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Sevoflurane and isoflurane anaesthesia in acute abdomen canine patients

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ABSTRACT

The present study was aimed to prepare a suitable anaesthetic combination of sevoflurane or isoflurane in acute abdomen critically ill canine patients. Acute abdomen was due to anatomical anomalies and due to lodgement of foreign bodies in the animals of group A and B respectively. The animals of group C were the normal healthy dogs used as control. These animals were further divided into 2 sub groups AI, All, BI and BII. The animals of subgroup AI, BI, and CI were subjected to administration of anaesthetic combination of atropine sulphate @ 0.04 mg/kg body weight, diazepam @ 1 mg/kg body weight, I.M. thiopental sodium @ 10–12 mg/kg body weight I.V. (just to pass endotracheal tube) and sevoflurane (3–3.5%) while the animals of sub group AII, BII and CII were subjected to the administration of anaesthetic combination of atropine sulphate @ 0.04 mg/kg body weight, diazepam @ 1 mg/kg body weight, I.M. and thiopental sodium @ 10–12 mg/kg body weight I.M. just to pass endotracheal tube, followed by isoflurane (2–2.5%). The efficacy of anaesthetic combinations was determined by observing different clinicophysiological and haematobiochemical parameters. There was a complete muscle relaxation in all the groups of animals. Corneal, palpebral reflexes were completely depressed during the surgical anaesthesia. An increase in heart rate and total erythrocyte count along with a decrease in respiration rate, rectal temperature, respiratory minute volume, haemoglobin, packed-cell volume, total leucocyte count and neutrophil count was observed during the period of anaesthesia. A gradual decrease in the mean values of total protein, albumin, gamma glutamyl transferase and calcium was observed during anaesthesia. These changes were less pronounced in group subjected to sevoflurane as compared to isoflurane. On the basis of the findings observed in this study it was concluded that the combination of thiopental sodium and sevoflurane was more safe as compared to the combination of thiopental sodium and isoflurane as it provides more cardiac and respiratory stability.

Key words: Acute abdomen, Isoflurane, Sevoflurane

The acute abdomen,one of the important ailments for severe pain in pets, may be due to either overfeeding, lodgement of foreign body or due some anatomical anomalies of gastrointestinal tract. The surgical intervention under the balanced anaesthesia is the only method to relieve the anxiety of such patients. Such critically ill animals cannot tolerate the potent anaesthetic drug and needs a combination of drugs which have least adverse effect on different body systems. Therefore this study was planned to find out a suitable anaesthetic regimen for the surgical management of acute abdomen canine patients.

MATERIALS AND METHODS

Dogs (16) having acute abdomen were diagnosed by plain and contrast radiography of abdominal region. On the basis of radiographic findings animals were divided into 2 groups, i.e. A and B having acute abdomen due to anatomical anomalies (intestinal strangulation) and physical obstruction in the gastrointestinal tract (due to lodgement of foreign bodies) respectively. The animals of each group were further divided into 2 sub groups AI, AII, BI and BII having equal number of dogs and were subjected to following anaesthetic regimen:

Group	Subgroup	Anaesthesia
A (8 animals)	Al (4 animals)	Atropine + diazepam + thiopental sodium + sevoflurane
	All (4 animals)	Atropine + diazepam + thiopental sodium + isoflurane
B (8 animals)	BI (4 animals)	Atropine + diazepam + thiopental sodium + sevoflurane
	BII (4 animals)	Atropine + diazepam + thiopental sodium + isoflurane
C (8 animals)	CI (4 animals)	Atropine + diazepam + thiopental sodium + sevoflurane
	CII (4 animals)	Atropine + diazepam + thiopental sodium + isoflurane

Atropine@0.04 mg/kg body wt; diazepam@ 1 mg/kg body wt; thiopental sodium@ 10–12 mg/kg body wt; sevoflurane @ 2–2.5%; isoflurane@3–3.5%.

