Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/15275
DOI URL: http://dx.doi.org/10.21474/IJAR01/15275

RESEARCH ARTICLE

AUGMENTING CERVIMETRY, FETAL SURVIVABILITY, CALVING EASE, AND UTERINE HEALTH DURING BUFFALO UTERINE TORSION TREATMENT

El-Raey M.[1] and Rasha E. Azab[2]

1. Department of Theriogenology, Faculty of Veterinary Medicine, Benha University, P.O. 13736, Tokh, Kaliobia, Egypt.
2. Department of Physiology Faculty of Veterinary Medicine, Benha University, P.O: 13736, Tokh, Kaliobia, Egypt.

……………………………………………………………………………………………………....

Manuscript Info

Manuscript History
Received: 27 June 2022
Final Accepted: 30 July 2022
Published: August 2022

Abstract

A total of 52 buffalo cows suffering from uterine torsion were divided into seven groups. Each animal in the group was subjected to diagnosis depending upon clinical signs, rectal, vaginal, and ultrasonographic examination then subjected to one of the formulated therapeutic regimes.Cervimetry, state of fetal livability, parturition easiness, placental dropping time, and uterine health with each specific treatment were recorded.

Results: groups injected with denaverine hydrochloride, denaverine hydrochloride potentiated with methylergometrine showed rapid cervical dilatation rate (3.1 ± 0.26^{cm} and 3.2 ± 0.19^{cm}, respectively). Moreover, had an extending effect, where an efficient cervimetry rate (17 ± 0.52^{cm} and16 ± 0.46^{cm}, respectively) was achieved after 24hrs from starting the treatment. Denaverine hydrochloride, denaverine hydrochloride potentiated with methylergometrine and cloprostenol sodium plus methylergometrine showed the unique parturition process that took place with no maneuverers (2.1±0.26, 1.8±0.22 and 2.1±0.55); with preserved fetal viability (100, 88.8 and 85.7 %) and uterine health (85.7, 88.8 and 85.7%). While, methylergometrine alone was an inefficient therapeutic protocol that didn't assisted the process of normal delivery (3.2±0.17) and increases the rate of fetal deaths (50%). Denaverine hydrochloride, denaverine hydrochloride potentiated with methylergometrine and cloprostenol plus methylergometrine treated groups showed significantly the shortest placental dropping time (9.4±1.2, 10±1.1, and 10±0.67hrs, respectively), while methylergometrine and misoprostol recorded the longest placental dropping time (13±0.49 and 13±0.37hrs, respectively). **In conclusion**, this study was considered the first attempt that follows the degree of cervimetry after uterine torsion correction. Denaverine hydrochloride plus methergin is an efficient treatment regime that improved the reproductive health of buffalo cow after uterine torsion correction.The cervical dilatation rate starting from $13.00 - 14.00^{cm}$ was an articulated size at which the process of eutocia can start in buffalo cows. The maximum achieved mean of the internal cervical luminal diameter for buffalo cow after detorsion was

Corresponding Author: - El-Raey M.
Address:- Department of Theriogenology, Faculty of Veterinary Medicine, Benha University, P.O. 13736, Tokh, Kaliobia, Egypt.

17±0.52cm, this diameter assisted the delivery process with little maneuverers.

……………………………………………………………………………………………………....

Introduction:-

Uterine torsion was defined as a rotation of the pregnant uterus around its long axis (Bai et al., 2016). It is an unusual complication of pregnancy, and usually ranged between 45-180 degrees but in some cases reached up to 270 degrees or more (Corr, 1943). The exact mechanism and etiology of uterine torsion are still unknown; although it had been observed that ruminants are more vulnerable to developing the condition than other domestic animals due to their uterine instability (Sloss and Dufty, 1980). This instability usually arises from many reasons such as the broad ligament supports the uterus dorsolaterally but attaches to the ventral lesser curvature, and as pregnancy progress, the broad ligaments don't spread out proportionately with the developing gravid horn, leading to instability (Frazer et al., 1996 and Drost, 2007). Fascinatingly, the condition was seen rarely in **Bos indicus** cattle where the broad ligament attachment changes from a ventral to a dorsal position towards the tip of the uterine horn, and this excellent position offers the developing gravid uterine horn greater stability (Sloss and Dufty, 1980). Robinson and Duvall (1931) stated that the unbalanced maternal posture or positions plus irregular body movements may help trigger uterine rotation. At this point, the way in which the buffalo cow stands from lying in sternal recumbency may contribute to uterine torsion. Where at the point when the front end is resting on the knees the hind limbs were fully extended so the longitudinal axis of the pregnant uterus is almost vertical, this position together with the weight of the pregnant uterine horn allows the uterus to rotate more easily about this axis (Noakes, 2009).Torsion of the gravid uterine horn during resting and standing might be found to be facilitated by the depth of the abdominal cavity in ruminants, together with increased calf mobility around the time of parturition (Frazer et al., 1996). Also, the condition was noted in cases suffered from abdominal trauma during pregnancy (Duplantier et al., 2002), intra-abdominal adhesions, ovarian or uterine tumors and fetal mal-formation and presentations (Dua et al., 2005), uterine asymmetry caused by unicorns pregnancy or others. On the other hand, the occurrence of uterine torsion is independent of maternal age, parity, and gestation (Kremer and van Dongen, 1989). In comparison, it was recorded that uterine torsion was seen more commonly in buffalo cows (67-83%), chiefly due to poorly broad ligament musculature, making buffalo even more prone to torsion (Prabhakar et al., 1994, Nanda et al., 2003, and Srinivaset al., 2007 and Purohit et al., 2011, Purohit et al., 2012).

The clinical consequences of uterine torsion appeared to be increased with increasing the degree and duration of torsion; where, the survival of affected buffalo cows and their calf depending mainly onthe commencement of vascular compromise and the degree of haemato-biochemical changes (Thangamani et al., 2018). Limited blood flow in the rotated gravid uterine horn leads to irreversible uterine changes that finally might end with fetal death (Thangamani et al., 2018); decreased uterine wall elasticity and viability making the rotated horn wall brittle and fragile,so subjecting the case to uterine rupture (Ghuman, 2010 and Purohit et al., 2014).

