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Effects of Dystocia on the Cardiac Biomarker Troponin I, Acid-Base Balance and Blood Gases Alongside the Hematobiochemical Profiles in Female Dromedary Camels

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ABSTRACT

This experiment was aimed to document the effect of dystocia in female camels on acid-base elements and blood gas parameters alongside the hemato-biochemical profiles compared to those with eutocia. Eighteen dystotic female dromedary camels were examined. Animals were received within 24, 48, 72, and >72h of birth. Signs included depression, anorexia, distress, colic, straining, and exhaustion. Ten eutocic females were used as controls. Compared to a mean value of 7.37±0.01in the control group, the blood pH in dystotic females was 7.32±0.13. The PO_2 was lower in dystotic females than in controls (61±58mmHg/L versus 183±15mmHg/L). The BE was also lower in dystotic females than controls (-8.8±6.0mmol/L versus -3.7±1.2mmol/L). The HCO_3 was lower in dystotic females than the controls (18±5mmol/L versus 21.4±1.5 mmol/L). The TCO_2 was also lower in dystotic females than in controls (19±5.0mmol/L versus 22.6±1.7mmol/L). The SO_2 decreased significantly in dystotic females than in controls. The PCO_2 and lactate concentrations did not change in a significant manner between the 2 groups. It is concluded that female camels with dystocia have metabolic acidosis compared to those with normal parturition. Changes in blood gases were remarkable that included significant decreases in PO_2, TCO_2, and SO_2 values when compared to eutocic camels.

Key words: Animals; Biomarkers; Blood; Pathophysiology; Ruminant.

INTRODUCTION

As a result of the high variability of gestation lengths in camelids, the dromedary camel's gestation can last 315 days to 440 days (Tibary et al. 2008; Nagy and Juhász 2019). There are two basic stages of parturition in camelids: the first is variable (2-6 h) and the second is short (10 - 45 min) and there has been a reported total period of 373.9±38.2 min for the entire parturition process (Elias and Cohen 1986). Each species has its own direct cause of dystocia. An abnormal presentation, position, or posture of mares is mostly the common etiology of difficult birth (McCue and Ferris 2012). Feto-pelvic disproportion is common in pregnant cows, especially in primipara (Mee et al. 2013). Dystocia in camels is uncommon as most births are presented in an anterior longitudinal position (Hussein et al. 1991; Purohit 2012). Deviation or flexion of the exceptionally long necks and limbs may jeopardize normal birth (Nagy et al. 2021; Nagy et al. 2023). Generally, it was reported that the incidence of difficult birth in camels ranged from as 2-5% (Tibary et al. 2008).

Most body functions in different species including biological mechanisms necessitate a constantly settled acid-base equilibrium (Quade et al. 2021). Imbalance in this criterion inside the animal's body associated with water deprivation or exhaustion endangers its life (Abdoun et al. 2012; Okab et al. 2012). One of the most threating factors for this balance is the reduction in the blood PH due to increase in the production of NH_4Cl in young dromedaries (Elkhair and Hartmann 2010). Manipulation of camels during semen collection or high parasitic infestation were found also to deteriorate this balance and risks the general health of this species

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(Tharwat et al. 2014; Tharwat and Al-Sobayil 2014). Several studies have investigated the gas contents of the blood of the dromedary during health and disease as well as during the act of labor (Tharwat 2015; Tharwat 2021a). In addition, the cardiac biomarker troponin I (cTnI) has been used in camels either in sound or non-sound states to monitor the health status of the camel as well as in deciding its prognosis (Tharwat 2020; 2023a). The present investigation reported the effects of dystocia on cTnI, acid-base status and blood gases in female dromedary camels, along with their hematobiochemical data compared to those that had normal parturition.

MATERIALS AND METHODS

The committee of Experimental Animal Care and Welfare of the Scientific Research Deanship at the University Qassim approved the experimental procedures (ethical code number 213293).