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Isoflurane and sevoflurane were administered with Boyle's apparatus using special vaporizer for isoflurane and sevoflurane. The efficacy of anaesthetic combinations was determined by observing clinicophysiological parameters, viz. onset of anaesthesia, duration of anaesthesia, recovery time, pedal reflexes, palpebral reflexes, pharyngeal reflexes, extent of salivation, heart rate, respiration rate, respiratory minute volume and rectal temperature. The haematobiochemical parameters including haemoglobin, packed-cell volume, total erythrocyte count, total leucocyte count, differential leucocyte count, total protein, albumin, glucose, blood urea nitrogen, creatinine, alanine amino transferase, aspartate amino transferase, gamma glutamyl transferase, and electrolytes, viz. sodium (Na+), potassium (K+), chloride (Cl-) and calcium (Ca+) were also determined to observe the effect of anaesthetic agents on various systems of the body.

Cardio pulmonary parameters, viz. electrocardiography and cardiac output, were recorded before and after anaesthesia by multiple channel biopotential amplifiers, while heart rate, respiration rate, respiratory minute volume, body temperature were recorded before and after the administration of anaesthetic agent at 15, 30, and 60 min, and 2, 6, 12, 24 and 48 h intervals.

The blood samples were collected at 0, 15, 30, 60 min, and 2, 6, 12, 24 and 48 h after administration of sevoflurane and isoflurane. All the samples were analyzed on the same day of collection of blood. Data were analysed using "t-test" as per the standard procedure described by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Administration of diazepam makes the animals calm and quiet. All the animals had partial closing of the eyelids, dropping of the ears, and it was noticed that these animals quickly responded to the external stimuli such as touch and pain. The combination of atropine, diazepam and thiopental sodium resulted in quick loss of consciousness and adequate relaxation. The dose of thiopental sodium required to pass the endotracheal tube varied from 10.50±0.67 to 12.00±0.57 mg/kg body weight intravenously. After the administration of isoflurane (2–2.5%) and sevoflurane (3–3.5%), the extent of muscle relaxation was similar in all the sub groups of animals. Corneal, palpebral and pedal reflexes were completely depressed during the surgical anaesthesia. The duration of onset of anaesthesia was 0.55±0.06, 0.69±0.08, 0.75±0.06, 0.67±0.04, 0.55±0.64 and 0.50±0.09 min. in the animals of sub groups AI, AII, BI, BII, CI and CII respectively. Similar observation was reported by Mutoh *et al*. (1995).

The duration of anaesthesia was comparatively higher in the animals of sub groups BI (112.5±3.2 min) and BII (109.5±4.8 min) followed by the animals of sub groups AI (99±4.2 min) and AII (102.5±3.2 min) and sub groups CI (68.75±2.3 min) and CII (67.5±3.2 min). The complete recovery was observed in 16.62±0.62, 16.0±0.40, 16.37± 0.31, 16.87±0.55, 15.75±0.48 and 15±0.32 min after the termination of sevoflurane or isoflurane administration in the animals of sub groups AI, AII, BI, BII, CI and CII respectively. Our observations are in accordance of the observation of Mutoh *et al*. (1995) and Bert *et al*. (2008). The recovery time was less in the animals of group C as compared to the animals of group A and B.

Pedal reflex, pharyngeal reflex and palpebral reflexes were lost within 2 min after administration of thiopental sodium and sevoflurane. The normal reflexes were observed by 15–16 min after termination of administration of inhalation anaesthetic agents (Merin *et al*. 1991).

There was a gradual and significant ($P<0.05$) increase in the level of heart rate (Table 1) up to 2 h after the administration of thiopental sodium and inhalation anaesthetic agents in all the animals. A slight increase in heart rate during induction of anaesthesia observed in this study is in accordance of Forrest *et al.* (1982) who reported mild increase in heart rate with isoflurane anaesthesia. Merin *et al*. (1991) and Mutoh *et al*. (1995) also reported that sevoflurane and isoflurane induces a rise in heart rate in dogs. A significant ($P<0.05$) increase in respiration rate (Table 1) in the sick animals of group A and B as compared to the normal healthy dogs observed in this study corroborates with finding of Sodhi *et al*. (2003). There was no significant ($P>0.05$) difference in the respiratory minute volume in the animals of sub groups AI and BI subjected to sevoflurane anaesthesia as compared to sub groups AII and BII subjected to isoflurane anaesthesia. Further decrease in the level of respiration rate and minute volume during anesthesia may be due to respiratory compensation for the metabolic alkalosis after frequent vomiting within a short period of time. A slight and gradual decrease in the body temperature observed up to 60 min after the administration of different anaesthetic combinations in all animals of different groups could be due to generalized sedation, inhibition of skeletal muscle movement, reduction in metabolic rate and depression of thermal regulatory centre (Jadon and Kumar 1994). An insignificant ($P>0.05$) decrease in haemoglobin, packed cell volume and total erythrocyte count level between 30 min and 2 h interval in the animals of group A, B and C may be attributed to the pooling of blood cells in the spleen. There was no significant ($P>0.05$) difference in the level of total erythrocyte count in the animals of sub groups AI, BI as compared to the animals of sub groups AII and BII at respective time intervals. However, it may be noted that the decrease in these parameters was transient and returned to preadministration levels by 24 to 48 h. No significant change observed in the level of neutrophil and lymphocyte count during anaesthesia is an indicative of least adverse effect of sevoflurane and isoflurane anaesthesia. Basophils, eosinophils and monocytes however, showed insignificant

