

**Mini Review****Anatomo-physiological involution of umbilical cord, umbilical hygiene and etiopathogenesis of the umbilical lesions in calves****E. Sinem Özdemir Salci¹ and Hakan Salci^{2*}**¹Department of Obstetrics and Gynecology; ²Department of Surgery, Faculty of Veterinary Medicine, Uludağ University, Bursa, Turkey**Abstract**

Umbilical cord is a fetal structure that provides connection between mother and fetus. It consists of an umbilical vein, two umbilical artery and urachus. Although umbilical lesions are usually sporadic but sometimes enzootic, their clinical appearances change from acute to chronic in terms of the affected umbilical organs. Umbilical hygiene together with anatomo-physiological involution of the umbilical cord should be taken into consideration to prevent contamination of the umbilical cord from the pathogen microorganism. Umbilical lesions have economic losses for farmers. Therefore, this article aims to review umbilical hygiene, anatomo-physiological involution and etiopathogenesis of the umbilical lesions in calves.

Keywords: Umbilical cord; calf; Anatomo-physiological features

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The term “*omphaloe*” determines the midpoint of the center in dictionary. Rome known as the center of the world in ancient age, the term “*umbilicus terrae*” has been in use. Because “*omphalos*” is roughly equivalent term in Latin, it has been used for the center of the world in Ancient Greek (Nuss, 2006).

Umbilical cord is a fetal and maternal structure that provides connection between mother and fetus. Umbilical cord consists of an umbilical vein, two umbilical artery and urachus. Although umbilical vein transfers the clean blood to liver of the fetus, umbilical artery transfers the deoxygenated blood to the placenta. Urachus is a tube-shaped structure connecting the allantois sac to the fetal urinary bladder. An amniotic membrane wraps the umbilical cord (Berchtold et al., 1990; Dirksen et al., 2002; Cihan et al., 2006; Nuss, 2006; Görgül et al., 2009).

Umbilical lesions result in the economic losses affecting the calve growing negatively. Although they origin from the genetic, environmental and iatrogenic causes, the main responsible factor is the disregarding of the umbilical cord hygiene following parturition (Belge et al., 1996; Cihan et al., 2006).

In the acute management of the umbilical disease resulted from the insufficient hygiene rules, antibiotherapy and NSAID are required initially. If the umbilical lesion is chronic, surgery should be considered (Nuss, 2006).

In this article, hygiene and anatomo-physiological involution of the umbilical cord and etiopathogenesis of the encountered umbilical lesions in calves have been reviewed.

Anatomo-physiological involution of the umbilical cord

Separately, umbilical cord has two part umbilical vein that combines and pass the umbilical hiatus of the fetus as unique cordon. In the peritoneal cavity, the cordon directs cranially to connect the liver and the portal vena. Coagulated blood presents in the umbilical vein in the postnatal period. Umbilical vein has connection in the umbilical hiatus and the coagulated blood in the vena closes up the umbilical hiatus. Occlusion of the venous lumen occurs with the help of abdominal muscle contraction and proliferation of connective tissue. Regressive umbilical vena in adult

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animals can remain a ligamentum teres hepatis near the free part of ligamentum falciforme (Dirksen et al., 2002; Nuss, 2006).

Umbilical arteries pass through the umbilical hiatus as two branches. They extend in the abdominal cavity caudodorsally, pass between the lateral ligament of the urinary bladder and connect separately with the arteria hypogastrica at the caudal portion of the pelvis. Umbilical arteries occlude reflexively. They contract 2-3 cm proximal to caudal part of umbilical hiatus following parturition and ascend to the urinary bladder level in a week. They constitute ligamentum teres vesicae together with the urachus (Dirksen et al., 2002; Nuss, 2006).

Urachus has connection with the urinary bladder in fetal period. It directs with the other structures to the umbilical hiatus passing the umbilical arteries and opens to the allantoic sac. After umbilical cord rupture, cranial part of the urachus comes back to the urinary bladder or 1-2 cm near to the umbilical arteries. Atrophied urachus has been observed as a scarred tissue on the urinary bladder in young animals (Dirksen et al., 2002; Nuss, 2006).