Camels, history, clinical examination and blood sampling

The experimental design has previously been described (Ali et al. 2016). To summarize, eighteen female camels suffering from difficult parturition were admitted to the Qassim University Veterinary Hospital. The animals arrived at the clinic after twenty-four, forty-eight, seventy-two, and over seventy-two h of parturition suffering. Except for five animals, all others were full-term (12 to 13 months of pregnancy). Clinical manifestations included depression, anorexia, distress, alternating stance, and sit-down positions, rolling, exaggerated straining, abnormal vaginal discharges, and fading signs of parturition. Upon entrance, the females were tested for adequate soft and bony birth ways for normal fetal passage. An evaluation of the fetus's position, position, posture, and viability was performed. Dystotic cases with inaccessible fetuses due to insufficiently dilated soft birth canal, were evaluated after laparohysterotomy. Forcible pulling, cutting of the dead fetus or laparohysterotomy were used to resolve dystocia. Ten eutocic female camels were assigned as a control group. All investigated animals including controls were venipunctured and blood was received in; EDTA tubes (2mL), heparinized tubes (2mL) and plain tubes (6mL for serum).

Determination of acid-base indexes, cardiac troponin I, blood gas elements and lactate concentration

The blood samples in heparin tubes were analyzed at once using a clinical veterinary device (I-STAT®, Abaxis, California, USA) to determine the acid-base elements and blood gas variables. Blood pH, carbon dioxide partial pressure (PCO_2), oxygen partial pressure (PO_2), bicarbonate (HCO_3), total carbon dioxide (TCO_2), oxygen saturation (SO_2), and lactic acid (LA) were all immediately measured. Estimation of acid-base elements, cTnI, blood gases, and measurement of lactate was carried according to Tharwat et al. (2014), Tharwat and Al-Sobayil (2014a,b,c), Tharwat (2015), Tharwat (2021a, b), Tharwat and Al-Sobayil (2022) and Tharwat (2023b).

Determination of haemato-biochemical profiles

The blood samples in EDTA tubes were tested to a total blood count including total white blood cell (WBCs) count, red blood cell (RBCs) count, packed cell volume or hematocrit (HCT), hemoglobin, and RBCs indices including mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) using the VetScan HM5, Abaxis, California, USA. The concentrations of albumin, globulin, total protein, creatinine, blood urea nitrogen (BUN), glucose, magnesium and calcium in serum were evaluated using an automated analyzer (VetScan VS2, Abaxis, California, USA). The VetScan VS2 analyser also measured enzymtix activity of creatine kinase (CK), glutamyl transferase (GGT), alkaline phosphatase (ALP) and aspartate aminotransferase (AST).

Statistical analysis

The results are expressed as mean±SD, and these were analyzed using the SPSS statistical program, number 25, 2017. Student's *t* test was applied for comparisons, and the statistical significance was set at $P<0.05$.

RESULTS

Table 1 illustrate the mean±SD values of blood pH, PCO_2, BE, HCO_3, TCO_2, and SO_2 alongside the 25, 50, 75, 95, and 99 percentiles in the female camels with dystocia compared to healthy females with normal parturition. Compared to a mean value of 7.37±0.01 in the control group, the blood pH in female camels with dystocia was 7.32±0.13, with a statistically insignificant difference ($P=0.2$). The PO_2 was lower in camels with dystocia than in control animals (61±58mmHg/L versus 183±15mmHg/L, $P<0.0001$). The BE was also lower in camels with difficult birth than control ones (-8.8±6.0mmol/L versus -3.7±1.2mmol/L, $P=0.01$). Likewise, the HCO_3 was lower in females with difficult birth than the controls (18±5mmol/L versus 21.4±1.5mmol/L, $P=0.03$). The TCO_2 was also lower in female camels with dystocia than in control camels (19±5.0mmol/L versus 22.6±1.7mmol/L) but with a non-significant difference ($P=0.7$). The SO_2 decreased significantly in females with difficult birth than normal parturition (66±25mmol/L versus 100mmol/L in healthy camels, $P<0.0001$). The PCO_2 and LA concentrations did not differ significantly between the 2 groups ($P=0.5$ and $P=0.8$, respectively).

