CHAPTER III

TRANSFUSION GELATIN: ITS DISCOVERY, PROPERTIES AND USES.
Transfusion gelatin: its discovery, properties & use.

Investigations regarding the manufacture of transfusion gelatin from bone by enzymic process were initiated by Professor B. Desai and of National Chemical Laboratory Poona, India. These were extended by Kalia, Singh, Ram and Weller\(^1\) in the same laboratory leading to the production of improved quality of the product. The technique of manufacture was repeatedly revised in the light of pharmacological tests. The new modified gelatin was termed "plasma expander"\(^1\) of more briefly "expander" since it was found suitable for intravenous injections as a substitute for plasma. The concentration of \(\text{early}\)\(^1\) was 3 percent but it was reduced to 6 percent with improvement in quality. Transfused gelatin (6% concentration in isotonic saline; batch 50.13,) was used throughout our studies on the interaction of metal ions with protein.

Properties:

The properties of transfusion gelatin were extensively studied by Kalia and others (loc. cit). The average molecular weight of the protein was found to be 78000. The relative viscosity and pH of the gelatin solution was reported\(^2\) to be 3.0 - 3.5 and 7.8 respectively. The gelling temperature was found to lie between 4-7°C. Wiggers\(^3\) found that plasma proteins were not regenerated for at least six
hours during non-fatal haemorrhage. It was therefore reason-
ably assumed by Kaipa and co-workers (loc.cit.) that the
change in the concentration of plasma protein, at the end
of four hours after infusion of transfusion gelatin should
be attributed to the dilution by the protein. This dilu-
tion was calculated (Kaipa et al., loc.cit.) by the help of
the expression.

\[ c = V \left( 1 - \frac{p}{P} \right) \]

where \( c \), \( V \), \( p \), \( P \) are the gelatin retained in the blood
stream, plasma volume at the end of four hours, plasma
protein concentration at the end of four hours, and the
plasma protein concentration in the beginning, respectively.
The water holding capacity of transfusion gelatin thus
calculated was 14 g 2.5 cc/gm. It is worthwhile to mention
here that storage at 37°C for one year did not bring about
any change in its physical properties. It conforms to the
limit tests for lead, zinc, arsenic, acetone and sulphur
dioxide as laid down by Indian Pharmacopoeia.

The pharmacological properties of gelatin were also
tested according to the standards laid down in the
Indian Pharmacopoeia. It has been successfully tried in
haemorrhaged dog's, splenectomised dog's and latter on the
original pharmacological findings on animals were confirmed
in fifteen human cases. It was pointed out that the gelatin was not pyrogenic or antigenic. Tests on rabbits, guinea pigs and dogs revealed that the gelatin was not toxic and had no adverse effects on the kidney and the liver. Neither did it cause antibody formation nor did it enhance the progress of pyogenic infection. After substituting half of the blood with transfusion gelatin in dogs, no effect on coagulation time, as determined by the capillary method, of the blood was noticed although its sedimentation rate was increased. Studies on the blood volume before bleeding and four hours after transfusion of the gelatin showed that the blood restored originally to 100% on a calculated basis was found to be 90% at the end of four hours. Furthermore blood pressure was restored to normal in fifteen minutes and sustained at that level for four hours and more. Estimation of gelatin in blood and urine following Hoffman and Kossel, and Metcalfe and Rouxlelet, carried out in National Chemical Laboratory Poema, revealed that in dogs, the gelatin was excreted to the extent of 37% at the end of four hours and 93% in four days. In survival experiments on dogs and rabbits it was found that replacement of half of the blood by transfusion gelatin in case of dogs and 50% of blood by the protein in case of rabbits did not cause any death.
In view of its unique properties, physical as well as pharmacological, transfusion gelatin can very well compete with other expanders such as Dextran (Bengar Laboratories Ltd., U.K.) and modified fluid gelatin (Charles, B.Knox Co., U.S.A.) for the purpose of transfusion.

It has been reported that the transfusion of Dextran may cause symptoms of urticaria, angioedematous oedema and asthma and may also have certain other undesirable side effects. The modified fluid gelatin (Knox Co., U.S.A.), less concentrated than transfusion gelatin or dextran and with greater water-holding capacity, was also found to be not as good as other expanders (Kalra et al., loc.cit). Of the other advantages attributed to transfusion gelatin mention may be made of its non-toxic non-antigenic properties and no side effects on the capillary permeability. It has got the fluidity which is within the normal limits of the relative viscosity of human plasma. Its comparatively low gelling temperature viz; 4-7°C makes it quite suitable for use in most of the climates as the process of preserving, to make it fluid would not be required. It should be noted that gum arabic, saline, glucose solution and other substances have been used in immediate treatment in case of rapid reduction of blood volume due to haemorrhage, but neither of these have been found entirely satisfactory. Blood or plasma transfusion is undeniably very useful in
such cases, but neither may be readily available. Trans-
fusion gelatin with its many useful properties offers great
promise as a good expander and hence deserves special atten-
tion for more studies - physical as well as physico-chemical.

REFERENCES

2. P. N. Bhardwaj and M. Ram, A.F.M.O. (India), 14, 63, 1960.