Table 1. Heart rate, temperature and respiration rate in canines after anathesia

Parameters	Group	Sub-group	Before (0 h)	15 min	30 min	60 min	2 h	6 h	12 h	24 h	48 h
	A	A1	128.50	133.50	137.50[a]	141.00[a]	135.00	135.25[a]	137.00[a]	132.50	134.00
			±2.99	±3.59	±3.59	±3.42	±1.30	±2.56	±1.91	±1.89	±1.15
		A2	134.50	136.50	138.50[a]	140.50[a]	139.00[a]	137.00	135.50[c]	135.00[c]	137.50
			±3.30	±2.60	±1.89	±3.30	±1.00	±3.11	±3.10	±1.73	±0.50
Heart rate	B	B1	137.00	140.50	145.00[b]	150.00[b]	144.50[b]	140.50	138.50	139.00	136.00
			±5.20	±4.86	±4.80	±3.90	±3.50	±3.50	±2.06	±1.73	±3.16
		B2	130.00	135.00[b]	138.50[b]	142.00[b]	139.00[b]	135.50[b]	135.50[b]	133.00	131.00
			±2.16	±2.65	±2.22	±2.16	±2.65	±2.36	±2.63	±1.29	±1.73
	C	C1	129.50	134.00[c]	136.50[c]	141.00[c]	137.00[c]	13.50	132.50	130.50[b]	132.00
			±1.26	±1.41	±0.96	±0.58	±0.58	±0.96	±0.50	±0.50	±1.41
		C2	126.00	129.75	133.50[c]	136.75[c]	135.25[c]	132.25	130.25	126.00	127.00
			±5.35	±5.60	±5.91	±6.99	±5.76	±4.01	±3.84	±4.81	±3.44
	A	A1	38.40	38.25	37.11	36.80	38.58	38.86	38.75	38.75	38.51
			±0.53	±0.43	±0.27	±0.25	±0.53	±0.26	±0.21	±0.40	±0.44
		A2	38.66	38.28	37.11	36.80	38.30	38.91	38.65	38.80	38.55
			±0.44	±0.43	±0.27	±0.25	±0.59	±0.24	±0.10	±0.42	±0.43
Temperature (°C)	B	B1	38.36	37.69	37.22	36.58	37.22	38.27	38.55	38.55	38.55
			±0.39	±0.36	±0.29	±0.13	±0.10	±0.35	±0.08	±0.29	±0.29
		B2	38.38	37.55	37.16	36.25	37.41	37.80	38.30	38.55	38.75
			±0.44	±0.29	±0.31	±0.05	±0.22	±0.22	±0.30	±0.08	±0.40
	C	C1	38.91	37.68	37.22	32.41	37.47	38.11	38.66	38.75	38.25
			±0.21	±0.21	±0.29	±7.66	±0.05	±0.24	±0.22	±0.21	±0.38
		C2	39.30	38.25	37.85	37.66	37.66	38.11	38.55	38.58	38.48
			±0.26	±0.63	±0.70	±0.62	±0.36	±0.24	±0.45	±0.15	±0.17
	A	A1	44.00	35.75[a]	36.28[a]	33.50[a]	39.75	49.25	50.50	52.50	54.75
			±1.83	±3.61	±1.03	±1.26	±3.33	±8.08	±10.44	±10.69	±7.82
		A2	49.00[c]	43.00[a]	35.00[a]	31.50[a]	36.50	39.00	38.50	38.50	42.00
			±6.45	±4.51	±3.11	±2.75	±2.22	±2.08	±1.71	±0.50	±0.82
Respiration rate	B	B1	42.50	37.50[b]	32.50[b]	27.00[b]	33.00	36.50	39.00	38.00	38.00
			±1.26	±0.50	±0.50	±1.00	±0.58	±1.50	±1.91	±1.63	±3.37
		B2	38.50	33.50[b]	28.50[b]	22.00[b]	27.00	31.00	33.50	33.50	36.00
			±2.50	±2.06	±1.71	±3.46	±1.00	±1.00	±2.06	±0.96	±1.41
	C	C1	34.50	31.00[c]	27.00[c]	23.50[c]	27.00	31.00	31.00	31.00	31.00
			±1.89	±1.91	±1.29	±1.50	±1.29	±1.29	±2.08	±1.29	±1.00
		C2	30.50	26.75[c]	23.75[c]	21.75[c]	22.75[c]	26.00	27.00	27.50	31.50
			±2.22	±2.29	±2.46	±1.84	±2.50	±2.94	±2.65	±2.75	±2.06

