Blood Transfusion Studies In Sheep and Goat

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(Received : October, 2022 227/22 Accepted : April, 2023)

Abstract
The present study entitled “Blood transfusion studies in sheep and goats” was conducted for a period of 12 months, from September 2019 to August 2020, with the objectives of studying the shelf life of donor blood and blood transfusion protocol in sheep and goats. Blood was collected in CPDA blood bags (@10-15ml/kg body weight) from 10 apparently healthy sheep and goat donors. Anaemia was diagnosed based on clinical examination and haemato-biochemical studies. Blood transfusion was carried out (with stored blood) in 6 sheep and 9 goats (@ 10-15ml/ kg body weight) post cross matching. Haemato-biochemical studies showed significant increase in Hb, PCV and total protein values in sheep and significant increase in Hb, PCV, RBC, WBC and eosinophils in goats after blood transfusion. In the present study, blood transfusion carried out was successful in all cases without any adverse reactions.

Key words: Sheep and goats – Anaemia – Blood transfusion

Anaemia is a decrease in the total amount of red blood cells or haemoglobin in the blood or a lowered ability of the blood to carry oxygen, associated with haemorrhage and increased destruction or the inefficient production of erythrocytes. Clinical signs of anaemia include pallor of mucous membranes, tachycardia, lethargy, exercise intolerance, ileus, decreased rumination and colic, or a combination of the above. Therapeutic management of anaemia can be done by treating the underlying cause, blood transfusion and haematinics. Even though the complications of blood transfusion and post-transfusion reactions are very less in small ruminants, few efforts have been taken to consider blood transfusion as a regular, lifesaving therapeutic protocol in anaemic sheep and goats.

Design of the Study
Whole blood was collected from 10 apparently healthy sheep and goats in Citrate-phosphate-dextrose-adenine (CPDA) blood bags (@10-15ml/kg body weight). Blood bags were procured from blood bank, Madras Veterinary College, Chennai 600 007. The collected blood was stored at 4-6°C and analysed for the integrity of red blood cells every day up to 20 days for transfusion in anaemic animals.

Clinical Cases
Sheep and goats that were brought to medical small ruminant unit of Veterinary Clinical Complex, Veterinary College and Research Institute, Namakkal with clinical signs of anaemia were screened. They were subjected to detailed physical, haemato-biochemical, peripheral blood smear, fine needle aspiration biopsy, faecal examination and ultrasonography. Animals with anaemia were transfused with stored whole blood as per standard protocol.

Twenty apparently healthy animals (10 sheep and 10 goats) were selected from different areas of Namakkal as donors. Blood was collected in blood bags containing CPDA (7:1) as anticoagulant by jugular puncture (@10-15ml/kg) (Roberson, 2010). Cross-matching was done before blood transfusion to detect the presence of pre-existing antibodies to avoid immune-mediated reactions (Kumar, 2017). The sheep with a PCV of less than 27 per cent (Radostits et al., 2007) and goats with a PCV of less than 22 per cent (Anumol et al., 2011) were considered as anaemic. Blood transfusion was carried out as per the standard protocol (Roberson, 2010)
in anaemic animals. Blood was transfused at 10-15ml/kg by monitoring the vital parameters before, during and after transfusion at regular intervals. The data obtained were statistically analyzed as described by Snedecor and Cochran (1994).

**Results and Discussion**

The present study was carried out with apparently healthy sheep and goats; and sheep and goats with incidence of anaemia due to various etiologies. The selected animals were screened for anaemia based on history, clinical, haematobiochemical examination, faecal sample examination and presence of ectoparasites on the body. The data generated in the present study were used for statistical analysis following standard methods and results were presented.