Normally cervix had a viscoelastic property that was responsible for ripening and dilatation during the normal parturition process but this property was mostly disturbed following the uterine torsion (Breeveld-Dwarkasing et al., 2003). Based on this concept, cervical dilatation depends principally on the resistance caused by cervical viscoelastic properties together with the uterine contraction force (Breeveld-Dwarkasing et al., 2003). The cervical resistance and collagen concentration usually start to diminish gradually by the end of the second trimester and reach the lowest point by the end of the third trimester (Shi et al., 1999), this consequently resulting in cervical softening which is an important prerequisite for cervical dilatation process (Breeveld-Dwarkasing et al., 2003). The speed of cervical dilatation depends on the frequency and strength of the uterine contractions that result in intra-amniotic fluid pressure changes; the latter usually provide the main tool to overcome cervical tissue resistance (Lindgren, 1973). All of these previous physico-physiological changes in cervical tissues are usually disrupted during the progress of uterine torsion. Depending upon the degree and duration of the uterine torsion there was a variable degree of cervical ischemia that leads to marked fragmentation of cervical elastic fibers, and coagulative necrosis of cervical smooth cells (Singla et al., 1989).Even though, our understanding to the mechanisms involved in cervical ripening and dilatation during torsion had been hampered by the lack of sufficient studies. As the majority of the previous studies concentrated on simultaneous changes in uterine activity and plasma hormone concentrations during the onset of normal labor, but little was focused on how cervical ripening and dilatation occurred during torsion.Cervical dilatation assistance is attempted with many treatments but till now there was no speedy effect of any of these medications to prompt cervical dilatation (Balkrishna, 2015).

So, the present study aims to explore the dynamics of cervimetry by ultrasound in buffalo cowduring uterine torsion to draw a new line about the linear progression of cervical dilatation with uterine torsion;estimating the relationship between the use of specific treatments regimes and fetal viability, ease of calving, and uterine health after detorsion.

Materials and Methods:-

Over 5 years a total of 52 buffalo cows suffering from uterine torsion were admitted to the clinic for inspection and treatment. Animals were grouped into (7) groups. All cases were subjected to diagnosis depending upon clinical signs, rectal and vaginal, and ultrasonographic examination.

Clinical signs:
The affected buffalo cow usually admitted to the clinic exhibited uneasiness, restlessness, kicking at their abdomen, and showed straining without fetal membranes appearance from the vulva. The vaginal mucus membrane was characteristically dry; however, this condition usually depends on the degree and duration of torsion.

Clinical Examination:
Body temperature, pulse and respiration rates, mucous membrane color, ruminal movements, appetite, body condition, and dehydration level were checked for each animal on arrival. All the animals were then examined per rectum and vagina to determine the type and degree of uterine torsion.

Vaginal examination:
(was performed by lubricated gloved hand inserted into the animal vagina) revealed that there was spiral twisting for different parts of the genital system of the animal that differ according to each case and each degree, labia invagination, and shrinking to the front part of the vagina.

Rectally:
The orientation of broad ligaments was altered; one side of the broad ligament is pulled strongly downward and under the twisted uterine body; while, the other side broad ligament was stretched strongly across over the uterine body and cervix.

Determining uterine torsion degree:
1. If the degree of torsion is 90^{o}, the spiral twisting could be felt in the vaginal tract.The fetal head and fore limbs could be palpated.
2. 90^{o}-180^{o} there was difficulty in inserting the lubricated hand into the soft birth way.
3. 180^{o}-270^{o}only one or two fingers could be inserted.
4. If the twist angle is 270^{o}-360^{o} there was vulvar twisting to the direction of torsion (displacement of upper vulvar commissure inward, left or right, vulvar edema due to compression of the vaginal veins, and lymphatic drainage).

Table (1):- Degrees of uterine torsion in relation to each treatment (G).

Treatment	90-180	270	360
G(I)	5 (71.43%)	2 (28.57%)	-
G (II)	7 (77.78%)	1 (11.11%)	1 (11.11%)
G (III)	6 (75%)	1 (12.5%)	1 (12.5%)
G (IV)	5 (71.43%)	1 (14.28%)	1 (14.28%)
G (V)	4 (66.67%)	2 (33.33%)	-
G (VI)	5 (55.55%)	3 (33.33%)	1 (11.11%)
G (VII)	4 (66.67%)	2 (22.22%)	-

Treatment:
All admitted buffalo cows were treated by the traditional ‘Schäffers’ rolling method (indirect method), a simple and conventional method for treating buffaloes' uterine torsion. Before rolling procedures all buffalo cows were injected with 10ml of Avil 45.5mg/2ml (Pheneramine maleate, Sanofi Egypt), 10 ml i/m of dexamethasone 8mg/2ml (Sigma TEC), 10 ml i/m of meloxicam 5mg/ml (El Naser Co) and dextrose saline three liters intravenously.

The buffalo cow was casted in lateral recumbency on the same side of torsion, with forelegs and hind legs tied separately. Consequently, a wooden plank (4.5-6 meters in length & 25cm in width) was applied to the upper side of the abdomen in an oblique direction. One person stood on the wooden plank (ground side), while only one person (around 70-80kg) applied pressure on the abdominal side of the wooden plank, the other side of the wooden plank was supported by another person that apply slight pressure to hold it in place. After fixing the wooden plank in its due position the animal was rolled rapidly in the same direction of the torsion (Schäffer's method by Arthur, (1966). After the animal was rolled 180^o, the animal body had to be brought back to the original position and the soft birth way was examined to check the progress of the process (Purohit, 2006), to be sure that every thing was gone in the correct direction, and to determine if it requires more rolling or not. Usually, 2-3 rolls were required and rare cases were required (4).

Confirmation and documentation of physical signs and follow:

Treated buffalo cows have checked for 1) the number of rolls 2) the disappearance of the spiral twisting in the vagina, the birth canal should offer accessibility for fetal palpation 3) the degree of cervical dilatation (cervimetry) by ultrasonography directly after (0) correction then after, 2, 4, 8, 12, 16, 20 and 24 hours after correction. Animals that suffered from poor cervical dilatation after the correction was injected with one of the following therapeutic regimes to augment cervical dilatation:

Table (2):- Therapeutic regimes to augment cervical dilatation.

