C-reactive protein to positive is considered to be a reaction of the body to the inflammation occurring at the fracture site (Anderson & McCarty 1950).

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