



# Cesarean section in dromedary camels (*Camelus dromedarius*): indications, surgical approaches and outcome

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**Abstract.** Cesarean section is a surgical procedure commonly utilized in emergency situations after normal delivery of the calf has failed (dystocia). Unfortunately, there is little clinical information regarding this important and life-saving procedure in dromedary camels. Therefore, the aims of this review article were to compile available data regarding indications, surgical approaches, and outcome of cesarean sections in dromedary camels. Scientific resources such as Pubmed, Google scholar, and Researchgate were searched for all published articles regarding camel dystocia, cesarean section, obstetrics and female reproductive tract surgery. Cesarean section in camels is commonly performed in cases of dystocia because of fetal or maternal reasons. Camels are restrained in a sitting position and surgery is performed under sedation using xylazine and local analgesia using lidocaine. Surgical sites are the left paralumbar fossa or the ventrolateral approach. Post-operative care includes administration of broad spectrum antibiotics and anti-inflammatory drugs. Orally administered fluids and electrolytes are indicated in dehydrated cases. Oxytocin is also indicated to facilitate discharge of the placenta and uterine involution. The most commonly reported complications are excessive edema at the surgical site, dehiscence of skin sutures and surgical site infections, metritis, and fatal peritonitis. Survival rates and post-operative fertility are variable and depend on individual cases.

**Key Words:** surgery, pregnant she-camel, parturition, dystocia, complications.

**Introduction.** Cesarean section is an emergency surgical procedure that can save the life of the she-camel and her calf if performed early enough after parturition starts (Tibary & Anouassi 2001; Agab 2006; Long 2007; Purohit 2012). The normal process of parturition in dromedary camels (*Camelus dromedarius*) can span over a variable period of time ranging from 2 to 6 hours (Purohit 2012; Ali & Derar 2015). The calf is commonly presents in the birth canal in an anterior longitudinal direction (Purohit 2012; Roberts 2012; Ali & Derar 2015). The first stage of parturition is usually characterized by signs of discomfort, restlessness and increased anxiety. The animal isolates itself from the herd and may alternate between standing, sitting and circling. During this time, the cervix is dilating gradually. This stage usually ends by breaking of the first water bag. By this time, the strength and frequency of abdominal contractions are increasing dramatically. The second stage of parturition is quick and marked by the expulsion of the fetus which can occur any time between 15 minutes to 45 minutes after the breaking of the first water bag (Purohit 2012; Roberts 2012; Ali & Derar 2015). The parturition process is then complete by the expulsion of the fetal membranes which usually occur within 4 to 6 hours after fetal expulsion (Purohit 2012; Roberts 2012; Ali & Derar 2015).

Early recognition of dystocia and proper intervention are essential for positive outcomes. Unfortunately, in the field, the diagnosis is usually late and attempts to correct the problem vaginally by inexperienced personnel increase the chances of complications and undesirable outcome. The camel fetus neck and extremities are exceptionally long making attempts to vaginal delivery futile in most cases and a decision to perform cesarean section must be taken as early as possible to ensure a desirable outcome (Purohit 2012; Roberts 2012; Ali & Derar 2015). Usually, delayed first stage of parturition for more than 2 hours or delayed second stage for more than 6 hours may

indicate possible dystocia and warrant immediate attention and examination. Pregnant camels that show increased signs of distress, abdominal pain and bloody vaginal discharge must be examined to rule out dystocia.

There is little clinical information regarding cesarean section in *C. dromedarius*. Therefore the aims of this review article were to compile available data regarding indications, surgical approaches, and outcome of cesarean sections in dromedary camels for the practicing veterinarian.

**Indications.** Scientific or clinical studies to investigate different causes of dystocia in *C. dromedarius* are rare (Table 1). The prevalence of dystocia in camels is around 2-9% (Arthur 1992; Aboul-Fadle et al 1993).

More recently, Tibary et al (2015) reported the causes of dystocia in 76 cases of *C. dromedarius*. All females were multiparous that were bred either naturally or by embryo transfer. He reported that failure of cervical dilation was the most common cause of dystocia in this population (81.6%; n=62). Other less common causes included uterine torsion, lateral head and neck deviation, bilateral carpal flexure, failure to extract fetus by fetotomy, emphysematous fetus, bilateral hip flexure and vaginal evisceration.

Ali et al (2016) conducted a large study where a total of 1,890 camel calvings were surveyed for causes of dystocia. An overall dystocia rate in this population was 8.6% (n=163). He reported that the risk of dystocia was higher in intensively managed camels compared to those reared in free-ranging systems. Premiparous she-camels were almost 2 times more likely to have dystocia. He reported that the most common reasons for dystocia were abnormal posture of the fetus (51.4%) followed by uterine torsion (23.4%).