a,Significant (P<0.05) within group as compared to subgroups AI and AII; c, significant (P<0.05) within group as compared to subgroups CI and CII; b: significant (P<0.05) within group as compared to subgroups BI and BII; c+ : Significant (P<0.05) within group as compared to groups C.

(P>0.05) fluctuating changes in all groups of animals after administration of anaesthetic agents and fluids. Same observation was reported by Koichev *et al.* (1988) in cattle and sheep. Overall sevoflurane maintained stable haemodynamics as compared to isoflurane in this study confirming the findings of Frink *et al.* (1992) and Lerman *et al.* (1994).

Total protein showed a gradual and significant (P<0.05) decrease from 15 to 60 min after the administration sevoflurane and isoflurane in all animals of group A and B. However, the values of total protein were comparatively higher in the sick animals as compared to the animals of control group up to 24 h of this study. Blood glucose is the primary regulator of both insulin release and its biosynthesis when blood glucose level in blood decreases; it potentiates the release of glucagon. Glucagon acts only in the liver where it stimulates glycogenolysis and gluconeogenesis, thereby increasing blood glucose. A significant increase in glucose level (Table 2) in the initial stage of study in sick animals could be due to anoxia which may have resulted in hyperglycaemia since the liver glycogen is relatively unstable in the presence of deficient oxygen supply. Under stressful conditions especially during anaesthesia, there is an increased liberation of glucocorticoids, which is responsible for the rise in glucose level. No significant changes observed in the level of creatinine (Table 3) after the anaesthesia excludes

the possibility of deleterious effect of sevoflurane and isoflurane on kidney. The less change in the level of serum urea nitrogen and creatinine in sevoflurane anaesthesia as compared to isoflurane anaesthesia show superiority of sevoflurane anaesthesia over isoflurane anaesthesia and confirm the findings of Mutoh *et al.* (1997) in dogs. Our study also revealed that there was no significant difference in the level of alanine amino transferase level after

Table 2. Blood glucose in canines after anaesthesia

Parameters	Group	Sub-group	Before (0 h)	15 min	30 min	60 min	2 h	6 h	12 h	24 h	48 h
	A	A1	113.30^{c+} ±1.79	113.60 ±1.63	115.23 ±1.70	116.53 ±3.01	113.50 ±0.80	115.25 ±2.45	112.65 ±2.22	108.58 ±0.85	86.88^{a} ±0.79
		A2	114.08^{c+} ±2.18	114.15 ±2.11	114.95 ±2.79	117.03 ±3.04	114.98 ±2.30	112.08 ±2.09	104.80 ±2.36	97.85 ±3.94	81.55^{a} ±3.87
Blood glucose	B	B1	116.25^{c+} ±1.93	116.55 ±2.25	116.68 ±2.43	117.35 ±2.70	116.48 ±2.14	112.23 ±2.03	110.15 ±1.05	107.28 ±1.42	101.35^{b} ±0.94
		B2	114.03^{c+} ±1.95	114.53 ±2.18	114.80 ±2.56	115.63 ±2.77	112.33 ±2.15	111.53 ±1.56	107.85 ±0.55	105.15 ±1.83	94.08^{b} ±3.86
	C	C1	88.70 ±2.99	89.48 ±2.32	90.60 ±2.26	91.48 ±2.51	89.10 ±4.20	91.18 ±3.86	88.30 ±2.66	89.05 ±2.39	90.73 ±1.65
		C2	87.75 ±2.01	87.75 ±2.36	88.70 ±2.09	89.08 ±3.22	87.00 ±2.26	89.65 ±2.00	88.95 ±2.30	91.10 ±2.64	90.60 ±2.75