Group (G)	No.	Therapeutic regime	Dose and route of administration	Commercial brand &Source
I	7	Denaverine hydrochloride 40.0 mg	10ml/IM	Sensiblex® Veyx-Pharma GmbH
II	9	Denaverine hydrochloride 40.0 mg + Methylergometrine hydrogen Maleate 200 Mcg / 1 ML- 5 amp	10ml/IM + 1amp/100 kg/bw/IM	Sensiblex® + Methergin, Novartis, Egypt
III	8	Cloprostenol sodium	2ml/IM	Estrumate® Schering-Plough Animal Health Limited.
IV	7	Cloprostenol sodium + Methylergometrine hydrogen Maleate 200 Mcg / 1 ML- 5 amp	2ml/IM + 1 amp/100kgbw/IM	Estrumate ® + Methergin®
V	6	Methylergometrine hydrogen Maleate 200 Mcg / 1 ML- 5 AMP	1 amp / 100kgbw/IM	Methergin®
VI	9	Misoprostol 25 Mcg	(5) Misoprostol Tabs were placed endocervical as far as possible. The tablets were triturated in 5 ml normal saline to form a paste to be easily applied endocervical with gloved hand.	Vagiprost tablet® Adwia vaginal tablet, Egypt
VII	6	Misoprostol + Methylergometrine hydrogen Maleate 200 Mcg / 1 ML- 5 amp	IV + 1 amp / 100kgbw/IM	Vagiprost tablet® + Methergin®

Additionally, the treated animals were also checked for 4) fetal viability immediately after correction; 5) the time elapsed between rolling and fetal delivery;6) condition of delivery;7) fetal viability (including; respiratory and pulse rate, coughing frequency ……) ;8) placental dropping time;9) Survival of the dam (respiration and pulse rate, severity of uterine injury and bleeding); 10) uterine health.

Table (3):- Calving difficulty scores measured at birth by visually scoring females on the following scale of 1 - 6.

Score	Code	Description
1	Unassisted	Cow calved unassisted / No difficulty
2	Easy Pull	One person without mechanical assistance
3	Hard Pull	• Two people without mechanical assistance • One person with mechanical assistance
4	Surgical Assistance	Veterinary intervention required
5	Mal-presentation	Eg. Breech
6	Elective Surgical	Surgical removal of calf before the cow has the opportunity to calve

Results:-

Table (4) of cervical dilatation rate/time in relation to the therapeutic regime found that there was a strong significant difference ($P<0.05$) between treatment protocols concerning buffalo cow cervimetry starting directly from the second hour (T_2) after treatment. Where GI and GII groups showed rapid cervical dilatation rate ($3.1±0.26^{cm}$ and $3.2±0.19^{cm}$, respectively) if compared with the other treatment groups GII (2.3±0.12), IV ($2.6±0.19^{cm}$), V ($1.9±0.15^{cm}$), VI ($1.9±0.08^{cm}$), and VII ($2.0±0.12^{cm}$). The strong difference in buffalo cervimetry continues to increase with time elapsing with a steady rate until (T_{12}) where there was significant an excellent rapid increase in cervimetry especially with GI and GII treatment groups ($8.2±0.13^{cm}$ and $8.1±0.18^{cm}$, respectively) if compared with the other treatment groups (table, 4); this rapid cervical dilatation rate was continued till (T_{20}).

Moreover, table (4) showed a highly significant difference ($P<0.05$) between the treatment groups concerning the number of buffalo cows that respond to treatment and gave parturition without any assistance at (T_{20}). Where, GI and GII recorded an efficient high parturition rate (42.86 and 55.56%, respectively) if compared with other treatment groups (GII-25, GIV-14.29, GV-0.00, GVI-11.12, and CVII-0.00 %, respectively), depending on the efficient cervimetry rate achieved with GI and GII treatment protocols at T_{20} (13±0.36, and 14±0.38, respectively) if compared with the other treatment groups.

Additionally, table (4) illustrates a strong significant extending effect for GI and GII therapeutic regimes till (T_{24}), where these two protocols of treatment achieved an excellent cervimetry rate after 24h from begining the treatment ($17±0.52^{cm}$ and $16±0.46^{cm}$, respectively), if compared with the other treatment groups (table, 4). This augmenting effects for GI and GII treatment protocols on the cervimetry rate were reflected in a significant difference between groups concerning the number of buffalo cows that were still in case after 24h and need help to complete their parturition process (14.28 and 22.22 %, respectively) if compared with the other treatment groups (table, 4).

Furthermore, table (4) revealed that in cases of uterine torsion parental administration of cervical dilators (GI, GII, GII, GIV, and GV) was more efficient than local ones (GVI and GVII). In addition, the cervical dilatation rate starting from 13.00 -14.00 ^{cm} was an articulated size at which the process of eutocia can start in buffalo cows.

Table (4):- Cervical dilatation rate/Time in relation to a specific treatment in buffalo cow just recovered from uterine torsion.

Cervimetry (Cm) in relation to treatment								
Time interval/h	G (I)^{cm}	G (II)^{cm}	G (III)^{cm}	G (IV)^{cm}	G (V)^{cm}	G (VI)^{cm}	G (VII)^{cm}	P< 0.05
T_0	0.86±0.09	0.83±0.08	0.63±0.16	0.57±0.17	0.67± 0.17	0.61±0.16	0.50±0.18	
T_2	$3.1±0.26^a$	$3.2±0.19^a$	$2.3±0.12^{bc}$	$2.6±0.19^b$	$1.9±0.15^c$	$1.9±0.08^c$	$2.0±0.12^c$	0.000
T_4	$3.7±0.11^a$	$3.8±0.13^a$	$3.0±0.14^b$	$3.5±0.17^a$	$2.3±0.18^c$	$2.5±0.09^c$	$2.5±0.15^c$	0.000
T_8	$5.7±0.14^a$	$5.6±0.13^a$	$4.8±0.12^b$	$5.1±0.16^b$	$4.0±0.19^c$	$3.9±0.07^c$	$4.2±0.26^c$	0.000
T_{12}	$8.2±0.13^a$	$8.1±0.18^a$	$6.6±0.14^b$	$6.8±0.25^b$	$5.3±0.20^d$	$5.7±0.12^{cd}$	$6.0±0.26^c$	0.000
T_{16}	$10±0.42^a$	$11±0.34^a$	$7.8±0.12^c$	$8.6±0.25^b$	$6.3±0.14^d$	$6.4±0.15^d$	$6.7±0.25^d$	0.000
T_{20}	$13±0.36^a$	$14±0.38^a$	$11±0.25^b$	$12±0.26^b$	$9.3±0.19^d$	$9.7±0.20^{cd}$	$10±0.31^c$	0.000
A. No. in case	4(57.14%)	4(44.44%)	6(75%)	6(85.71%)	6(100%)	8(88.88%)	6 (100%)	
	Chi^2= 34.44 (P value =0.000005)							
T_{24}	$17±0.52^a$	$16±0.46^{ab}$	$15±0.31^{cd}$	$15±0.32^{bc}$	$13±0.72^e$	$12±0.40^e$	$14±0.63^{de}$	0.000
A. No. in case+	1(14.28%)	2(22.22%)	4(50%)	3(42.86%)	4(66.67%)	4(44.44%)	3(50%)	
	Chi^2= 45.81 (P value =3.221e-8)							

help	

[a, b, c]Superscripted letters in the table were calculated using Duncan's Multiple Range at ($p < 0.05$) using Costat statistics program

T: Time interval between each two cervimetry by hour; IV: Intra-vaginal; A. No.: animal numbers still in case due to incomplete cervical dilatation; A. No. in case + help: Animal numbers still in case and need external maneuvers (traction) and artificial lubricants to help the process of delivery to save calves and dams.