**Blood Transfusion**

In both, sheep and goats, no haemagglutination or haemolysis was noted either macroscopically or microscopically during cross matching of donor and recipient blood, indicating that donor blood was compatible with recipient blood for transfusion. There was no incompatibility observed during cross matching of donor and recipient blood in the present study, probably due to the weak antigenicity of ruminant blood, which was in agreement with the findings of Ermilio and Smith (2011). In sheep, there was a marked change in the behaviour of the animals observed soon after transfusion. Animals were more alert, there was improvement in posture from recumbency to an upright posture and they began to stand and start walking soon after. One animal (16.67 per cent) started taking feed and water within 30 minutes, whereas 5 animals (83.88 per cent) began within 24 hours post-transfusion. Three animals (50.00 per cent) urinated within 30 minutes and 3 animals (50.00 per cent) within 24 hours post-transfusion. Four animals (66.67 per cent) defecated within 30 minutes and 2 animals (33.33 per cent) within 24 hours post-transfusion.

In goats, two animals (22.22 per cent) started taking feed and water within 30 minutes, whereas four animals (44.44 per cent) began within 24 hours post-transfusion. Six animals urinated (66.67 per cent) within 30 minutes and three animals (33.33 per cent) within 24 hours post-transfusion. Six animals (66.67 per cent) defecated within 30 minutes and three animals (33.33 per cent) within 24 hours post-transfusion. In the present study, all the animals became bright and alert, able to stand and walk, voided urine and dung, started taking feed and water within 24 hours after blood transfusion. These findings were in agreement with Kaltungo et al., 2016; Najarnezhad et al., 2016. Sousa et al. (2014) based on their studies on blood transfusion in sheep stated that, due to anaemia, there was sympathetic vasoconstriction of blood vessels in the kidneys and gastrointestinal tract.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Parameters</th>
<th>Sheep (n=6)</th>
<th>Goats (n=9)</th>
<th>p-value Before transfusion</th>
<th>p-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Before</td>
<td>24hrs. after</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>transfusion</td>
<td>transfusion</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1.</td>
<td>Hb (g/dl)</td>
<td>4.90 ± 0.37</td>
<td>6.42 ± 0.27</td>
<td>0.008**</td>
<td>5.00 ± 0.70</td>
<td>7.72 ± 0.44</td>
</tr>
<tr>
<td>2.</td>
<td>PCV (%)</td>
<td>12.53 ± 0.72</td>
<td>17.81 ± 1.82</td>
<td>0.022**</td>
<td>12.28 ± 1.31</td>
<td>20.94 ± 1.24</td>
</tr>
<tr>
<td>3.</td>
<td>RBC (10⁶/cumm)</td>
<td>7.36 ± 1.68</td>
<td>11.81 ± 1.90</td>
<td>0.11NS</td>
<td>9.19 ± 1.01</td>
<td>12.78 ± 0.95</td>
</tr>
<tr>
<td>4.</td>
<td>MCV (fl)</td>
<td>23.34 ± 3.21</td>
<td>18.63 ± 3.47</td>
<td>0.34NS</td>
<td>14.41 ± 2.23</td>
<td>17.13 ± 1.74</td>
</tr>
<tr>
<td>5.</td>
<td>MCH (pg)</td>
<td>7.24 ± 1.05</td>
<td>6.98 ± 1.33</td>
<td>0.88NS</td>
<td>5.52 ± 0.71</td>
<td>6.26 ± 0.54</td>
</tr>
<tr>
<td>6.</td>
<td>MCHC (g/dl)</td>
<td>29.67 ± 1.92</td>
<td>34.92 ± 1.75</td>
<td>0.08**</td>
<td>40.06 ± 3.55</td>
<td>37.05 ± 1.43</td>
</tr>
<tr>
<td>7.</td>
<td>WBC (10⁶/cumm)</td>
<td>9.34 ± 2.37</td>
<td>10.93 ± 2.94</td>
<td>0.68NS</td>
<td>14.01 ± 0.55</td>
<td>15.42 ± 0.34</td>
</tr>
<tr>
<td>8.</td>
<td>Neutrophils (%)</td>
<td>18.80 ± 9.45</td>
<td>27.82 ± 10.08</td>
<td>0.53NS</td>
<td>44.60 ± 7.37</td>
<td>46.25 ± 9.35</td>
</tr>
<tr>
<td>9.</td>
<td>Lymphocytes (%)</td>
<td>80.53 ±10.07</td>
<td>71.02 ± 10.73</td>
<td>0.53NS</td>
<td>53.63 ± 7.57</td>
<td>51.60 ± 9.50</td>
</tr>
<tr>
<td>10.</td>
<td>Monocytes (%)</td>
<td>1.30 ± 0.68</td>
<td>1.17 ± 0.68</td>
<td>0.89NS</td>
<td>1.77 ± 0.65</td>
<td>1.91 ± 0.54</td>
</tr>
<tr>
<td>11.</td>
<td>Eosinophils (%)</td>
<td>0.50 ± 0.0</td>
<td>0.07 ± 0.07</td>
<td>0.06NS</td>
<td>0 ± 0</td>
<td>0.57 ± 0.03</td>
</tr>
</tbody>
</table>
Posttransfusion, there was an increase in the total blood volume in the body that caused redistribution of the blood volume and subsequent resumption of the normal function of the kidneys and GIT, which allowed for micturition and defecation.

