

Red Blood Cell Metabolism in Goats after Blood Transfusion

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Introduction

Four reports have appeared on erythrocyte survival after blood transfusion in the goat (Kaneko & Cornelius, 1962; Wels & Horn, 1966; Fitzsimmons et al., 1967; Gulliani, 1975). Fitzsimmons et al. (1967) described that "We are not aware of any published work on blood transfusion and red cell survival in goats except that of Wels & Horn (1966)". In order to understand that the blood physiology of goat, the following experiment was undertaken in which some biochemical parameters of the RBC and the possibility of producing sustained polycythemia by infusion of homologous erythrocytes were studied in goats after they had blood transfusion.

Materials and Methods

Seven adult Angora goats were used. Three recipients and four as donors. Blood was collected with aseptic precautions from a jugular vein of the donor goats into acid citrate dextrose (ACD) solution (100ml per 350ml of blood). Blood was given over a period of about 20 minutes in the jugular vein. Approximately 350ml of blood was transfused on 2 consecutive days. After each transfusion the animals were observed for one hour for clinical response. Temperatures and pulse rates were not recorded. Samples were collected into heparinized tubes for hematological and chemical estimations. The packed cell volume (PCV) was determined with a micro-hematocrit centrifuge (Hawksley, London).

Hemoglobin (Hb) concentrations were determined using a Spectronic 20 (Bausch & Lomb). Reduced glutathione (GSH) levels were measured using the method of Beutler (1975). Adenosine triphosphate (ATP) and 2,3-diphosphoglycerate (2,3-DPG) levels were determined by Sigma and Calbicochem kits respectively.

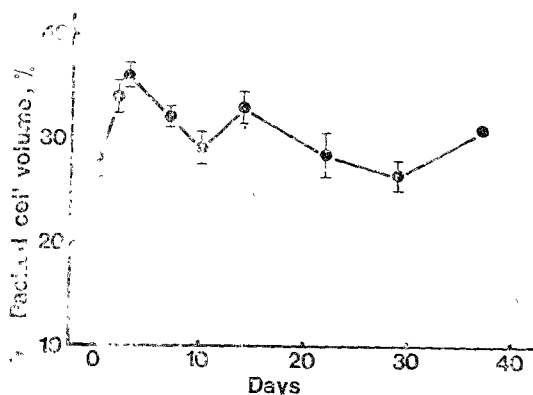


Fig. 1 Effect of blood transfusion on PCV.

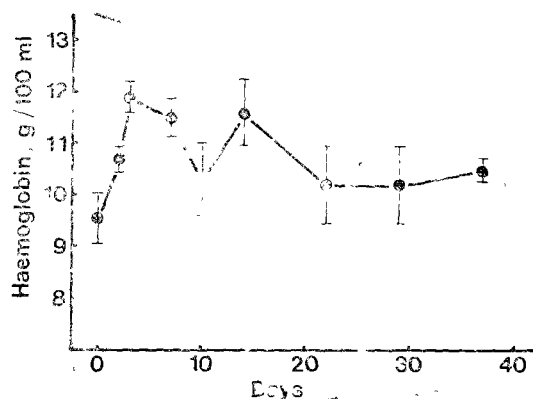


Fig. 2 Effect of blood transfusion on Hb.

Results

All goats remained in good clinical status throughout the duration of study. The PCV increased from a mean of 28.3% to 36.1% (Fig. 1) and Hb concentration from 9.5g % to 11.9g % (Fig. 2) on day 4 of rise of both these parameters was statistically significant and the values returned to pretransfusion value by day 11. GSH concentration increased from an average of $3.2\mu\text{M/g Hb}$ to $4.1\mu\text{M/g Hb}$ by day 8 and then fell steadily. However this increase was not significant (Fig. 3).

The level of red blood cell ATP was not changed significantly from an average of $1.8\mu\text{M/g Hb}$ during the first 10 days (Fig. 4). Changes in the level of red blood cell 2,3-DPG did not significantly changed throughout all the experimental period (Fig. 5).

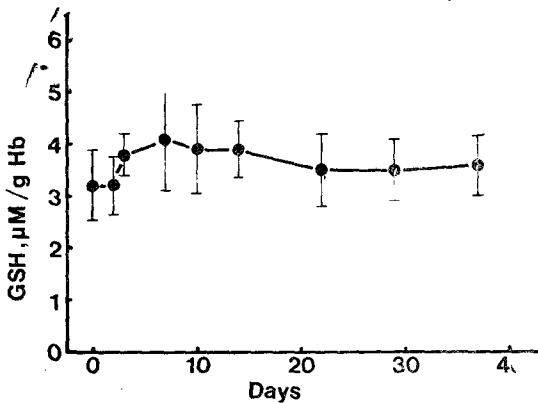


Fig. 3 Effect of blood transfusion on GSH.