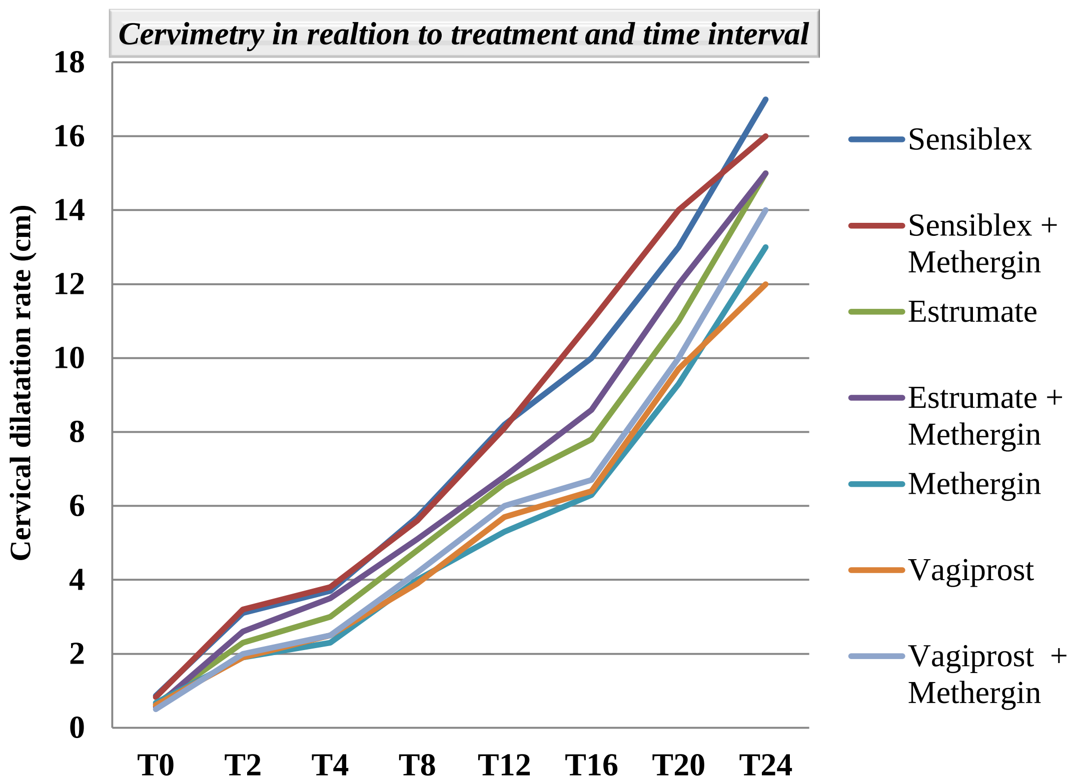

Figure (1):-Ultrasound cervimetry rate of buffalo cows suffered from uterine torsion in relation to therapeutic treatments and time. Note rapid cervical dilatation rate in time ranged between T_{12}-T_{20} after starting treatments by (Sensiblex® +Methergin® and Sensiblex®) and this effect was extending till T_{24}.

Table (5) presents a significant difference between the different therapeutic regimes concerning fetal viability at the interference time; where, GI and GII treatment protocols preserve fetal viability (100 and 88.8 %, respectively) if compared with other treatment groups (table, 5). Additionally, it was noted that there was a significant difference between groups concerning the parturition easiness where GII showed the unique parturition process that took place with no maneuverers (1.8±0.22), while GV was the an inefficient therapeutic protocol that did not assisted the process of normal delivery (3.2±0.17), and increases the rate of fetal deaths (50%).

Moreover, GII, GIV, and GI treatment protocols showed significantly the shortest placental dropping time (9.4±1.2, 10±0.67, and 10±1.1hrs, respectively), while GV and GVI recorded the longest placental dropping time (13±0.49 and 13±0.37hrs, respectively). Furthermore, the augmenting effects of GII, GI and GIV treatment protocols on fetal viability, parturition easiness, and placental dropping time were reflected clearly inthe uterine health after the process of delivery, where these groups recorded the highest efficiency of the uterine health (88.8, 85.7, and 85.7%, respectively) on the other hand GV and GVI chronicled the lowest value for the uterine health after the process of delivery (66.6).

Results of the table (5) undoubtedly illustrate a synergistic potentiating relationship between methylergometrine hydrogen maleate and denaverine hydrochloride /or cloprostenol sodium on fetal livability at interference, parturition easiness, placental dropping time, and uterine health more than it was used alone.

Table (5):- State of Fetal Livability at Injection (SFL) / Interference, Parturition Easiness (PE), Placental Dropping Time (PDT), and Uterine Health (UH) in relation to the specific treatment:

	SFL at injection*		SFL at interference**		PE	PDT/(h)	UH	
G(I)	7/7	100%	7/7	100%	2.1 ± 0.26^{bc}	10 ± 1.1^{c}	6/7	85.7%
G (II)	9/9	100%	8/9	88.8%	1.8 ± 0.22^{c}	9.4 ± 1.2^{c}	8/9	88.8%
G (III)	8/8	100%	6/8	75%	3.0 ± 0.38^{ab}	12 ± 0.73^{abc}	6/8	75%
G (IV)	7/7	100%	6/7	85.7%	2.1 ± 0.55^{bc}	10 ± 0.67^{c}	6/7	85.7%
G (V)	6/6	100%	3/6	50%	3.2 ± 0.17^{a}	13 ± 0.49^{a}	4/6	66.6%
G (VI)	9/9	100%	6/9	66.6%	2.6 ± 0.24^{abc}	13 ± 0.37^{ab}	6/9	66.6%
G (VII)	6/6	100%	5/6	83.3%	2.3 ± 0.21^{abc}	11 ± 0.37^{bc}	6/6	100
Chi^2 p value			0.002				0.07	
Anova p value					0.03^{*}	0.007^{**}		