Hematological parameters in female camels with difficult birth compared to healthy camels alongside the 25, 50, 75, 95, and 99 percentiles are presented in Table 2. Significant hematological alterations in the females with difficult birth compared to the healthy group included lymphopenia ($P=0.002$), and decreased values of RBCs, hemoglobin, and HCT ($P=0.02$, 0.03, and 0.007, respectively). Other values that included WBCs, neutrophils, MCV, MCH, and MCHC did not differ significantly between females with dystocia and that of controls ($P>0.05$). Table 3 describes biochemical parameters in camels with dystocia compared to healthy camels alongside the 25, 50, 75, 95, and 99 percentiles. Most of the tested variables that included TP, ALB, ALP, AST, calcium, globulin, BUN, CK, and phosphorus, differed significantly between the 2 groups ($P<0.05$). Only GGT and magnesium mean values did not differ significantly between camels with difficult birth and those

Table 1: Acid-base balance, blood gases and lactic acid concentration in female camels with dystocia versus normal parturition

Parameters	Dystocia (n=18)						Normal parturition (n=10)						P value
	Mean±SD	Percentiles					Mean±SD	Percentiles					
		25	50	25	95	25		25	50	25	95	25	
pH	7.32±0.13	7.26	7.32	7.37	7.49	7.50	7.37±0.01	7.37	7.37	7.37	7.38	7.38	0.2
PCO_2 mmHg	34.0±12.0	25.0	34.0	46.0	47.0	47.0	37.2±3.5	35.4	37.5	37.7	42.2	45.5	0.5
PO_2 mmHg	61±58	27	30	74	149	165	183±15	174	185	192	203	210	<0.0001
BE mmol/L	-8.8±6.0	-15.0	-8.0	-3.7	-1.7	-1.1	-3.7±1.2	-4.3	-4.0	-3.1	-2.0	-1.2	0.01
HCO_3 mmol/L	18.0±5.0	12.8	19.0	21.0	24.0	25.0	21.4±1.5	20.6	21.5	21.8	23.5	24.8	0.03
TCO_2 mmol/L	19.0±5.0	14.1	20.3	21.7	25.9	26.8	22.6±1.7	21.8	23.0	23.0	25.0	26.6	0.7
SO_2 %	66±25	46	59	86	98	99	100	100	100	100	100	100	<0.0001
LA mmol/L	4.2±3.0	2.0	4.0	5.4	8.2	8.9	4.3±3.3	2.3	3.0	5.4	11.7	11.7	0.8

PCO_2, partial pressure of carbon dioxide; PO_2, partial pressure of oxygen; BE, base excess; HCO_3, bicarbonate; TCO_2, total carbon dioxide; SO2, oxygen saturation; LA, lactic acid.

Table 2: Hematological parameters in female camels with dystocia versus normal parturition

Parameters	Dystocia (n=18)						Normal parturition (n=10)						P value
	Mean±SD	Percentiles					Mean±SD	Percentiles					
		25%	50%	75%	95%	99%		25%	50%	75%	95%	99%	
WBCs ($\times10^9$/L)	14.0±5.8	11.7	14.5	18.1	20.5	20.9	16.8±3.9	15.7	17.9	18.6	21.3	22.3	0.2
LYM ($\times10^9$/L)	2.4±0.6	2.0	2.3	2.7	3.2	3.3	6.2±2.9	4.4	5.9	6.6	11.1	12.9	0.002
NEU ($\times10^9$/L)	11.1±5.6	8.6	10.6	15.9	17.5	17.5	9.7±3.0	7.6	9.8	12.0	13.8	14.3	0.4
RBCs ($\times10^{12}$/L)	10.1±0.6	9.8	9.8	10.4	10.9	11.0	11.3±1.4	10.4	11.5	12.0	13.5	13.6	0.02
HB (g/dL)	13.4±2.7	12.2	14.1	14.8	16.5	17.1	16.4±2.8	14.6	16.0	18.0	21.0	23.0	0.03
HCT (%)	25.8±3.2	23.8	25.1	27.2	30.7	31.8	28.9±2.7	27.4	29.0	30.5	33.0	33.2	0.007
MCV (fl)	25.3±3.0	24.5	25.0	26.5	29.1	29.8	25.5±1.5	24.0	26.0	26.0	27.1	27.8	0.8
MCH (pg)	13.5±3.1	12.0	14.6	15.1	16.7	17.3	14.7±2.4	12.7	13.9	16.7	18.7	19.7	0.5
MCHC (g/dL)	53.5±12.7	46.1	54.4	59.6	69.4	72.6	57.6±9.0	50.6	53.7	64.3	74.3	74.9	0.6