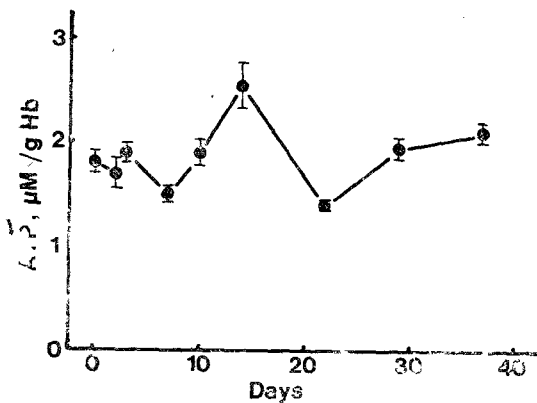


Fig. 4 Effect of blood transfusion on ATP.

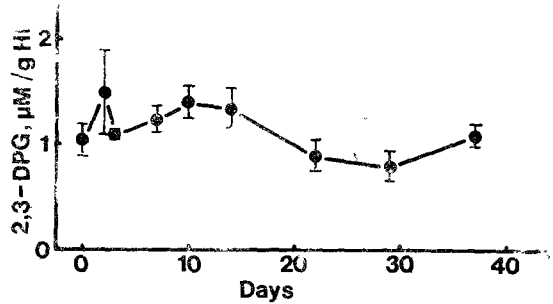


Fig. 5 Effect of blood transfusion on 2,3-DPG.

Discussion

Wels & Horn (1966) studied autologous red blood cell survival in eight white German pedigree goats, using the ^{51}Cr method of labelling. They estimated the half life of the red blood cells to be 12.4 days as compared with Fitzsimmons et al. (1967) figure of 15.8 days and 8 days were obtained by Gulliani et al. (1975)

In the case of homologous transfusion the mean half lives and one percent survival times were 3.4 and 8.2 days by Fitzsimmons (1967). The half-survival time of ^{51}Cr -tagged homologous erythrocytes on two goats by Gulliani (1975) was approximately 2.4 and 5.1 days, respectively. After homologous transfusion of ^{51}Cr labeled caprine erythrocytes virtually all activity had disappeared from circulation by the 7th day (Gulliani et al., 1975). Similar rapid losses of activity have been reported after transfusion of ^{59}Fe - and ^{51}Cr -labeled erythrocytes in cattle (Baker et al., 1961; Schnappauf et al., 1965; McSherry et al., 1966; Schnappauf et al., 1966; Kallfelz & Whitlock, 1973), ^{51}Cr -labeled erythrocytes in sheep (Drury & Tucker, 1958; Giles et al., 1975) and swine (Talbot & Swenson, 1963). The most likely explanation of the apparent shortened survival is the action of serum-hemolyzing isoantibodies. Such isoantibodies have been demonstrated in the plasma of cattle (Stone & Mitter, 1961) and sheep (Drury & Tucker, 1958). From these results it can be concluded that a clinical

cal reaction to the intravenous transfusion of homologous is unlikely to occur in the goat. However the degree to which such a transfusion is likely to be of any value to a recipient in need of red blood cells is variable. Clearly the goats may be divided into transfusion tolerant and intolerant groups. Unfortunately there is, at present, no satisfactory in vitro method of predicting whether any particular pair of goats would make a good donor-recipient combination (Fitzsimmons et al., 1967).

The author is not aware of any published work on the effect of blood transfusion on red blood cell glycolytic intermediates (GSH, 2, 3-DPG and ATP) in the goat. As shown in fig. 1 & 2 the PCV and Hb concentration were significantly increased after blood transfusion but there was no change in the levels of GSH, 2, 3-DPG and ATP. There is a feed-back relationship between erythropoiesis and the numbers of red blood cell in peripheral blood. The hematological constituents (PCV and Hb) were significantly increased, so if the feed-back mechanism works, the new red blood cells making should be reduced. The activity of reticulocytes is higher than that of mature cells. The biochemical constituents did not fall indicating that the new red blood cells were produced at normal rate because the transfused red blood cells disappeared so quickly in the present data.

Conclusion

The present study was designed to investigate as part of polycythemia and the possibility of producing sustained polycythemia and the changes of biochemical constituents by infusion of homologous erythrocytes. The results obtained are summarized as follows:

1. The homologous goat erythrocytes disappeared from circulation very rapidly, thereby indicating that it is not possible to produce sustained polycythemia with homologous erythrocytes without appropriate matching.

2. The PCU and Hb concentration were significantly increased after two consecutive days of blood transfusion. However the biochemical constituents

(GSH, 2, 3-DPG and ATP) were not significantly changed.

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山羊에서 輸血後의 赤血球 代謝에 關하여

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抄 錄

山羊에서 輸血後 赤血球過多症을 지속시킬 수 있는지 또 解糖中間生産物들이 어떻게 變하는 가에 關하여 研究한 바 아래의 結論을 얻었다.

1. 山羊의 相同赤血球는 순환혈액에서 곧 사라졌다. 이와 같은 현상은 輸血赤血球가 지속적으로 赤血球過多症을 일으킬 수 없다는 것을 시사한다.

2. 赤血球容積과 血色素濃度는 輸血後 有意性 있게 증가되었으나 解糖中間生産物인 GSH 2,3-DPG 및 ATP는 有意性 있게 變하지 아니하였다.