Umbilical cord separates and retracts either spontaneously or with the help of abdominal muscle contractions of the cattle. Umbilical cord is incised about 6-7 cm long after ligation of the cord and then it is disinfected by iodine solution. The ligated umbilical cord rapidly dries and mummifies. Wharton gelatin, urachus, umbilical arteries and vena atrophies are seen at fourth day after parturition, and a scar tissue forms between 5 and 10 days. Cicatrix completes in 2-3 weeks (Dirksen et al., 2002; Bostedt 2003; Nuss, 2006; Görgül et al., 2009).

Umbilical cord hygiene

Cattle should be taken in dry and non-contaminated area before parturition to prevent contamination of the umbilical cord from the pathogen microorganism. If the parturition is manipulated in dirty place (feces, urine etc.) and the umbilical cord contacts these contaminants, the umbilical infections arise (Berchtold et al., 1990; Bostedt, 2003; Cihan et al., 2006).

The umbilical cord should be pressed between two fingers to remove the bloody fluid in the cord following parturition (Bostedt, 2003; Dirksen et al., 2002). Because umbilical cord has intraabdominal expansion (Berchtold et al., 1990), the cord lumen leads to possible ascending transfer of the infectious agents (Berchtold et al., 1990) and spraying of the antiseptics to the umbilical cord is not effective (Bostedt, 2003). The umbilical cord should be immersed to antiseptic solution (7% iodine) (Berchtold et al., 1990; Bostedt, 2003). Alcohol helps in rapid umbilical cord drying; therefore, usage of alcohol containing antiseptic

solutions is a good choice to provide rapid mummification of the cord (Berchtold et al., 1990).

The umbilical cord should be re-examined at 12 and 24 hours after parturition and antiseptic immersion should be repeated at 24 hours. This antiseptic application should be repeated at least three times, periodically (Bostedt, 2003). After immersion of the umbilical cord, this antiseptic should be applied to the skin surface of the ventral abdominal wall in order to prevent possible contact of skin flora microorganisms resulting in the umbilical cord infections. Iodine also has orange colour that it is easy to remark umbilical cord sucking by another animals. Radically, all new born calves should be taken in an individual box to prevent the sucking problem each other (Bostedt, 2003).

Etiopathogenesis of umbilical lesions

Umbilical lesions in calves are usually sporadic but sometimes enzootic (Dirksen et al., 2002). Its incidence in neonatal calves is about 5-10% (Salcı et al., 2007). Particularly, lesions occurring in first week after parturition have acute form although some slow developing chronic lesions are encountered. All umbilical lesions have been observed in all ages of the calves. The most commonly encountered lesion is umbilical hernia and its incidence is 25%. Umbilical lesions in dairy breeds have high incidence than the fattened breeds (Dirksen et al., 2002).

Predisposing factors lead to umbilical infections are contamination or dirty barns/boxes, negligence of the umbilical cord hygiene after parturition, malnutrition problems of cattle, insufficient colostrum intake of the calf, passive antibody transfer, umbilical cord sucking by another animals, hematomas of the umbilical region resulted from dystocia, insufficient intraabdominal retraction of the umbilical vessels, shorter incision of the umbilical cord, abnormal width created umbilical hiatus, abnormally thick umbilical cord, general condition of the calf, abnormal body condition and undetermined aetiology (Zaremba and Heuwieser, 1984; Dirksen et al., 2002; Cihan et al., 2006; Nuss, 2006). The other predisposing factors include anatomic feature of the umbilical cord, delayed umbilical involution and ascending entrance of the microorganisms by umbilical cord (Zaremba and Heuwieser, 1984; Dirksen et al., 2002; Nuss, 2006). Commonly encountered umbilical cord pathogens are *Aktinomyces pyogenes*, *Fusobacterium necroforum*, *Pasteurella spp.*, *Streptokok spp.*, *Stafilokok spp.*, *Proteus bacterioides* and *Escherichia coli*. *Clostridium tetani* and the other microorganisms cause the secondary infectious (Dirksen et al., 2002).