Table 1

Types of dystocia in *Camelus dromedarius*

<i>Origin of dystocia</i>	<i>Description</i>	<i>Reference</i>
Fetal	Emphysematous fetus	Elias 1991; Chandolia et al
	Malposition	1991; Arthur 1992; Straten
	Breech presentation	2000; Purohit et al 2011;
	Head/neck deviation	Anwar et al 2013; Tibary et al
	Limb deviation/flexion	2015; Ali et al 2016
	Fetal malformations	
Maternal	Uterine torsion	Sharma & Vyas 1970;
	Failure of cervical dilatation	Moldagaliev 1975; Straten
	Feto-maternal disproportion	2000; Anwar et al 2013; Ali et
	Uterine inertia	al 2016

**Pre-operative evaluation.** A general physical examination of the she-camel must be performed before surgery (Ramadan et al 1986; Khanvilkar et al 2009; Lopes 2013). Dehydrated animals and severely ill animals must be stabilized by administering fluids intravenously. Pre-operative antibiotics and anti-inflammatory administration is indicated in most cases to prevent post-operative peritonitis and toxemia (Ramadan et al 1986; Khanvilkar et al 2009; Lopes 2013).

The she-camel must be examined in a sitting position by rectal and vaginal palpation (Ramadan et al 1986; Khanvilkar et al 2009; Lopes 2013). Vaginal examination must be performed after appropriate cleansing and disinfecting of the vulva and vestibule. Attempts should be taken to determine the viability of the fetus, extent to which the birth canal is dilated and the position and orientation of the fetal limbs and head if possible. If available, transcutaneous ultrasonography may be used to determine fetal health and viability (Noakes et al 2009). A decision to perform surgery must be taken as soon as the condition is diagnosed in order to minimize chances of post-operative complications.

**Restraint and anesthesia.** The camel is restraint in a sitting position and secured using ropes to tie the fore and hind limbs (Siddiqui & Telfah 2010). Sternal or sitting position is reported to be normal resting position of camels and exerts the least undesirable effects on the cardiopulmonary systems during the long surgery.

Sedation using xylazine (0.25-2.2 mg/kg) intravenously or intramuscularly along with local infiltration of analgesia (inverted "L" or line block techniques) using lidocaine 2% are usually adequate (Siddiqui & Telfah 2010; Purohit 2012; Lopes 2013; Tibary et al 2015; Kumar et al 2015; Ali et al 2016). A combination of xylazine (0.25 mg/kg, IV) with butorphanol (0.05 mg/kg IV) has also been used effectively to restraint camels for cesarean section (Tibary et al 2015). Lower doses of xylazine may require re-administration during the procedure. Yohimbine (0.125 mg/kg) or tolazoline (1-2 mg/kg) are used to reverse xylazine anesthesia in camels (Anderson 2009; Purohit 2012). Epidural analgesia using 2% lidocaine administered into the sacro-coccygeal space is sometimes utilized to help prevent straining during surgery (Anderson 2009; Purohit 2012).

Alternatively, injectable general anesthesia has been used for cesarean section in camels. Premedication using xylazine (0.1 mg/kg IV) followed guaifenesin (100 mg/kg IV) as a 10% solution in 5% dextrose to induce anesthesia while the she-camel is sitting in sterna recumbency (Lopes 2013). Intranasal oxygen can be administered at a rate of 10 L/minute (Lopes 2013).

**Surgical approaches.** Cesarean section in camels is commonly performed via a left paralumbar fossa approach (Siddiqui & Telfah 2010; Purohit 2012; Roberts 2012; Lopes 2013; Ali & Derar 2015; Kumar et al 2015; Tibary et al 2015; Ali et al 2016). The surgical site is easily accessible in the sitting position and the part of the gravid uterus can be exteriorized in most cases. The skin incision is positioned in the middle of the flank and extends up to 40 cm in a vertical direction parallel to the last rib. Another position of the skin incision is obliquely directed about 10 cm posterior to the last rib in the lower flank area. The second most common approach is the ventrolateral approach. In this approach, the skin incision is positioned about 5-10 cm above and parallel to the subcutaneous abdominal vein in an oblique direction. Another but less common approach is in right lateral recumbency where the skin incision is positioned just lateral to arcus cruralis and the stifle joint. In *C. dromedarius*, the ventral midline laparotomy approach is not recommended because of high risk of complications (Siddiqui & Telfah 2010; Purohit 2012; Roberts 2012; Lopes 2013; Ali & Derar 2015; Tibary et al 2015; Ali et al 2016).