**Clinical examination after blood transfusion**

In sheep and goats, the vital parameters of recipients were monitored before, during and after transfusion, at regular intervals to check the stability of animals and to assess recovery. In sheep, rectal temperature before, during, 30 minutes and 24 hours post-transfusion was noted as 38.1 ± 0.3°C, 38.6 ± 0.3°C, 39 ± 0.2°C and 38.9 ± 0.3°C. Heart rate before, during, 30 minutes and 24 hours post-transfusion was noted as 87 ± 3 beats per minute, 93 ± 2 beats per minute, 92 ± 2 beats per minute and 89 ± 1 beats per minute, respectively. Respiratory rate before, during, 30 minutes and 24 hours post-transfusion was noted as 27 ± 2 breaths/minute, 32 ± 1 breaths/minute, 30 ± 1 breaths/minute and 24 ± 2 breaths/minute, respectively. In goats, rectal temperature before, during, 30 minutes and 24 hours post-transfusion was noted as 38.1 ± 0.3°C, 38.8 ± 0.4°C, 38.9 ± 0.3°C and 38.3 ± 0.4°C, respectively. Heart rate before, during, 30 minutes and 24 hours post-transfusion was noted as 119 ± 12 beats per minute, 135 ± 13 beats per minute, 123 ± 10 beats per minute and 99 ± 11 beats per minute, respectively. Respiratory rate before, during, 30 minutes and 24 hours post-transfusion was noted as 31 ± 2 breaths/minute, 42 ± 4 breaths/minute, 39 ± 4 breaths/minute and 35 ± 1 breaths/minute, respectively.

The colour of the mucous membranes became pink and moist after the blood transfusion. Rumination was observed in all the animals after transfusion. Capillary refill time was reduced and colour of mucous membranes started improving as the blood volume increased. Rumination was observed within 24 hours in all animals. Similar findings were observed by Klaser et al. (2005), Najarnezhad et al. (2016) and Sousa et al. (2012, 2014).

**Haematology and serum biochemistry after blood transfusion**

In sheep, there was a highly significant (p<0.01) increase in the value of haemoglobin and PCV. The average value of RBC count was found to increase post-transfusion; however, the increase was statistically insignificant (p>0.05). In goats, there was a highly significant (p<0.01) increase in the value of haemoglobin and PCV and a significant (p<0.05) increase in the value of RBC, indicating improvement in condition. There was a significant (p<0.05) increase in the value of WBC and a highly significant (p<0.01) increase in the level of eosinophils post-transfusion, possibly due to a febrile, non-haemolytic reaction.

