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SERUM IRON INDICES IN VARIOUS TYPES OF ACUTE INFECTION.

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ABSTRACT

Objective of this paper is to describe how iron indices ie Serum iron concentration and Total iron binding capacity are effected during acute infection. Previousely, the work was done on the affect of Acute bacterial infection on Serum iron indices .It was observed that both were reduced .Because micro-organism invades our body and utilises iron for their growth and multiplication. Though ,iron comes under the group of trace element but plays a very important role in our body. A total of 120 patient were taken out of which 50 were healthy control and 70 were those with acute bacterial , viral and protozoal infection. It was observed that there was significant reduction in Serum iron indices as compared to control.And the total protein was slightly high. . Knowledge of these interactions is essential in assessing likely morbidity responses to iron supplementation.

KEYWORDS : Serum iron concentration, Iron binding capacity, Siderophore, Hyperferrimia.

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INTRODUCTION

Infectious disease pervades human existence. Despite decades of dramatic progress in their treatment and prevention, infectious diseases remain a major cause of death and debility and are responsible for worsening the living conditions of many millions of people around the world. Infections frequently challenge the physician's diagnostic skill and must be considered in the differential diagnoses of syndromes affecting every organ system [1]A few centuries back, countries were devasted by small pox, bubonic plague. Fortunately, advances in medical science and public health has markedly reduced the risk of most infectious disease for example disposal of human waste has reduced the frequency of bacterial and helminthic enteric infection. Infection occurs when a pathogenic organism causes sign and symptoms of inflammation or organ dysfunction. It might be due to a number of factors for example 1.Multiplication of pathogen in the host. 2. Intoxication of host by cellular poisons generated by a non-infecting organism. Virulence of pathogens depends on its ability to colonize, proliferate, invade and destroy the host tissue. Normally, they do not grow due to the host defense mechanism. But interruption of defense mechanism will lead to infection. Micro organism like Bacteria, virus and protozoa invades our body and utilizes some of our nutrient for their growth and multiplication [2].Among the 40 or so nutrients essential to human health, iron plays important role in relation to the host' interaction with pathogens like viruses, bacteria and protozoa.[3,4,5] One such nutrient is the trace element "Iron". There is a decrease in Serum Iron Concentration and Total iron binding Capacity during early phase of acute infection.[6] Acute febrile illness of less than 2 weeks duration is usually common in medical practice. The following characteristic though not restricted solely to acute infection, their presence is highly suggestive of infection. They are 1.Abrupt onset 2. High fever ie 38.9 to 40.6^0–C (102-105F) with or without chill. 3. Respiratory symptom 5. GIT symptom 6. Acute tender enlarged lymphnode or spleen 7. Meningeal sign with or without pleocytosis 8.Dysuria.[7]

Hypoferraemia may protect individuals against infection by withholding iron from pathogenic micro-organisms and by reducing the potential pro-oxidant properties of iron which may exacerbate tissue damage at the site of inflammation where reactive oxygen species are being produced and the body's cells are at risk of damage. One theory suggested that lactoferrin acts in the hypoferraemic-hyperferritinaemic response to inflammation by causing a drop in plasma iron concentration and a rise in plasma ferritin by removing iron from transferrin and delivering it to the macrophages [8]. It has been also suggested that as host defense mechanism comes into action making iron non available by trapping it in neutrophil, lactoferrin, transferrinn .[9] As iron is insoluble at physiological pH, availability in vivo is poor (10^{-18}M).[10].Micro organism isolated directly from infection have surface properties similar to those of iron-starved pathogens and number of studies have suggested that iron and iron containing compound increases susceptibility to infection as they utilizes iron for their growth and multiplication.Pathogen like bacteria release low molecular weight siderophore which has high affinity for iron.[11] Another reason for reduction in serum iron concentration is Fenton reaction[6] . Iron catalyses oxidative radical reaction and with formation of Hydroxy radical and there is subsequent lipid peroxidation[12]. These free radical causes severe tissue damage and disruption promoting inflammatory changes in tissue. Along with changes in serum iron there is also change in serum protein. Albumin is reduced while, globulin is high resulting in rise in total protein concentration. Hence, this study was taken up to observe the changes in Serum Iron concentration, Total iron binding capacity with albumin, globulin and total protein in different types of acute infection.

MATERIALS AND METHODS

This work was done in the Department of Biochemistry, Hi-Tech Medical College and Hospital, Bhubaneswar . Mostly the work was confined to serum iron indices. Total protein was estimated with albumin and globulin, hemoglobin, differential count and total leukocyte count. Ethical clearance was taken from local Ethical committee A total number of 120 cases were investigated, out of which 70 were cases of different varieties of acute infection ie. Bacterial, Viral and Protozoa with age and sex matched healthy non-infective controls 50 in number. Consent was taken from all the person ,who were either patient or volunteers .All the glassware and samples tubes were made iron free before they were used by treating them with 6N hydrochloric acid overnight, then washed with distill water and dried. 10ml of free flowing, fasting blood was collected in iron free centrifuge tube or vials. Serum iron concentration was determined by 2-2´ Dipyridyl method [13]. Total iron binding capacity by Dipyridyl method. The Total protein by Biuret method and albumin was determined by Biuret method [14].

