Short Communication

Effect of thiopentone on osmotic fragility of erythrocytes in camels

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Abstract

The study was conducted in six adult clinically healthy domesticated camels with the objective to know about the osmotic resistance of erythrocytes during thiopentone anaesthesia. Thiopentone sodium (5% solution) was administered intravenously 'to effect'. The mean dose of thiopentone was 10.35±0.642 mg/kg. The erythrocyte fragility test was done before thiopentome administration and then at peak effect of thiopentone, at recovery, 24 hours, 48 hours and 72 hours after recovery by using saline solutions having concentrations of 0.00, 0.10, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80 and 0.85 percent. The percent haemolysis of erythrocytes was observed at different time intervals. The results showed that there were no significant variations in haemolysis pattern before, during and after thiopentone anaesthesia.

Key words: Camel, Osmotic Fragility, Thiopentone.

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1. Introduction

The study was done in six adult clinically healthy domesticated camels *(Camelus dromedarius)* of 8 to 12 years and weighing 375 to 550 kg. Anaesthesia was induced by administering 5% thiopentone sodium solution '*to effect*' in the jugular vein. Venous blood was collected before induction of anaesthesia, at peak anaesthetic effect, at recovery from anaesthesia, and then at 24, 48 and 72 hours after the recovery of anaesthesia. Erythrocyte fragility test was done by the method described by Schalm *et al.,* 1975. The data was analyzed by using Students''t' test.

2. Results and Discussion

The mean dose of thiopentone sodium required to induce "*to effect*" anaesthesia in camels was 10.35±0.642 mg/kg. The total time taken to administer thopentone was 98.48±12.685 seconds. An apnoea of 3.214±0.305 minutes followed immediately after administration of thiopentone and camels went in lateral recumbency with legs fully relaxed. Moderate to copious salivation was observed at 9.50±2.50 minutes after induction of anaesthesia in all animals. Anaesthesia in these animals was characterized by sleepy look, relaxation of jaws, flaccidity of tongue, abolition of swallowing reflex, relaxation of neck, drooping of lower lip and relaxation of upper eyelids. Corneal reflex was sluggish. The palpebral reflex was abolished for 15 to 20 minutes. The tail was relaxed for 25 to 35 minutes, while relaxation of limbs and anal sphincter was seen for 20 to 30 minutes. Adequate relaxation of the abdominal muscles was observed for 30 to 45 minutes. The duration of analgesia as judged by deep pin-pricks was 32.60±6.00 minutes. The recovery of

camels from anaesthesia was marked by the return of swallowing reflex at 27.60±5.25 minutes after induction of anaesthesia. Lifting of the head was recorded at 33.28±4.90 minutes. The animals returned to sternal recumbency in 39.28±3.846 minutes. Animals stood of their own by 91.14±13.91 minutes but were ataxic. The complete recovery *i.e.* animal standing without in-coordination of limbs was observed at 111.42±12.61 minutes after induction of anaesthesia.

The percent haemolysis at different intervals in various salt solution concentrations is shown in table 1 and figure 1.

Table 1. The effects of 5% thiopentone sodium (10.35 ± 0.642 mg/kg bodyweight) on osmotic fragility of erythrocytes in six camels (*Mean values* ± *SE*).

Concentration of saline solution (%)	Tube No.	% Haemolysis					
		Base Value	At Peak effect	At Recovery	At 24 hours	At 48 hours	At 72 hours
0.85	1	0.510 ±0.254	1.108 ±0.708	0.630 ±0.359	0.303 ±0.195	1.245 ±0.943	0.374 ±0.229
0.80	2	0.676 ±0.242	1.101 ±0.703	1.116 ±0.389	0.685 ±0.224	1.411 ±0.914	0.824 ±0.361
0.75	3	0.510 ±0.254	1.041 ±0.444	1.260 ±0.384	1.236 ±0.319	1.876 ±0.681	0.604 ±0.230
0.70	4	0.510 ±0.254	1.215 ±0.460	0.916 ±0.316	1.378 ±0.296	1.730 ±0.655	1.458 ±0.258
0.65	5	0.510 ±0.254	1.488 ±0.415	1.083 ±0.258	2.038 ±0.939	2.393 ±1.069	1.288 ±0.383
0.60	6	0.681 ±0.243	1.788 ±0.637	1.330 ±0.562	1.538 ±0.271	2.525 ±0.922	2.150 ±0.295
0.55	7	0.510 ±0.254	1.673 ±0.282	1.370 ±0.470	1.538 ±0.271	2.251 ±0.929	1.710 ±0.269
0.50	8	0.808 ±0.270	1.823 ±0.351	1.370 ±0.470	1.410 ±0.233	2.073 ±0.755	1.886 ±0.355
0.45	9	1.626 ±0.333	3.568 ±1.420	2.086 ±0.712	2.766 ±1.047	2.581 ±0.972	2.632 ±0.328
0.40	10	2.523 ±0.828	3.685 ±0.850	4.221 ±1.312	3.505 ±0.700	4.028 ±1.101	4.254 ±1.468
0.35	11	9.838 ±5.043	10.813 ±2.473	13.226 ±3.000	13.993 ±6.297	8.273 ±2.130	9.560 ±2.971
0.30	12	33.838 ±10.432	39.858 ±11.069	41.733 ±10.478	36.611 ±11.201	33.116 ±10.817	28.624 ±2.652
0.25	13	67.375 ±9.265	72.148 ±0.163	67.066 ±9.021	65.931 ±12.844	67.370 ±9.521	72.586 ±5.658
0.20	14	88.605 ±8.500	94.871 ±2.879	97.361 ±1.348	82.503 ±10.486	88.555 ±6.706	92.180 ±1.356
0.10	15	98.665 ±0.938	96.861 ±1.515	98.766 ±2.048	99.650 ±4.686	93.023 ±1.539	98.440 ±2.132
0.00	16	100.00 ±0.00	100.00 ±0.00	100.00 ±0.00	100.00 ±0.00	100.00 ±0.00	100.00 ±0.00

