Effect of exogenous thyroxine supplementation on haematobiochemical status in calves

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Abstract The lipid and HDL cholesterol levels are higher in the buffalo calves than in the cow calves of the same age. Hyperlipidemia in the calves might be the result of hypothyroidism in neonatal calves. Poor utilization of lipids might be the triggering element for hypothermia in these neonatal buffalo calves. Exogenous supplementation of thyroxine will help in the maintenance of BMR of calves due to its calorigenic effects by uncoupling of oxidative phosphorylation process. Thyroxine was administered orally once a day at 0.167 mg/kg body weight in powder form mixed with 5 g jaggery on the 15th day, 30th day and 45th day to each experimental calf. Therefore, elevated body temperature will lead to sustenance of calves during initial two months of age. The total erythrocyte count (TEC) recorded was higher and it decreased significantly (P<0.05) in thyroxine supplemented buffalo calves and cow calves. In early age, the total leukocytes count (TLC) of thyroxine supplemented buffalo calves and cow calves decreased in comparison to control group. The biochemical parameters such as serum glucose and serum triglycerides increased significantly (P<0.05) whereas, serum protein and cholesterol level was decreased in thyroxine supplemented buffalo calves and cow calves as compared to buffalo calves and cow calves, respectively. The HDL cholesterol did not differ significantly in treatment groups as compared to control group. Mobilisation of lipids and HDL cholesterol of buffalo calves has produced heat to maintain homeostasis in buffalo calves. The increased thyroxine level in thyroxine supplemented buffalo calves helped to maintain their body temperature and increased basal metabolic rate, thus helped in the reduction of calf mortality.

Keywords: Thyroxine, buffalo calves, cow calves, lipid, basal metabolic rate

Introduction

Thyroid hormones are general metabolic hormones required to the neonates to build up their immune competence along with other homeostatic activities. Thyroid hormones; Triiodothyronine (T3) and thyroxine (T4) increase oxygen consumption and heat production to a large extent by stimulating Na+, K+-ATPase in all tissues except brain, spleen and testis. Therefore, thyroid hormones regulate calorigenesis, basal metabolic rate (BMR) (Capen and Martin, 2003), growth and maturation as well as lipid and carbohydrate metabolism. They also affect cardiovascular, neuromuscular, gastrointestinal, reproductive, immunological, haematological and endocrine functions of the animals (Riviere and Papich, 2009).

The nervous and endocrine systems regulates fat synthesis and degradation in animals. Verma et al. (1993) reported that the level of cholesterol increases with age. Brown adipose fat - thermogenin, a special protein, in contrast to the white fat, is responsible for production of heat in neonates to maintain the homeothermy. The lipid and HDL cholesterol levels are higher in the buffalo calves than that in the cow calves of the same age (Jain et al., 2007). This is due to lesser utilization of lipid substrates during the first week of post-natal life by the buffalo calves in comparison to that by the cow calves. Hyperlipidemia in the calves might have been the result of hypothyroidism in neonatal calves. The neonatal buffalo calves have lower rectal
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The production of heat is by utilization of brown fat in early neonatal life, when the young one is exposed suddenly to the new environment and faces the crisis of thermoregulation. Higher serum lipids further potentiate the cause of hypothermia due to underutilization of lipids by the buffalo calves (Jain et al., 2007).

Hypothermia might be an important factor for higher mortality of buffalo calves, particularly during winter season. Poor utilization of lipids might be the triggering element for hypothermia in these neonatal buffalo calves. Exogenous supplementation of particular drug will help in maintenance of BMR of calves by its calorigenic effects by uncoupling of oxidative phosphorylation process. Therefore, elevated body temperature will lead to sustenance of calves during initial two months of age. Hence, the present study was planned to explore the effect of exogenous thyroxine supplementation on haemato-biochemical status in calves.