COMPARISON OF VALUES BETWEEN CONTROL AND CASES

Table 1
CONTROL VERSUS BACTERIAL INFECTION

	Serum Iron Conc Mean ± SD µgm/dl	Total Iron Binding Capacity Mean ± SD µgm/dl	Total Protein Mean ± SD gm/dl	Albumin Mean ± SD gm/dl	Globulin Mean ± SD gm/dl
CONTROL	78.45±9.8	298.45±40.33	5.84±2.1	3.2±1.1	2.65±0.87
BACTERIAL INFECTION	35.66±5.0	239.3±35.8	7.1±0.9	3.2±1.0	3.96±1.2
T	19.2	4.9	2.4	3.8	4.0
P	< 0.001	< 0.001	< 0.05	< 0.01	< 0.01

Table 2
CONTROL VERSUS VIRAL INFECTION

	Serum Iron Conc Mean ± SD µgm/dl	Total Iron Binding Capacity Mean ± SD µgm/dl	Total Protein Mean ± SD gm/dl	Albumin Mean ± SD gm/dl	Globulin Mean ± SD gm/dl
CONTROL	78.45±9.8	298.45±40.33	5.84±2.1	3.2±1.1	2.65±0.87
VIRAL INFECTION	39.31±6.09	216.0±25.78	7.38±0.87	3.85±1.11	3.52±1.02
T	15.25	6.81	3.29	2.19	2.49
P	< 0.001	< 0.001	< 0.01	< 0.05	< 0.05

Table 3
CONTROL VERSUS PROTOZOAL INFECTION

	Serum Iron Conc Mean ± SD µgm/dl	Total Iron Binding Capacity Mean ± SD µgm/dl	Total Protein Mean ± SD gm/dl	Albumin Mean ± SD gm/dl	Globulin Mean ± SD gm/dl
CONTROL	78.45±9.8	298.45±40.33	5.84±2.1	3.2±1.1	2.65±0.87
PROTOZOAL INFECTION	30.27±2.89	230.6±23.39	6.98±1.07	2.87±0.91	4.16±1.2
T	20.36	5.58	2.22	1.02	4.0
P	< 0.001	< 0.01	< 0.05	< 0.05	< 0.01

RESULTS

Serum iron concentration and Total Iron Binding Capacity in control subject was within normal limits [15]. It ranges from 68-91ug/dl with a mean value of 78.45±9.8ug/dl. It was observed that there was significant reduction in serum iron concentration and Total Iron Binding Capacity as compared to control .In patient with Bacterial, Viral and Protozoal infection the mean was 35.66±5.0ug/dl, 39.31±6.09 ug/dl , 30.27±2.89 ug/dl respectively In each group the concentration was greatly reduced and was highly significant($p< 0.001$). This due to the fact that iron has been found to be an essential nutrient for bacterial growth and multiplication[16]. They even have the ability to scavenge this essential nutrient from an iron restricted environment with the help of the membrane protein Siderophore which has high affinity for iron. It solubilizes ferric iron which reenters the bacteria leading to its growth and multiplication. Another reason for the decrease in serum iron concentration is Fenton-Reaction. The Total iron binding capacity was 298.45±40.33 which is within normal range in control ie 204-300ug/dl [15]. When compared with bacterial, viral and protozoa infection it was greatly reduced . It was found to be 239.3±35.8ug/dl in bacterial, 216±25.78ug/dl in viral and 230.6±23.39ug/dl in protozoa infection respectively. The fall in TIBC was significant ($P<0.001$).The fall in both serum iron concentration and Total iron binding capacity serve as body's defense mechanism which plays important role by making this essential nutrient non-available for the micro-organism. This happens with the trapping of iron in neutrophil, lactoferrin and transferrin as observed by Molly, A.L(1990) and Winterbourne C,C[2]. The follow up study showed that the iron level comes back to normal range within three weeks of infection .As serum iron concentration reached a mean value of 82.8±8.55ug/dl. The total iron binding capacity too was within the range, its mean being 291.2±36.62 ug/dl.

The total protein mean in control was5.84±2.1g/dl, albumin was3.20±1.1 g/dl and globulin mean was 2.65±0.87 .All values were within normal limits. Total protein was increased in all cases of infection. There was a fall in albumin level in all except viral infection ie 3.2±1.0 g/dl in Bacterial, 3.85±1.11 g/dl in viral and 2.87±0.91 in protozoa infection. There is increase in endothelial permeability leading to increase in urinary loss of small molecular weight protein like albumin which might have resulted in either normal or reduced albumin level. Globulin was 3.96±1.2 g/dl in bacterial, 3.52±1.02 g/dl in viral and 4.16±1.24 g/dl in protozoa infection. It was high in all three types of infection influencing the rise in total protein. This could be due to the fact that globulins, mostly serve as antibodies. Hence their synthesis is boosted up.

DISCUSSION

This study was done taking a total no. of 120 cases , out of which 50 were control and 70 were cases of different types of Acute infection ie bacterial, viral and protozoa. It was observed that there was highly significant reduction in serum iron concentration all these patient compared to control. The total iron binding too showed highly significant fall. Globulin concentration was found significantly high in all infected individual with mild rise in total protein. In the light of the observation in this study it is suggested that history of recent infection should be excluded before prescribing supplementation of iron as it might land up in hyperferrimia and excess iron may induce oxidative damage as measured by increases in lipid peroxidation and DNA damage.

CONCLUSION

This shows that iron plays a key role in regulation of host- pathogen interaction by describing the iron acquisition mechanism of the invading pathogen. It also clearly describes how disturbances of iron homeostasis have been implicated in acute infection pathogenesis.

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