a, Significant (P<0.05) within group as compared to subgroups AI and AII; b, significant (P<0.05) within group as compared to subgroups BI and BII; c, significant (P<0.05) within group as compared to subgroups CI and CII; c+ ,significant (P<0.05) within group as compared to groups C.

Table 3. Blood urea nitrogen and blood creatinine after anaesthesia

Parameters	Group	Sub-group	Before (0 h)	15 min	30 min	60 min	2 h	6 h	12 h	24 h	48 h
	A	A1	28.20^{c+} ±0.83	28.00^{c+} ±0.41	27.70^{c+} ±0.68	26.85^{c+} ±0.68	27.25^{c+} ±0.43	26.93^{c+} ±0.66	26.93^{c+} ±0.77	25.25^{a} ±0.75	19.68^{a} ±1.71
		A2	29.75^{c+} ±0.57	29.05^{c+} ±0.29	29.15^{c+} ±0.89	28.88^{c+} ±0.98	27.23^{c+} ±0.58	27.20^{c+} ±0.84	26.83^{c+} ±0.85	25.48^{c+} ±0.49	21.00^{a} ±0.98
Blood urea nitrogen	B	B1	32.78^{c+} ±1.60	31.63^{c+} ±1.33	31.73^{c+} ±1.20	30.45^{c+} ±1.33	30.75^{c+} ±1.54	31.28^{c+} ±1.06	30.13^{c+} ±1.11	28.85^{c+} ±0.76	22.00^{b} ±1.17
		B2	29.85^{c+} ±1.16	29.60^{c+} ±1.16	29.85^{c+} ±1.21	29.38^{c+} ±0.80	28.78^{c+} ±0.82	28.00^{c+} ±0.79	27.88^{c+} ±0.41	26.30^{c+} ±0.76	21.98^{b} ±2.02
	C	C1	14.78 ±1.37	14.43 ±1.32	14.28 ±1.13	14.50 ±1.19	14.15 ±0.90	14.55 ±0.99	14.28 ±1.25	13.90 ±1.30	13.63 ±1.15
		C2	7.73 ±0.38	7.43 ±0.15	7.35 ±0.16	7.29 ±0.06	7.39 ±0.15	7.45 ±0.20	7.55 ±0.25	7.63 ±0.31	7.85 ±0.46
	A	A1	2.03^{c+} ±0.10	1.98^{c+} ±0.05	2.03^{c+} ±0.11	2.13^{c+} ±0.15	1.88^{c+} ±0.09	1.78^{c+} ±0.03	1.75^{c+} ±0.06	1.85^{c+} ±0.13	1.38^{a} ±0.06
		A2	2.00^{c+} ±0.09	2.00^{c+} ±0.11	1.88^{c+} ±0.03	2.10^{c+} ±0.07	2.00^{c+} ±0.12	1.88^{c+} ±0.03	1.70^{c+} ±0.06	1.58^{c+} ±0.13	1.15^{a} ±0.14
Blood creatinine	B	B1	2.18^{c+} ±0.13	2.13^{c+} ±0.13	2.13$_{c+}$ ±0.17	1.90^{c+} ±0.14	1.83^{c+} ±0.13	2.05^{c+} ±0.12	±1.80^{c+} ±0.23	1.70^{c+} ±0.15	1.23^{b} ±0.14
		B2	2.20^{c+} ±0.12	2.15^{c+} ±0.09	1.95^{c+} ±0.09	2.15^{c+} ±0.10	1.95^{c+} ±0.13	2.03^{c+} ±0.09	1.78^{c+} ±0.06	1.70^{c+} ±0.04	1.40 ±0.08
	C	C1	1.00 ±0.07	1.00 ±0.08	1.05 ±0.10	0.98 ±0.11	0.98 ±0.11	1.03 ±0.05	1.10 ±0.04	0.95 ±0.18	0.88 ±0.05
		C2	1.18 ±0.05	1.08 ±0.09	1.04 ±0.04	1.07 ±0.08	1.00 ±0.04	0.98 ±0.10	0.90 ±0.04	0.92 ±0.08	1.13 ±0.10