WBCs, white blood cells; LYM, lymphocytes; MON, monocytes; NEU, neutrophils; RBCs, red blood cells; HB, hemoglobin; HCT, hematocrit; MCV, Mean corpuscular volume; MCH, Mean corpuscular hemoglobin; MCHC, Mean corpuscular hemoglobin concentration.

Table 3: Biochemical parameters in female camels with dystocia versus normal parturition

Parameters	Dystocia (n=18)						Normal parturition (n=10)						P value
	Mean±SD	Percentiles					Mean±SD	Percentiles					
		25%	50%	75%	95%	99%		25%	50%	75%	95%	99%	
TP (G/L)	75.1±5.9	71.0	77.0	77.5	82.2	83.6	67.3±4.3	63.0	67.5	68.8	74.0	76.4	0.003
ALB (G/L)	56.1±8.7	49.5	59.0	63.0	65.0	65.0	60.39±3.0	60.8	61.5	62.0	64.3	64.9	0.09
ALP (U/L)	40.4±36.4	10.5	17.0	76.0	83.5	84.7	6.6±2.8	5.8	6.5	8.0	10.8	12.6	0.003
AST (U/L)	164.2±121	88.5	133.4	168.6	350.4	410.0	79.5±16.5	69.5	80.5	85.0	104.8	118.6	0.02
CA (mmol/L)	1.3±0.7	1.0	1.0	1.0	2.2	2.4	2.4±0.1	2.3	2.4	2.5	2.6	2.6	<0.0001
GGT (U/L)	19.4±14.1	8.5	10.0	29.0	38.8	42.2	12.2±5.3	8.8	12.5	13.0	19.8	26.4	0.1
GLOB (G/L)	20.4±10.3	14.0	23.0	24.0	32.0	33.6	7.0±3.8	5.0	7.0	9.0	12.5	15.3	0.001
BUN (mmol/L)	13.1±9.0	6.8	9.4	16.0	28.3	30.5	6.4±1.1	5.9	6.4	6.7	8.1	8.2	0.01
CK (U/L)	416.1±365.0	247.6	332.4	355.9	964.0	1169.5	139.0±21.6	127.0	136.0	148.8	171.8	178.4	0.01
PHOS (mmol/L)	1.6±0.9	1.1	1.4	2.0	2.9	3.0	2.6±0.4	2.6	2.7	2.8	3.0	3.1	0.001
MG (mmol /L)	0.24±0.2	0.14	0.20	0.21	0.54	0.64	0.3±0.0	0.2	0.3	0.3	0.3	0.3	0.7

TP, total protein; ALB, albumin; ALP, alkaline phosphatase; AST, aspartate aminotransferase; CA, calcium; GGT, γ-glutamyl transferase; GLOB, globulin; BUN, blood urea nitrogen; CK, creatine kinase; PHOS, phosphorus; MG, magnesium.+.

