SUMMARY AND CONCLUSIONS
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The present work has been carried out in the Department of Pediatrics, M.L.B. Medical College and Allied Hospital, Jhansi, with active collaboration of Department of Obstetrics and Gynaecology. Eighty newborns belonging to various clinical groups were subjected to immunological studies for the purposes of the present study. Out of these, 20 were normal healthy full-term neonates taken as control, 20 were low birth weight infants, 20 cases were of neonatal hyperbilirubinemia, while the remaining 20 newborns had infections. All the cases were selected only after satisfying the selection criteria for each study group. A detailed history and physical examination of the mother was done along with special stress over the antenatal and natal factors. Necessary investigations to confirm the diagnosis, were carried out in each case. All the newborns were subjected to various immunological tests for assessment of humoral immunity according to the method given by Mancini et al (1965) and modified by Fahey et al (1965).

Brief account of the work conducted in the present study is being summarised here.
Group I (CONTROL) Full term normal newborns -

Twenty full term normal, healthy newborns acted as control in the present study. Following are the values of immunoglobulins and complement $C_3$ in the control group of cases.

**Serum IgG levels**

The mean serum IgG level in the cord blood of the control group of cases was $1365.00 \pm 453.41$ mg%, with a range of 1050.00 to 2500.00 mg%.

**Serum IgM levels**

The values of serum IgM, obtained in control cases had a mean $\pm$ S.D. of $22.70 \pm 4.76$ mg%, with a range of 17.00 to 28.00 mg%.

**Serum complement $C_3$ levels**

The values of serum complement $C_3$ in the cord blood of the control group had a mean $\pm$ S.D. of $51.40 \pm 18.76$ mg% with a range of 34.50 to 74.50 mg%.

Amongst the 20 control group of cases, there were 8 cases having gestational age of 38 weeks, 2 cases of 39 weeks and 10 cases of 40 weeks. On evaluating the IgG levels in these sub-groups of control group of cases, a significant finding observed was, that cases having
gestational age of 40 weeks had mean values of 1610.00 ± 549.31 mg%, which was found to be highly significant from mean values (1137.5 ± 110.86 mg%) observed in the 8 cases having gestational age of 38 weeks (P ≤ 0.05). Our observation of the IgG levels in normal healthy full term newborns, therefore amply demonstrate, that there is a linear correlation between increasing gestational age and the increasing levels of immunoglobulin IgG. However, no such correlation of the increasing gestational age to the IgM and complement C₃ values was seen in our study.

Group II - Low birth weight newborn babies -

Twenty low birth weight babies (less than 2500 gms.), which included both premature and IUGR (10 cases in each group) babies constituted this group of our study. Following are the values of IgG, IgM and complement C₃, obtained in our study.

Serum IgG levels

The mean value of immunoglobulin IgG in low birth weight infants was 1050.25 ± 515.00 mg% with a range of 450.00 to 2000.00 mg%. These values were found to be significantly lower when compared with the control group (P ≤ 0.05).

The mean value of immunoglobulin IgG in premature babies was 800.50 ± 232.38 mg% with a range of 450.00 to 1002.00 mg% and this value was significantly lower (P ≤ 0.01) as compared to the control group.
The value of IgG in the IUGR babies had a mean 
± S.D. of 1300.00 ± 501.24 mg% with a range of 700.00 to 
2000.00 mg%. However, a comparison of these values with 
the control group did not reveal any significant difference 
($p_g > 0.05$).

On statistical analysis of IgG values in sub-groups 
of low birth weight babies, it was observed that IUGR babies 
demonstrated higher values as compared to the premature 
babies and the difference was statistically significant 
($p_g < 0.01$).

The decrease observed in the IgG levels in low 
birth weight babies in our study is mainly accounted by 
the premature babies. This is further substantiated by 
the fact that two most premature babies of 30 weeks 
gestational age, having birth weight of 800 gm each, 
manifested the least values of serum IgG. Since the major 
portion of the IgG of the newborn is derived transplacentally 
from the mother during the third trimester of pregnancy, 
the decrease in the level of this class of immunoglobulins 
in premature babies can be accounted by the shorter period 
of gestation available in these neonates for the transfer 
of this immunoglobulin IgG.