[a,b,c]Superscripted letters in the table were calculated using Duncan's Multiple Range at ($p<0.05$) using Costat statistics program

*****SFL at injection it means that the rectally palpated calves were a live and had movements.

**SFL at interference it means at parturition the calves suffering from one or more of the following distress: (calving asphyxia or hypoxia; decreased fetal movement; meconium in the amniotic fluid (meconium aspiration syndrome); weak and slow to stand and suckle; reduced consumption of colostrum during the first 12hrs after birth, non-shivering thermogenesis although there was cold body according to (Hard, 2008). PE:Calving Ease according to table (2), and UH: Uterine health (it means that animals checked for signs or degree of endometritis or pyometra by ultrasonography from 3 weeks after delivery to 40 days post parturient).

Discussion:-

Over years, several instruments had been designed to measure cervical dilatation (Van Dessel et al., 1991, Lucidi et al., 2000), but they hadn't been used in combination with uterine torsion. Recently, non-invasive real-time ultrasonography had been used to follow the cervical dilatation rate either abdominally or vaginally in women (Burger et al., 1997; Iams, 1997; Rageth et al., 1997); where by ultrasonography cervical length, dilatation of the internal Os and the dilatation of the cervical canal could be visualized (Breeveld-Dwarkasing et al., 2002). Cervical priming refers to the dilatation and softening of the cervix in the first stage of labor and this usually runs gradually (Jackson, 2004). The period of myometrial dormancy accompanying prepartum luteolysis in ruminants was a significant moment for the beginning of morphological and biochemical preparation of both the cervix and myometrium for the normal parturition process (Janszen et al., 1990, Janszen et al., 1993).With a normal parturition process, cow's cervical dilatation progressed gradually (up to the first 11.00 hrs) then proceeded into a rapid dilatation phase during the next two to three hours (Breeveld-Dwarkasing et al., 2003 and Kumbhar 2015). It was recorded that near the time of parturition the extent of cervical dilatation was increased at a faster speed for the last 30 to 45 minutes (Kumbhar 2015, Kumbhar and Markandeya, 2017). But the graphic presentation of time interval and extent of cervical dilatation indicated that the speed of cervical dilatation was very slow in buffaloes than in cows (Kumbhar 2015, Kumbhar and Markandeya, 2017). The situation was more complicated with uterine torsion which was the predominant cause of dystocia among buffaloes (Jeenger et al., 2015, Noakes et al., 2002), mainly due to cervical dilatation failure which was observed in many buffaloes after uterine torsion correction (Purohit and Gaur, 2014, Prabhakar et al., 2007). Opinion differs on how long to leave the animal after correction before further intervention is required. If possible, the calf should be delivered immediately after correction; when this isn't possible it was advocated to leave the cow for up to three hours to allow the second stage of parturition to precede (Lyons et al., 2013). The duration required for cervical dilatation was defined as the time required from the closed state of the cervix (01 to 02 mm) to its full dilatation (Kumbhar, 2015). In the present study closed cervical diameter ranged between 0.50 ± 0.18 to 0.86 ± 0.09^{cm}. The difference in measurements between the current study and the previous records might be due to species differences where the previous records concentrated on cows, while the current study runs on buffalo cows that usually have special cervical dynamics that differ widely from other ruminants.

Kumbhar (2015), Kumbhar and Markandeya (2017) stated that the mean time interval of 12.20 ± 02.33 hrs was required in cows and 14.98 ± 02.01 hrs in buffaloes for cervical dilatation before the normal delivery process; the authors attributed this difference between cow and buffalo cows due to heavy weight and large size of buffalo fetus. The situation differed with uterine torsion cases where Purohit and Gaur (2014) reported that cervical dilatation may take about 12hrs or more, so the obstetrician should not take a rapid decision to deliver the fetus after torsion correction without proper cervical dilatation. As early attempts to deliver the calf with cervical dilatation failure can result in cervical laceration (Lyons et al., 2013). The current study results came in harmony with these previous results where the buffalo cow cervix took about twenty hours to allow delivery to take place depending on the kind of treatment used to augment the process of cervical ripening and dilatation following torsion correction.

The duration required for cervical dilatation in the present study was much higher than that recorded by Franz and Wright (2001), William (2005), and Hafez (2013) who had recorded that 2-6 hours was a sufficient period for cervical dilatation in cows and buffaloes. Moreover, Engelen et al. (2007) stated that cows treated with $PGF_2\alpha$ for induction of parturition need 4.9 ± 2.1 hours interval between the onset and maximal cervical dilatation. Additionally, Kumbhar (2015) observed that the mean time interval of 07.76 ± 00.51 hrs was required in cows and 08.40 ± 00.24 hrs in buffaloes for cervical dilatation during the estrus stage. The results of the current study came in inconsistency with previous reports; where with using the cloprostenol (GIII) or the cloprostenol potentiated with methergin (GIV) regimes required at least 16-20hrs to achieve an acceptable level of cervical ripening and dilatation in buffalo cows suffering from uterine torsion. Even with this time limit, the process of delivery may require different kinds of maneuverers to accomplish or additional time should pass to ensure an efficient degree of cervical dilatation. The difference between the current study results and previous reports concerning cervical dilatation duration might be attributed to species differences, the difference between cases where they carried their studies on normal cervix while the current study carried on cases suffering from uterine torsion in which the cervical dynamics usually disrupted. Furthermore, Shukla et al. (2010) stated that induction of parturition using prostaglandins required a time range from 24-72hrs (mean of 45 hrs). Additionally, Purohit et al., (2012) cited that prostaglandin alone induces the parturition within two to three days of the administration, both in cattle and buffaloes.