**Surgical procedure.** The surgical procedure is relatively well described (Siddiqui & Telfah 2010; Purohit 2012; Roberts 2012; Lopes 2013; Ali & Derar 2015; Kumar et al 2015; Tibary et al 2015; Ali et al 2016). After the skin and subcutaneous tissues are incised using sharp and blunt dissection, the underneath muscle layers are cut with scissors. Attempts should be made to minimize bleeding by ligating bleeding vessels. In order to prevent inadvertent cutting through viscera, the peritoneum must be grasped with tissue forceps and cut with scissors. A small incision is made into the peritoneum using the scissors and then the entire peritoneum is cut with the finger guiding the scissor. Attempts must be made to exteriorize the uterus before it is incised using fetal limbs. In cases where the fetus is dead, it is recommended to pack the surgical site around the exteriorized uterus with sterile drapes to prevent contamination with fetal fluid. Attempts must be made to make the incision in the uterus along the greater curvature avoiding major vessels. Ropes or chains are then attached to the limbs of the fetus using half-hitch ties to prevent bone fractures and dislocations of distal joints and the fetus is pulled out. After removal of the fetus, loose parts of the placenta must be removed by cutting using scissors. Excessive traction of the placenta is not recommended. The incision in the uterus is sutured using a double layer closure using Lambert pattern and size 2 absorbable suture materials. The outside wall of the uterus is flushed using sterile saline solution and all blood clots are removed to prevent adhesion formation. The uterus is then placed back in the abdominal cavity. The peritoneum,

muscle layers and subcutaneous tissues are sutured carefully in separate layers using size 2 absorbable suture materials in a continuous pattern. The skin is sutured using unabsorbable suture materials using simple interrupted or interlocking pattern.

**Post-operative care.** Post-operatively, antibiotics (potassium penicillin at 22,000 IU/kg and gentamicin at 6.6 mg/kg intravenously) and anti-inflammatory drugs (flunixin meglumine at 1 mg/kg intravenously) must be administered for 5-7 days (Jones 2009; Lopes 2013; Kumar et al 2015). To stimulate uterine contraction and placenta expulsion, oxytocin (30 IU intramuscularly) can be administered immediately after surgery (Jones 2009; Lopes 2013; Kumar et al 2015). If the placenta is not expelled within 12 hours, estradiol cypionate (10 mg intramuscularly) can be administered followed by oxytocin (10-20 IU intramuscularly) (Lopes 2013; Kumar et al 2015). Oral fluids and electrolytes solution (20 L) containing sodium, chloride and potassium can be administered using orogastric tube (Lopes 2013; Kumar et al 2015). Skin suture must be removed in 21 days. Feeding the camel immediately after complete recovery from anesthesia is recommended using highly palatable roughages.

**Post-operative complications.** The most commonly encountered complications following cesarean section in camels are dehiscence of skin sutures, excessive edema at the surgical site, herniation at the operative site, and peritonitis. Tibary et al 2015 reported that the most common non-lethal postsurgical complications were surgical site infection or dehiscence (mostly due to myiasis; 20%) and retained placenta (15.7%). Calf survival rates at delivery, 1 week of age and at weaning were 81.6%, 75% and 73.7%, respectively. The most common causes of newborn calf death during the first week of life were sepsis, encephalopathy and trauma (Tibary et al 2015).

**Outcome and fertility.** There are little information in the literature concerning survival rates and post-operative fertility in camels following cesarean section. In one study, the overall dam survival rate was 92.1% (n=70) (Tibary et al 2015). The most common cause of death included peritonitis (n=3), septic metritis (n=2) and euthanasia due to vaginal evisceration (n=1) (Tibary et al 2015). Forty-eight females were used as recipients in an embryo transfer program one year after surgery. Of these, 70.8% (34/48) became pregnant following one to three embryo transfers (Tibary et al 2015).

Ali et al (2016) reported a significant association between survival of both the dam (17.85) and calf (87.9%) and duration of dystocia. He reported that the dam and calf death were 4.7 and 8 times more likely in prolonged cases of dystocia, respectively (Ali et al 2016). He concluded that survival of the dam and calf are excellent for field cesarean section in camels if intervention is early.

**Conclusions.** Dystocia in camels are underreported. Manual manipulation and attempts for vaginal intervention are usually futile. Early surgical intervention is significantly associated with better survival rates of both the dam and calf. The surgery is usually performed through a left flank skin incision in sternally recumbent camels under xylazine sedation and local analgesia.

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