In goats, highly significant (p<0.01) increase in the value of haemoglobin and PCV and a non-significant (p>0.05) increase in RBC count and in goats, a highly significant (p<0.01) increase in the value of haemoglobin, PCV and eosinophils and a significant(p<0.05) increase in RBC and WBC count were observed 24 hours after blood transfusion. Jones and Allison (2007) reported that physiologic leukocytosis results from epinephrine release during excitation brought by an increase in blood pressure and splenic contraction, leading to transient mild leukocytosis and mature neutrophilia.

Najarnezhad et al. (2016) stated that transfusion of whole blood @ 15ml/kg BW could increase the recipient’s PCV by 3.25 per cent. Post-transfusion, there was a significant increase in haematological parameters including RBC count and PCV, indicative of an increased supply of circulating blood volume. A significant rise was also noted in the WBC count, possibly as an immune response, or due to storage.

**Table II. Serum biochemistry in anaemic sheep and goats before transfusion and 24hrs after transfusion (Mean ± S.E.)**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Parameters</th>
<th>Sheep(n=6) Before transfusion</th>
<th>Sheep(n=6) 24hrs. after transfusion</th>
<th>p-value</th>
<th>Goats(n=9) Before transfusion</th>
<th>Goats(n=9) 24hrs. after transfusion</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Total Protein (g/dl)</td>
<td>5.54 ± 0.36</td>
<td>6.90 ± 0.36</td>
<td>0.02*</td>
<td>5.49 ± 0.43</td>
<td>5.98 ± 0.39</td>
<td>0.4NS</td>
</tr>
<tr>
<td>2.</td>
<td>Albumin (g/dl)</td>
<td>2.39 ± 0.28</td>
<td>2.53 ± 0.33</td>
<td>0.75NS</td>
<td>1.93 ± 0.19</td>
<td>2.35 ± 0.20</td>
<td>0.2NS</td>
</tr>
</tbody>
</table>

NS: Non-significant (P>0.05) *Significant (P<0.05) **Highly significant (P<0.01)
related lysis of leucocytes that caused release of cytokines and inflammatory immuno-modulators like histamine, responsible for triggering an immune response and the subsequent increase of WBCs post-transfusion (Kisielewicz and Self, 2014).

In goats, there was an increase in the average value of total protein and albumin, indicating improvement in condition, however, the increase was statistically insignificant (p>0.05). In sheep, there was significant (p<0.05) increase in the value of total protein and in goats, there was a non-significant (p>0.05) increase in the average value of total protein and albumin observed 24 hours post-transfusion. Sousa et al. (2012, 2014) explained that the significant increase in total protein and albumin levels post-transfusion could be due to the preservation of the protein fraction during storage period and its subsequent reinfusion into the blood stream of the recipient.

**Transfusion reactions**

In both sheep and goats, no adverse reaction could be noticed after blood transfusion. In sheep and goats there was mild elevation in temperature (0.9 ± 0.04°C and 0.8 ± 0.06°C respectively) 15-30 minutes after transfusion. There was an average increase of temperature by 0.9 ± 0.04°C in sheep and 0.8 ± 0.06°C in goats after 15-30 minutes of transfusion (febrile non-haemolytic reaction that leads to increase of body temperature) (Luethy et al., 2017).

Febrile non-haemolytic reactions, usually considered mild and self-limiting (Jutkowitz et al., 2002) are brought about by reaction of the organism to cytokines, either due to leucocyte breakdown during storage or antigen-antibody reactions that activate the compliment system and cause production of pyrogenic cytokines (Sousa et al., 2014).

**Conclusion**

PCV and haemoglobin (Hb) concentration are important transfusion indicators or “transfusion triggers” in haemolytic and sub-acute to chronic blood-loss disorders. Sheep and goats with PCV values less than 15% (approximately 5 g/ dl Hb) should be considered at risk for having inadequate oxygen carrying capacity and tissue hypoxia. There was a marked improvement within 24 hours in the condition of the sheep and goats post-transfusion with no adverse effects observed and a success rate of 100 per cent of blood transfusion.

**References**


The Indian Veterinary Journal (April, 2023) 31