Furthermore, the maximum achieved mean of the internal cervical luminal diameter for buffalo cow after detorsion was 17 ± 0.52^{cm} (GI), this diameter assisted the delivery process with little maneuverers. The observation of the current study was differing from that recorded by Kumbhar (2015) who stated that the mean internal cervical luminal diameter of buffalo at the time of calving was found to be 25.00 ± 0.25^{cm}. The contradiction in results between previous reports and current study findings might be explained by several factors such as previous reports used buffalo cows in a normal delivery process, not cases suffering from uterine torsion which usually affect the cervical histo-physiological dynamics that usually run at the end of gestation period to prepare for normal cervical ripening and dilatation due to vascular disruption Kumbhar (2015). Also, this difference might be due to the difference in the tool used to measure this parameter. Moreover, this study was considered the first attempt to follow the degree of cervical dilatation following uterine torsion correction.

In the current study, the clinical cases of incomplete cervical dilatation treated with misoprostol tablets (GVI) endocervical showed a less efficient response concerning cervical dilatation/time (12±0.40)/24h. Even though, methylergometrine hydrogen maleate injection after uterine torsion correction can potentiate misoprostol action in enhancing cervical ripening and dilatation rate (GVII, 14±0.63/24h). These results disagreed with Kumbhar (2015), Kumbhar and Markandeya (2017) who cited that 5.66 ± 0.52 hrs and 3.97 ± 0.38 hrs were sufficient time ranges for misoprostol treated buffalo and cow respectively to ensure delivery. Furthermore, Azawi et al., (2011) stated that administration of 200 mcg of misoprostol in the partially dilated cervix in cows led to complete cervical dilatation within 45 minutes. The lack of harmony between the previous reports and the current study results might be due to the fact that previous reports applied the treatment on normal cases not uterine torsion suffered ones, also in the preceding studies wasn't clear the level of cervical dilatation at the time of application.Treatment application on the advanced level of cervical dilatation logic required a shorter time so their treatment was directed only to support the process of cervical dilatation not to deal with cases suffering from cervical dilatation failure like the current study.The earlier authors added that even after dilatation assisted delivery was required in all cases to protect the dam and fetus; this indicated that cases have not reached to full cervimetry rate and may require additional time to achieve this. On the other side, our results came partially in harmony with Patil (2013) who cited that misoprostol (200 mcg) was efficient to ensure cervical dilatation within 10.00 ± 0.61 and 13.42 ± 1.61 hrs in cows and buffaloes respectively. Misoprostol, an analogue of prostaglandin E1 (PGE1), was extensively used to ripen the cervix, initiate labor, and control post-partum bleeding in women (Weeks et al., 2007, Fiala et al., 2007). Leethongdee et al. (2007)

investigated the effectiveness of misoprostol as a cervical relaxant for ewes and he concluded that the action seems to be ineffective because there was only intrauterine penetration after 54hrs post-treatment in cyclic ewes. To our knowledge, PGE1 has never been used in buffalo obstetrics to dilate the cervix in uterine torsion. So, this report documented the first use of misoprostol for treatment of the incomplete cervical dilatation in buffalo cows suffering from uterine torsion. Building on this fact, misoprostol might be less effective in buffalo like ewes in induction full rapid cervical dilatation especially with uterine torsion condition, especially if compared with denaverine hydrochloride (GI) and denaverine hydrochloride plus methylergometrine hydrogen maleate (GII).

According to the current study results, it was found denaverine hydrochloride plus methylergometrine hydrogen maleate (GII) ensured the efficient cervical dilatation rate (14 ± 0.38-16 ± 0.46^{cm}) within a time range of 20-24hrs which considers the most efficient line of treatment in the current study. Denaverine hydrochloride (DNH) is a neurotropic-musculotropic spasmolytic agent with analgesic effects (Gahlot et al., 2017, Hüller and Scheler1963 and Hüller, 1970) that is indicated to regulate labor contractions, promote cervical dilatation and improves the elasticity of the soft birth canal (Lange, 2020, EMA, 1997 and Veyx-Pharma GmbH, 2009). A positive effect of DNH had been described to reduce the number of assisted calving and improve uterine health and reproductive performance in the next lactation (Zobel and Taponen, 2014). DNH is approved to ease calving specifically in heifers (Lange, 2020 and Golob, 2015), accelerating placental detachment (Köpernik and Schwarz, 1973) and lochiometra flu after delivery (Amon and Amon, 1970). The influence of denaverine hydrochloride, prostaglandin and misoprostol on calf vitality, parturition easiness, placental dropping time, and uterine health after uterine torsion correction had not been investigated yet in Egyptian buffalos. So, the current study is considered the first report dealing with these issues in buffalo cows suffering from uterine torsion. The current results indicated that denaverine hydrochloride plus methergin (GII) is an efficient treatment regime that ensures parturition easiness, short placental dropping time, and improves uterine health followed by GI and GIV therapeutic regimes.While, cloprostenol sodium (GIII), methylergometrine hydrogen maleate (GV), and GVI treatment protocols did not support efficiently the fetal viability, parturition easiness, and placental dropping time as well as the uterine health. Although, when misoprostol potentiated with methergin (GVII) the fetal viability, and placental dropping time, as well as the uterine health were improved but the level of placental dropping time after uterine torsion correction is still questionable.

In Conclusion:-

In buffalo, uterine torsion significantly affects cervical dynamics which in turn affects its ripping and dilatation. Denaverine hydrochloride plus methergin is an efficient therapeutic regime that ensures rapid efficient cervical dilatation, parturition easiness, short placental dropping time, and improves uterine health after detorsion. Misoprostol as a local vaginal treatment might be less effective in buffalo like ewes in induction full rapid cervical dilatation, especially with uterine torsion. Cloprostenol or cloprostenol potentiated with methergin regimes required at least 16-20 hrs to achieve an acceptable level of cervical ripening and dilatation in buffalo cows suffering from uterine torsion. A synergistic potentiating relationship between methylergometrine hydrogen maleate and denaverine hydrochloride /or cloprostenol sodium which in turn improves the fetal livability, parturition easiness, placental dropping time, and uterine health more than it was used alone.

Conflict of interest statement

The authors declare that there is no conflict of interest.