Materials and Methods

The study was conducted on a total of 24 calves; 12 healthy buffalo calves and 12 healthy cow calves at Livestock Farm (calf unit), Adhartal, N.D.V.S.U., Jabalpur (M.P.). The experiment consisted of four groups of animals (I-IV); the control group of buffalo calves and cow calves, thyroxine supplemented buffalo and cow calves, respectively. Each group had six animals. Thyroxine was administered orally once a day at 0.167 mg/kg body weight in powder form mixed with 5 gaggery on the 15th day, 30th day and 45th day to each experimental calf. The blood samples were collected on the 16th, 31st and 46th day in sterilized glass vials containing 10% aqueous solution of EDTA for haematological parameters as well as without anticoagulant for separation and collection of serum. The selected biochemical parameters Serum glucose (Trinder's method of Pileggi and Szuskeiweiz, 1974), Total protein (Biuret method of Tietz, 1986), Serum triglycerides (Wako method modified by Fossati, 1982), Serum cholesterol (modified Roeschlau's method, 1974) and Serum HDL (Burstein et al., 1970) were estimated using serological auto-analyzer. The experimental data were analysed by analysis of variance using hierarchical design Snedecor and Cochran (1989).

Results and Discussion

Table 1  Profile of erythrocytes in different groups (Mean ± SE) of calves

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Group IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV (%)</td>
<td>45.56± 1.41a</td>
<td>41.37± 0.85b</td>
<td>42.19± 1.46ab</td>
<td>34.74± 1.32c</td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>14.30± 0.72a</td>
<td>12.38± 0.31b</td>
<td>14.34± 0.59a</td>
<td>10.67± 0.34c</td>
</tr>
<tr>
<td>TEC (10⁶/mm³)</td>
<td>9.66± 0.42a</td>
<td>9.60± 0.12a</td>
<td>8.09± 0.21b</td>
<td>8.71± 0.22b</td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>53.39± 0.79a</td>
<td>41.86± 0.92b</td>
<td>53.17± 0.54a</td>
<td>43.01± 0.63b</td>
</tr>
<tr>
<td>MCH (pg)</td>
<td>17.66± 0.82a</td>
<td>12.81± 0.32b</td>
<td>17.67± 0.62a</td>
<td>12.02± 0.26b</td>
</tr>
<tr>
<td>MCHC (%)</td>
<td>31.39± 0.89a</td>
<td>30.84± 0.57b</td>
<td>33.71± 1.08a</td>
<td>29.87± 0.61b</td>
</tr>
</tbody>
</table>

Mean values bearing different superscripts in row, differ significantly (P < 0.05)

Group I control group of buffalo calves, Group II control group of cow calves, Group III control group of thyroxine supplemented buffalo calves, Group IV control group of thyroxine supplemented cow calves

In the present investigation, the total leukocyte count (TLC), of thyroxine supplemented buffalo calves and cow calves, decreases in comparison to control groups (Table 2 and Fig. 2). This finding is contraindicated by Abdelatif and Saeed, (2009) who reported that T4 treated groups had increased TLC, which may be attributed to the effect of T4 on the bone marrow as exogenous T4 enhanced the bone marrow and led to an increase in myelopoiesis in mice.

The serum glucose increased significantly (P<0.05) in thyroxine supplemented buffalo calves (52.53± 2.44) and cow calves.
Table 2  Profile of leukocyte in different groups (Mean ± SE) of calves