The IUGR babies did not show any significant 
difference in the IgG levels from the control group of 
cases, possibly due to the fact, that all our IUGR babies 
were having mild intra-uterine growth retardation.
Serum IgM levels

The mean value of IgM in low birth weight neonates was 30.05 ± 15.02 mg% with a range of 11.00 to 49.50 mg%. On comparison of these values with that observed in the control group of cases, a significant increase was observed ($P_M \leq 0.05$) in the low birth weight group as compared to the control.

The mean value of immunoglobulin IgM in premature babies was 18.1 ± 7.30 mg% with a range of 11.00 to 28.00 mg% and this value was significantly lower ($P_M \leq 0.05$) as compared to the values observed in the control group of cases.

The value of IgM in the IUGR babies had a mean ± S.D. of 42.00 ± 9.88 mg% with a range of 25.00 to 49.50 mg%. On comparison of these values with the values observed in the control group, a significant increase ($P \leq 0.01$) was observed in the intra-uterine growth retarded babies.

When a comparison of the IgM values was done between the sub-groups of low birth weight babies, a significantly higher difference was observed in the values of IgM ($P_M \leq 0.01$) in the IUGR babies.

The increase observed in the serum IgM levels in low birth weight babies in our study is mainly accounted by rise of immunoglobulin IgM in IUGR group of babies.
It was also observed in our study, that premature babies demonstrated lower levels of immunoglobulin IgM while IUGR babies manifested with highest level of IgM. The rise of IgM in IUGR babies is easily explainable since all these babies were an outcome of deliveries in which the mother had some systemic disease or infection. The low levels of IgM in premature babies goes to prove that immunoglobulin IgM has got no correlation to the gestational age.

**Serum complement C₃ levels**

The mean serum complement C₃ value of the low birth weight babies was 42.55 ± 6.59 mg% with a range of 31.50 to 57.50 mg% which did not reveal any significant difference when compared to the control group value (P > 0.05).

The mean value of complement C₃ in the premature babies was 38.90 ± 4.72 mg% with a range of 31.50 to 44.50 mg%. These values were found to be significantly lower when compared to the values observed in the control group of cases (P_C < 0.05).

The mean serum complement C₃ value in the low birth weight IUGR babies was 46.20 ± 6.49 mg% with a range of 41.50 to 57.50 mg%. No significant difference was observed when this value was compared with that observed in the control group (P_C > 0.05).
When complement $C_3$ values obtained in the sub-groups of low birth weight babies were compared with one another, it was observed that IUGR babies had higher values as compared to the premature babies ($P_C \leq 0.05$).

A significant finding of complement $C_3$ activity in low birth weight babies was, that premature babies had lower values of serum complement $C_3$. The depression of complement activity in premature babies is well documented fact in literature, which accounts for one of the factors enhancing infection in the premature babies. Another fact highlighted by our study was that IUGR babies had more or less normal complement activity, akin to that observed in full term babies.

**Group III - Neonatal hyperbilirubinemia**

Twenty neonates having neonatal hyperbilirubinemia of 3 to 6 days duration, bilirubin level ranging from 10.8 mg% to 30 mg%, with a mean of $19.34 \pm 7.33$ mg% constituted the present group in our study. Out of these 20 neonates, 14 were having prolongation of physiological jaundice due to umbilical sepsis, 4 had Rh incompatibility and remaining 2 neonates had jaundice within physiological limits.

The values of immunoglobulins and complement $C_3$ detected in our study are as follows -
**Serum IgG levels**

The mean value of serum IgG in neonates having hyperbilirubinemia was $1139.25 \pm 319.85$ mg% with a range of 750 to 1550 mg per 100 ml. It is evident from our study, that infants with hyperbilirubinemia did not reveal any significant alteration in the mean serum IgG values as compared to control group of cases ($P_G > 0.05$). It is thus evident from our study that hyperbilirubinemia per se has no effect on the immunoglobulin IgG.

**Serum IgM levels**

The mean value of serum IgM in the neonatal hyperbilirubinemia group was $50.60 \pm 14.30$ mg% with a range of 27.50 to 65.00 mg per 100 ml. The mean value of IgM was higher in the neonatal hyperbilirubinemia group as compared to the control group of cases, values being statistically significant ($P_M < 0.01$).