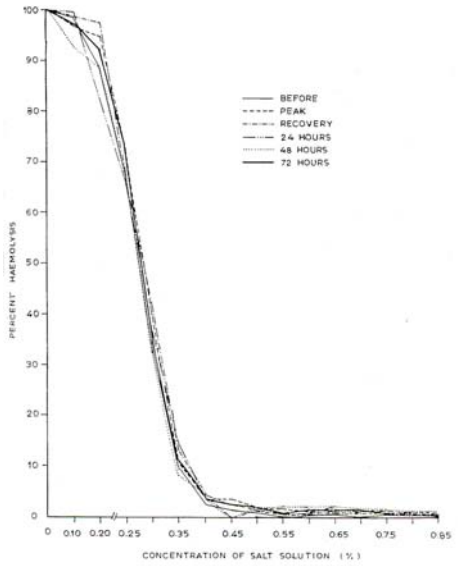

Figure 1. Effect of thiopentone on osmotic fragility of erythrocytes in camel.

There was no significant change in pattern of percent haemolysis before, during or after thiopentone anaesthesia. Homeostasis of erythrocytes is maintained by electrolytes inside and outside the cells. The ensuing electrical gradient is maintained by the active transport of cations and anions and by diffusion. Any disturbance in electrolyte concentration is likely to disturb the stability of the membrane. The change in blood pH and other metabolites depresses the ability of erythrocytes to maintain hyperactive cation pump to compensate for leaky membrane (Shohet and Ness 1976). The lower osmotic fragility of the erythrocytes of camel is due, in part, to the high concentration of total lipids, cholesterol, proteins, sphingomyelin and phosphatidylcholine in the erythrocyte membrane of camels when compared with the concentrations of these parameters in the erythrocyte membrane of sheep and goats. The higher ratio of proteins to total lipids; cholesterol to phospholipids in the erythrocyte membrane of camels may have a role in the stability of the camel erythrocytes (Al-Qarawi and Mousa, 2004). Yagil *et al.* (1974) found that the red blood cells of the dehydrated camel were more resistant to hypotonic saline solutions than those of hydrated camels. In contrast, there was gradual and significant decrease in osmotic fragility with increase in concentration of saline solution in dogs under pentobarbitone anaesthesia (Olaifa *et al*., 1999). Sodium thiopental interacts with the membrane by inserting into the lipid bilayer and causing alterations of the membrane properties such as curvature and hypotonic lysis resistance. Bazzoni and Rasia (1998) observed that sodium thiopental affected the membrane rheological properties by improving erythrocyte deformability; this effect resulted from a reduction of both the elastic modulus and surface viscosity. Thiopental molecules enter the bilayer of desialated cells in a higher proportion, as compared to the normal erythrocyte, promoting a disorganization that results in a greater inner friction. The changes in the rheological parameters, triggered by sodium thiopental, could be attributed to the bilayer contribution to the membrane mechanical properties, either directly or through interaction between the bilayer and the cytoskeleton.

Little is known about osmotic fragility of erythrocytes in animal diseases. It is a well-known fact that the resistance of erythrocytes to haemolysis may be increased or decreased in disease processes (Coles, 1967). Red blood cells of animals infected with *T.evansi* show an increase in osmotic fragility. This increased fragility of erythrocytes of animals experimentally infected with *T.evansi* could be due to, in part, by the direct attack of reactive oxygen species (ROS) on the erythrocyte's plasma membrane and the decrease of calcium ATPase activity (Portillo, 2010). The normal ovoid erythrocytes become spherical when the solution surrounding the erythrocytes is diluted ionically, and the cells swell to 240% of the initial volume. After hemolysis, the erythrocyte membrane (ghost) reverts to its original oval form (Perk, 1966). Stone *et al.* (1953) reported that the change in pH towards acidic side and lower oxygen concentration result into lower osmotic resistance of erythrocytes. Several other extrinsic (pH, temperature, oxygenation) and intrinsic (age, species, breed, age of erythrocyte) factors influence the osmotic fragility (Schalm *et al.*, 1975). The osmotic fragility of duck erythrocytes increased in acidic solution and also as the temperature increased. However, storage of blood decreased the fragility of duck erythrocytes (Oyewale *et al.*, 1991).

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