References:-

1. Amon, K., Amon, I. (1970):Klinische Erfahrungen bei der Behandlung der Lochiometra mitSpasmoanalgetika. ZentralblGynakol, 92 (9): S 272.
2. Arthur, G.H. (1966): Recent advances in Bovine Obstetrics. Veterinary Record, 79: 630.
3. Azawi, O.I., Naoman, U.T., Al-Kass, Z.M., Lazim, E.H., and Fathi, N.G. (2011): Misoprostol treatment of dystocia due to incomplete dilatation of the cervix in a cow. Iraqi J. Vet. Sci., 25 (2): 97-98.
4. Bai, T., Diraviyam, T., Zhou, Z., Jiang, Z., and Zhang, X. (2016): A comparative study of two uterine torsion correction methods in parturient cows. VeterinarskiArhiv.,86 (6): 787-793.
5. Breeveld-Dwarkasing, V.N., Struijk, P.C., Lotgering, F.K., Eijskoot, F., Kindahl, H., van der Weijden, G.C. and Taverne, M.A. (2003):Cervical dilatation related to uterine electromyographic activity and endocrinological changes during prostaglandin F (2alpha) - induced parturition in cows. Biology of Reproduction, 68: 536-542.

6. Breeveld-Dwarkasing, V.N.A., Struijk, P.C., Eijskoot, F., Lotgering, F.K., van Dissel-Emiliani, F.M.F., van der Weyden, G.C. and Taverne, M.A.M. (2002): Ultrasonic cervimetry to study the dilatation of the caudal cervix of the cow at parturition Theriogenology, 57: 1989-2002.
7. Burger, M., Weber-Rössler, T., Willmann, M. (1997): Measurement of the pregnant cervix by transvaginal ultrasonography: an intra-observer study and new standards to improve the interobserver variability. Ultrasound Obstetrics and Gynecology, 9: 188-193.
8. Corr, J.E. (1943): Axial torsion of the gravid uterus in two successive pregnancies. Am. J. Obstet. Gynecol., 46: 749-751.
9. Drost, M. (2007): Complications during gestation in the cow. Theriogenology, 68(3):487-91.
10. Dua, A., Fishwick, K., Deverashetty, B. (2005): Uterine Torsion in Pregnancy: A Review. The Internet Journal of Gynecology and Obstetrics, 6 (1): 1-3.
11. Duplantier, N., Begneaud, W., Wood, R., Dabezies, C. (2002): Torsion of gravid uterus associated with maternal trauma: A case report. J. Reprod Med., 47: 683-685.
12. EMA.(1997):The European agency for the evaluation of medicinal products. Denaverine Hydrochloride, Summary Report.
13. Engelen, E.V., Taverne, M.A.M., Everts, M.E., Weijden, G.C.V., Doornenbal, A. and Breeveld-Dwarkasing, V.N.A. (2007): EMG activity of the muscular and stromal layer of the cervix in relation to EMG activity of the myometrium and cervical dilatation in $PGF_2\alpha$ induced parturition in the cow. Theriogenology, 67: 1158-1167.
14. Fiala, C., Gemzell-Danielsson, K., Tang, O.S., Von Hertzen, H. (2007): Cervical priming with misoprostol prior to transcervical procedure. Intern J. Gynecol. Obstet., 99:168-171.
15. Franz, B. and Wright, J.G. (2001): Veterinary obstetrics. Green world publishers, pp. 76.
16. Frazer, G.S., Perkins, N.R. and Constable, P.D. (1996): Bovine uterine torsion: 164 hospital referral cases. Theriogenology, 46(5):739-758.
17. Gahlot, S.C., Kumaresan, A., Kumar, S., Yadav, S., Saraf, K.K., Karan, P. and Verma, K. (2017): Incomplete cervical dilatation in animals -An update. Review Article, International Journal of Science, Environment and Technology, 6 (2): 1036-1048.
18. Ghuman, S.P.S. (2010): Uterine torsion in bovines: a review. Indian Journal of Animal Sciences, 80(4): 289-305.
19. Golob, A.L. (2015): Use of Denaverine hydrochloride in dairy cows and heifers with disturbed birth process. PhD degree, Veterinary Medicine, Justus Liebig University in Giessen, Gießen.
20. Hafez, E.S.E. (2013): Reproduction in farm animals, 7th ed. Blackwell publishing Ltd. pp. 153.
21. Hard, K.E. (2008): Predictive measures of fetal distress in calves during delivery. Graduate Theses and Dissertations. 11436. https://core.ac.uk/download/pdf/38923099.pdf
22. Hüller, H. and Scheler, W. (1963): ZurPharmakologieeinerSerieneuerBenzilsäurederi-vate. ActabiologicaetmedicaGermanica, 11.
23. Hüller, H. (1970): Pharmakologie und Klinik von O-(2-Äthylbutoxy)-benzil-säure-2-dimethylaminoäthylesterhydrochlorid (= Spasmalgan). Zentralbl Pharm, 109.
24. Iams, J.D., Goldenberg, R.L., Meis, P.J., Mercer, B.M., Moawad, A., Das, A., Thom, E., McNellis, D., Copper, R.L., Johnson, F., Roberts, J.M.(1996):The length of the cervix and the risk of spontaneous premature delivery. New England Journal of Medicine, 334: 567-572.
25. Jackson, P.G.G. (2004): Handbook of Veterinary Obstetrics. 2nded, Elsevier Sci Ltd., 42-43.
26. Janszen, B.P.M., Bevers, M.M., Ravenshorst, M.M., van der Weijden, G.C., Dieleman, S.J., Taverne, M.A.M. (1993): The relation between prostaglandin-induced luteolysis and temporary inhibition of myometrial activity in late pregnant cows with progestagen containing ear implants. J. Reprod. Fertil., 97 (2):457-461.
27. Janszen, B.P.M., Knijn, H., van der Weijden, G.C., Bevers, M.M., Dieleman, S.J., Taverne, M.A.M. (1990): Flumethason-induced calving is preceded by a period of myometrial inhibition during luteolysis. Biol. Reprod., 43:466-471.
28. KamleshJeengar, Purohit, G., Mehta, J.S., Choudhary, V., Tripathi, A.(2015): Prognostic tests for uterine torsion affected buffaloes. Theriogenology Insight, 5(1): 33-40.
29. Kopernik, H., Schwarz, B. (1973): Klinische Erfahrungen mit dem Spasmoanalgetikum Spasmalgan in der Geburtshilfe. Zschr arztl Fortbild, 67 (13): 656-658.
30. Kremer, J.A.M., van Dongen, P.W.J. (1989): Torsion of the pregnant uterus with a change in placental localization on ultrasound; a case report. Eur. J. Obstet. Gynecol. Reprod. Biol., 31:273-275.
31. Kumbhar, G.B. (2015): Physio-pathological studies and efficacy of different therapeutic approaches for cervical dilatation in large ruminants. Master of veterinary science in animal reproduction, gynaecology and