The rise in the IgM level in cases of hyperbilirubinemia could possibly be because of associated infections in many of our cases, which is substantiated by the fact that highest values of IgM were found in severe neonatal hyperbilirubinemia which are more prone to infection.

**Serum complement C₃ levels**

Infants with hyperbilirubinemia were having mean serum complement C₃ values of $70.45 \pm 23.65$ mg% with a
range of 44.00 to 110.50 mg%. A comparison of these values to the values observed in the control group of cases revealed a highly significant rise ($P \leq 0.01$) of the serum complement $C_3$ level in the neonates having hyperbilirubinemia.

A rise in the values of complement $C_3$ activity was observed in our study in cases of neonatal hyperbilirubinemia. This rise of complement activity in these cases is not easily explainable since many of the cases of neonatal hyperbilirubinemia were also having umbilical sepsis. Why there was a rise of complement activity in hyperbilirubinemia remains still to be answered and further work has to be done to elucidate the effect of hyperbilirubinemia on complement activity. However, it has been mentioned in literature that complement activity may be normal or elevated earlier in the disease and declines in the late terminal stages of the infection.

In our study, we also observed an inverse correlation between the increasing serum bilirubin levels to the decrease in the serum IgG as well as complement $C_3$ activity in cases of neonatal hyperbilirubinemia, values being maximally decreased in cases with serum bilirubin above 20 mg%. Contrary to this a direct correlation was observed in serum IgM values with increasing severity of jaundice, value being highest in those cases having serum bilirubin more than 20 mg%.
Group IV - Neonatal infections -

Twenty newborns suffering from various infections were selected for the present study. Out of these 20 neonates, 6 had umbilical sepsis, another 6 had pyogenic meningitis, 4 were having pneumonitis while remaining other 4 had neonatal septicemia with multiple pyemic abscesses. All the cases having infections were subjected to various tests for the assessment of serum IgG, IgM and complement C₃. The values of immunoglobulins and complement C₃ observed in our study are as follows -

Serum IgG levels

The mean IgG value in cases of neonatal infections group was 865.00 ± 97.32 mg% with a range of 700.50 to 1050.00 mg%. These values were found to be significantly lower than compared to the values observed in the control group of cases (P < 0.01).

This significant finding of decrease in IgG in cases of neonatal infection is easily explainable on the basis, that decreased levels of IgG is the cause of infection in the newborn babies.

Serum IgM levels

The mean value of immunoglobulin IgM in cases of neonatal infections group was 66.05 ± 18.36 mg% with a range of 27.50 to 85.00 mg% which was significantly higher
The significant findings of raised levels of immunoglobulin IgM in response to infections is possibly an exaggeration of the normal response to a myriad of antigens in the extra-uterine environment.

**Serum complement C₃ levels**

The mean value of complement C₃ in cases of neonates having infections, was $34.60 \pm 6.87$ mg% with a range of 27.00 to 44.50 mg%. A comparison of these values to the values observed in the control group of cases revealed a significant decrease of the serum complement C₃ level in the neonates having infections.

This significant finding of decreased complement C₃ activity in infected neonates could be explained on the basis of consumption of various components of complement system in various infections.

An attempt was also made in our study to observe a correlation of the severity of neonatal infection, to the immunological profile of the newborn babies. It is evident from our study, that whereas serum IgG levels decreased with increasing severity of neonatal infection, the values of IgM on the contrary increased with severe infection. Neonatal septicemia with multiple pyemic abscesses, the most severe form of neonatal infection in our study, recorded the lowest values of IgG and the highest values of immunoglobulin IgM. However, cases of umblical sepsis,
the milder form of neonatal infection recorded higher values of IgG and low levels of IgM. A fall and rise of IgG and IgM respectively are the cause and effect of neonatal infection.

Another highlight of the present study in neonatal infection was, that staphylococcus aureus was found to have a greater impact on the humoral immune status of the newborn baby as compared to the E. coli infection. However, further work is needed in larger number of infected babies to confirm the above observations.

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