a, Significant (P<0.05) within group as compared to subgroups AI and AII, b, Significant (P<0.05) within group as compared to subgroups BI and BII, c, Significant (P<0.05) within group as compared to subgroups CI and CII, c^{+}, significant (P<0.05) within group as compared to groups C

sevoflurane and isoflurane anaesthesia (Valentine *et al.* 1990). Calado *et al.* (2003) reported that there was no significant change in alanine amino transferase and direct bilirubin along with increase in the level of alkaline phosphatase after sevoflurane anaesthesia. No significant change in serum chloride level, after anaesthesia observed in this study, was indicative of almost normal absorption process of chloride so that level of the chloride remained unaffected.

On the basis of our findings it was concluded that the combination of thiopental sodium and sevoflurane or isoflurane gave smooth induction and uneventful recovery, and can be used safely in critically ill canine patients. However less pronounced changes in clinicophysiological and haematobiochemical parameters observed in sevoflurane group as compared to isoflurane group may be an indication of the less adverse effects on different body systems.

REFERENCES

Bert b, Hartje I, Voigt J P, Arndt G, Vlbrich H F, Fink H and Hauff P. 2008. Repeated anaesthesia with isoflurane and ylazine/levomethadone/fenpipramide premedication in female beagle dogs: influence on general health and well being. *Laboratory Animal* **42**: 474–86.

Calado E B, Carvalho M B, Nunes N, Santana E, Santos P S P and Rezende M L. 2003. Effects of sevoflurane anaesthesia on complete blood count and hepatic function of dogs. *Ars Veterinaria* **19**: 135–42.

Forrest J B, Buffington C and Cahalan, M K. 1982. A multi-centre clinical evaluation of isoflurane. *Canine Aneaesthesia Society Journal* **29** (Supplement): 51–59.

Frink E J Jr, Ghantous H and Malan T P. 1992. Plasma inorganic fluoride with sevoflurane anesthesia: correlation with indices of hepatic and renal function. *Anesthesia Analgesia* **74**: 231–35.

Jadon N S and Kumar A. 1994. Effect of paranephric blockade on haematological and biochemical attributes after gastrointestinal surgery in buffalo. *Indian Journal of Animal Sciences* **64**: 823–26.

Koichev K, Golemanov D, Houbenov H and Aminokov B. 1988. Experimental study of effect of "Domosedan" in sheep and cattle. *Journal of American Veterinary Medical Association Anaesthesia* **15**: 114.

Lerman J, Sikich N, Kleinman S and Yentis S. 1994. The pharmacology of sevoflurane in infants and children. *Anesthesiology* **80**: 814–24.

Merin R G, Bernard J M, Doursout M F, Cohen M and Chelly J E. 1991. Comparative study of cardiopulmonary parameter by using halothane, Isoflurane and Sevolurane. *Anesthesiology* **74**: 568–76.

Mutoh T, Nishimuar R, Kim H Y, Matsunaga S and Sasaki N. 1997. Cardiopulmonary effects of sevoflurane, compared with halothane enflurane and isoflurane in dogs. *America Journal of Veterinary Research* **58**: 885–90.

Mutoh T, Nishimura R and Kim H Y. 1995. Rapid inhalation induction of anaesthesia by halothane, enflurane, isoflurane and sevolurane and their cardiopulmonary effects in dogs. *Journal of Veterinary Medical Science* **57**: 1007–13.

Snedecor G W and Cochran W G. 1994. *Statistical Methods.* 7th edn. Oxford & IBM Publication, Mumbai.

Sodhi G S, Hussain S S, Moulvi B A and Fazili M R. 2003. Induced simple and strangulated jejunal obstruction in dogs clinical, haematological and biochemical changes. *Indian Journal of Animal Sciences* **73**: 885–87.

Valentine B A, Blue J T, Shelly S M and Copper B J. 1990. Clinical enzymalogy. *Journal of Veterinary International Medicine* **4**: 140.