obstetrics.College of Veterinary and Animal Sciences, Parbhani Maharashtra Animal and Fishery Sciences University, Nagpur, India.
32. Kumbhar, M. and Markandeya, N. (2017): Studies of cervical dynamics in cows and buffaloes. International Journal of Livestock Research, 7(12): 52-58.
33. Lange, K.S. (2020): Calving prediction and evaluation of calving ease after medical treatment in Holstein-Friesian heifers. PhD of veterinary medicine, the Freie Universität Berlin.
34. Leethongdee, S., Khalid, M. and Bhatti, A. (2007): The effects of prostaglandin analogue misoprostol and follicle-stimulating hormone on cervical penetration in ewes during the periovulatory period. Theriogenology, 67: 767-77.
35. Lindgren, L. (1973): The influence of uterine motility upon cervical dilatation in labor. Am. J. Obstet. Gynecol., 117:530-536.
36. Lucidi, R.S., Blumenfeld, L.A., Chez, R.A. (2000): Cervimetry: a review of methods for measuring cervical dilatation during labor. Obstet. Gynecol. Surv., 55:312-320.
37. Lyons, N., Gordon, P., Borsberry, S., Macfarlane, J., Lindsay, C., Mouncey, J. (2013): Clinical Forum: Bovine uterine torsion: A review. Livestock, 18 (1):18-24.
38. Nanda, A.S., Brar, P.S. and Prabhakar, S. (2003): Enhancing reproductive performance in dairy buffalo: Major constraints and achievements. Reproduction Supplement, 61: 27-36.
39. Noakes, D.E., Parkinson, T.J., England, G.C.W., Arthur, G.H. (2002): Arthur’s veterinary reproduction and obstetrics. 8thed, Elsevier Sci Ltd., 335.
40. Noakes, D.E. (2009): Maternal dystocia: causes and treatment. In Veterinary Reproduction and Obstetrics, ed. D E Noakes, T. J. Parkinson, and G. C. W. England, 232-246. 9thed. Elsevier.
41. Patil, A.D. (2013): Comparative efficacy of different cervical dilators in cows and buffaloes. Vet. Pract., 14 (1): 58-59.
42. Prabhakar, S., Matharu, S.S., Gandotra, V.K. and Brar, R.S. (2007): Corpus luteum does not contribute to higher progesterone concentration around parturition in buffaloes with uterine torsion. Indian J. Anim. Sci., 77: 956-959.
43. Prabhakar, S., Singh, P., Nanda, A.S. and Sharma, R.D. (1994):Clinico-Obstetrical Observations on Uterine Torsion in Bovines. Indian Veterinary Journal, 71(8):822-824.
44. Purohit, G.N. and Gaur, M. (2014): Uterine torsion in buffaloes: a critical analysis. Review Article. Buffalo Bulletin, 33(4): 363-378.
45. Purohit, G.N., Barolia, Y., Shekhar, C., Kumar, P. (2011): Maternal dystocia in cows and buffaloes: a review. Open J. Anim. Sci., 1, 41-53.
46. Purohit, G.N., Barolia, Y., Shekher, C. and Kumar, P. (2011): Maternal Dystocia in cows and buffaloes: A review. Open J. Anim. Sci.,1(2): 41-53.
47. Purohit, G.N., Shekher, C., Kumar, P. and Solanki, K. (2012): Induced termination of pregnancy in domestic farm animals. Iranian journal of applied animal science, 2(1):1-12.
48. Purohit, G.N. (2006): Maternal causes of dystocia in cows and buffaloes: p 16-20. In, Suresh SH, Tandle MK eds. Veterinary Obstetrics a Practical Guide Jaypee Brothers Medical Publishers New Delhi, p 16-25
49. Rageth, J.C., Kernen, B., Sauernmann, E., Unger, C. (1997): Premature contractions: possible influence of sonographic measurement of cervical length on clinical management. Ultrasound Obstetrics and Gynecology, 9: 183-187.
50. Shi, L., Shi, S.Q., Saade, G.R., Chwalisz, K., Garfield, R.E. (1999): Changes in resistance and collagen fluorescence during gestation in rat. J Perinat Med., 27:188-194.
51. Shukla, S.P., Bajaj, N.K., Shukla, M.K. (2010): Innovation in induction of parturition, XXVI Annual convention of ISSAR: 72-82.
52. Singla, V.K., Roy, K.S., Sharma, R.D., Gandotra, V.K. and Dhaliwal, G.S. (1989): Histopathological studies of cervix and vagina in buffaloes suffering from uterine torsion. Proceedings of VIIIth National symposium of Indian Society for the study of animal reproduction, Anand, Gujrat, India.
53. Sloss, V. and Dufty, J.H. (1980): Dystocia. In Handbook of Bovine Obstetrics, 108-111. Baltimore; London: Williams & Wilkins. Robinson AL, Duvall HM. Torsion of the pregnant uterus. J ObstetGynaec Br Commonw., 1931; 38: 55-84.
54. Srinivas, M., Sreenu, M., Lakshmi Rani, N., Subramanyam Naidu, K. and Devi Prasad, V. (2007): Studies on dystocia in graded Murrah buffaloes: a retrospective study. Buffalo Bulletin, 26: 40-45.
55. Thangamani, A., Srinivas, M., Chandra Prasad, B. (2018): Pathophysiological Changes Following Uterine Torsion in Bovines - A Review. Int. J. Pure App. Biosci., 6 (2): 872-876.

56. Van Dessel, T., Frijns, J.H., Kok, F.T., Wallenburg, H.C. (1991): Assessment of cervical dilatation during labor: a review. Eur. J. Obstet. Gynecol. Reprod. Biol., 41:165-171.
57. Veyx-Pharma Gmb H.,(2009):Fachinformation Sensiblex 40 mg/mL. (Zulassungsnummer 3100278.00.00.) Veyx-Pharma GmbH, Schwarzenborn, Germany.
58. Weeks, A.D., Alfirevic, Z., Faunders, A., Hofmeyr, J., Safar, P. and Wing, D. (2007): Misoprostol for induction of labor with a live fetus. Intern. J. Gynac. Obst., 99:194-197.
59. William, O.R. (2005): Dukes Physiology of Domestic Animals, 12th ed. Poniama Publishing Corporation, pp. 715.
60. Zobel, R.and Taponen, J. (2014): Denaverine hydrochloride and carbetocin increased welfare during and after parturition and enhanced subsequent fertility in cattle. J. Dairy Sci., 97 (06) 3570-3577.