<table>
<thead>
<tr>
<th>Groups /Parameters</th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Group IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLC(10⁹/mm³)</td>
<td>7.47± 0.26a</td>
<td>6.86± 0.22a</td>
<td>5.78± 0.25b</td>
<td>4.88± 0.23c</td>
</tr>
<tr>
<td>Neutrophil (%)</td>
<td>42.78± 0.53c</td>
<td>36.56± 0.74b</td>
<td>42.61± 0.59a</td>
<td>42.39± 0.48a</td>
</tr>
<tr>
<td>Lymphocyte (%)</td>
<td>47.78± 0.73b</td>
<td>55.67± 0.79a</td>
<td>49.22± 0.84b</td>
<td>49.44± 0.73b</td>
</tr>
<tr>
<td>Monocyte (%)</td>
<td>3.56± 0.27b</td>
<td>4.50± 0.30a</td>
<td>3.22± 0.27b</td>
<td>4.56± 0.29a</td>
</tr>
<tr>
<td>Eosinophil (%)</td>
<td>5.89± 0.40a</td>
<td>3.39± 0.21c</td>
<td>4.94± 0.36b</td>
<td>4.17± 0.29c</td>
</tr>
</tbody>
</table>

Mean values bearing different superscripts in row, differ significantly (P < 0.05)
(46.12±1.37) as compared to control groups of buffalo (43.68±1.75) and cow calves (39.74±1.01), respectively as shown in Table 3. This finding is also supported by Slebodzinski et al. (1995). Single injections of T₃ (7 ng·g⁻¹i.p.) rapidly and markedly attenuated hyperglycemia in studies, in which mouse model was used as experimental animal (Lin and Sun, 2011).

The buffalo calves had higher levels of serum glucose than the cow calves. The increased blood glucose level during the early neonatal period of the calves may be attributed to the energy requirement of newly born calves for their survival in alien environment. Here, it may be emphasized that the rigours of environment imposed a condition of stress to the calves, which, in turn, causes release of catecholamines resulting into glycogenolysis, thus elevating blood glucose level.

The serum proteins play an important role in the formation of body tissues and also for the formation of functional components within the body. The serum protein level in thyroxine supplemented cow calves (8.21±0.69) decreased significantly (P<0.05) as compared to control group of cow calves (11.83±0.47). Buffalo treatment (6.32±0.26) group did not differ significantly as compared to control group (6.80±0.23) of buffalo calves as shown in Table 3. The similar findings were also reported by Slebodzinski et al. (1995).

The serum triglyceride concentration in thyroxine supplemented buffalo and cow calves increased significantly (P<0.05) as compared to control groups of buffalo and cow calves. Similar findings were reported by Slebodzinski et al. (1995). Guyton and Hall, (2007) reported that fat metabolism is enhanced under the influence of thyroid hormone. In particular, lipids are mobilized rapidly from the fat tissue, which decreases the fat stores of the body to a greater extent than almost any other tissue element. This also increases the free fatty acid concentration in the plasma and greatly accelerates the oxidation of free fatty acids by the cells. Increased thyroid hormone decreases the concentrations of cholesterol, phospholipids and triglycerides in the plasma.
The serum cholesterol concentration decreased significantly (P<0.05) in thyroxine supplemented buffalo and cow calves as compared to control groups of buffalo calves and cow calves, respectively (Table 3 and Fig. 3). The cholesterol 7α-hydroxylation is more susceptible to thyroid function than in cholesterol synthesis. These results are reconcilable with the supposition that thyroxine increases cholesterogenesis but further increases cholesterol catabolism as also reported by various researcher (Rosenman et. al., 1952; Weiss & Marx, 1955; Lepp et al., 1964 and Takeuchi et al., 1975).

Large oral doses of thyroid hormones affect carbohydrate metabolism by increasing glycolysis, glycogenolysis and gluconeogenesis. They increase lipolysis in adipose tissue, depress the synthesis of lipids, accelerate the oxidation of fatty acids and suppress protein synthesis (Hoch, 1974). The results reveal that thyroid hormones appear to exert control over metabolic system in newborn calves.

Conclusions

Hyperlipidemia in the calves might have been the result of hypothyroidism in neonatal buffalo calves. Poor utilization of lipids might be the triggering element for hypothermia in these neonatal buffalo calves. Mobilisation of lipids and HDL cholesterol of buffalo calves, generate heat that could have maintained the thermal balance in buffalo calves. The results reveal that thyroxine hormones appear to exert control over metabolic system in newborn calves.

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