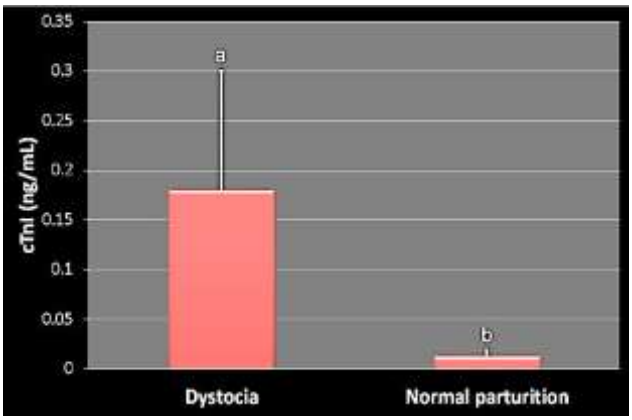

Fig. 1: Serum concentrations of cardiac troponin I in female camels with dystocia (n=18) compared to those with normal parturition (n=10). Different superscripts on bars indicate significant differences.

are healthy (P=0.1 and 0.7, respectively). The serum concentrations of cTnI differed significantly between camels with dystocia and control group (0.18±0.12ng/mL versus 0.03±0.02ng/mL, P=0.0007) (Fig. 1).

DISCUSSION

The dystocia of camels is a severe problem. It is more common in the more intensive systems than in the free less intensive systems. Generally, the most popular type of difficult parturition is postural abnormality. The most common cause of maternal dystocia was uterine torsion. Dystocia is also linked to a high fetal mortality rate (Ali et al. 2016; Nagy et al. 2021; Nagy et al. 2023). This study is the first one that documents the cTnI, acid-base elements, and blood gas variables in female camels with dystocia compared to those with normal parturition, alongside the hematobiochemical profiles.

In this study, camels with difficult parturition had significantly lower pH values than females with normal parturition. This decrease is easily justified by the measured low levels of HCO_3 and BE values. The BE, which is the sum of all basic ingredients rather than just HCO_3, is an active and sensible tool for evaluating metabolic acidosis than HCO_3 does alone (Sigaard-Andersen and Fogh-Andersen 1995; Tharwat and Al-Sobayil 2022; Tharwat 2023b). The low levels of BE and HCO_3 values in this study could be attributed to metabolic acidosis; this is the apparent etiology of the passive BE values.

The cardiac biomarker cTnI is detected in serum within little hours of cardiac insult in humans and reaches its maximum between 12 and 18 hours (Bassand et al. 2007). Its blood levels rise following severe cardiac infarction due to seepage from injured cardiac cells (O'Brien et al. 2006). In this study, dystocia stress was linked to advanced failure of the organs, which has consequences for myocardial function, which usually appears as an elevation in the cardiac biomarker cTnI. In dromedary camels, the cardiac biomarker cTnI is used practically to monitor early myocardial damage and prognosis during several disorders (Tharwat 2020; 2023a).

In regard to the hematological alterations, significant hematological alterations compared to female camels at normal parturition included lymphopenia, erythrocytopenia, decreased hemoglobin concentration and HCT percent. Convening the biochemical changes, most of the tested variables that included TP, ALB, ALP, AST, calcium, globulin, BUN, CK and phosphorus, differed significantly between the 2 groups. These results agree well with findings published in camels with difficult parturition (Ali et al. 2016).

We can conclude from this study that female camels with dystocia have metabolic acidosis compared to those with normal parturition based on the measured values of HCO3 and BE. The observed metabolic acidosis in this study should be treated parallel with interference to manage cases of difficult parturition. Prolonged dystocia in female camels also lead to an injury in the myocardium as evidenced by the significant elevations in cTnI. Changes in blood gases were also remarkable that included significant decreases in PO_2, TCO_2 and SO_2 values when compared to healthy camels with normal birth. Finally, the PCO_2 and lactate did not differ significantly between females with dystocia and controls.

Author Contributions

MT, AA and DD conceived, designed the experiments and carried out the practical work. TIA carried out the laboratory work. MT and DD wrote the manuscript draft, and prepared Figures/Tables. SO has revised the manuscript draft. All authors re-read, revised and approved the manuscript.

Conflict of Interest Statement

The authors declare that there is no conflict of interest.

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