Because the coagulated blood in the umbilical vessels is a proper medium for environmental pathogen

bacteria, speedy invasion of acute inflammation is unavoidable (Dirksen et al., 2002).

Umbilical arteries and its lumen end obliquely in the umbilical cord. This is an anatomic predisposing for calves that if the cord is incised shortly or the cord is chewed or licked by cattle, umbilical infectious become inevitable. This infection is named as “*infective umbilical region hematoma*”. If the infection is not early diagnosed and treated, peritonitis can occur (Nuss, 2006; Nuss, 2007). Non-infective thrombi in the umbilical arteries can extend the iliac artery or abdominal aorta and then they result in avascular necrosis of the hind limbs (Dirksen et al., 2002).

Umbilical vein lumen is more wider than umbilical artery, but its muscular layer is weaker. Thus, umbilical vein is more sensitive than infections. Inflammation of the umbilical vein starts peripherally. Although umbilical vena lumen is larger than the umbilical arteries, its muscular layer is thinner. Thus, umbilical vein is more sensitive to the infections. Inflammation in the umbilical vein starts peripherally. If infection affects the umbilical vein, the inflammatory processes can easily extent to the liver and result in the chronic inflammation. If chronic infection causes the liver abscess, bacteriemia and its general clinical findings occur in the calf (Dirksen et al., 2002; Salcı et al., 2007).

After spontaneous rupture or incision of the umbilical cord, umbilical hematoma and umbilical region infections are encountered due to exterior openness of umbilical cord and its components (vein, arteries, and urachus). Delayed scarring of the umbilical hiatus and local umbilical infections lead to abdominal wall weakness (locus minoris resistance) associated with umbilical hernias (Dirksen et al., 2002). It means that the calf with umbilical abscess or enlarged umbilical cord due to infection predisposes the umbilical hernia. Clinically, enlarged umbilical cord can have similar anamnesis and clinical findings with the umbilical hernia that deep examination with diagnostic examination techniques should be performed for differential diagnosis (Fubini and Durcharme, 2004).

If there is only umbilical inflammation, the conical shaped swelling on the umbilical region is inspected. However, spheroidal swelling on the umbilical region reveals umbilical hernia. Physical examination (inspection, palpation) is also determinant for differential diagnosis of the swelling (Görgül, 2007; Görgül et al., 2009).

Omphalitis is a term that determines general inflammation of the umbilical cord and its interior organelles (arteries, vena and urachus). Initially, acute form of the inflammation is usually seen in gangrenous form. Umbilical fistula is the terminal pathology of the omphalitis (Görgül et al., 2009). Omphalophlebitis is

the inflammation of the umbilical vein that is commonly encountered secondary pathology (Anderson, 2004).

In pyrogen omphaloarteritis, inflammation affects one or both umbilical arteries (Görgül, 1986; Dirksen et al., 2002; Anderson, 2004; Fubini and Durcharme, 2004; Nuss, 2006; Görgül, 2007; Görgül et al., 2009). Progression of the omphaloflebitis leads to leukocytosis and bilirubinemia, liver abscess and diffuse peritonitis, meningitis, arthritis, tetani and pneumoni etc. Surgical resection of liver abscess and treatment of the arthritis can be unsuccessful (Salcı et al., 2007).

Urachus fistula is dropping of the urine from the umbilical region. This pathology usually results from the obstructive or stenotic urinary tract anomaly or disease in neonatal calves (Dirksen et al., 2002; Görgül, 2007; Salcı et al., 2007; Görgül et al., 2009). Furthermore, close incision or rupture of the umbilical cord and cicatrization problem of the umbilical wound result in the urachus fistula (Görgül, 2007; Görgül et al., 2009).

In urachus empyema, irritative effect of the urine and delayed cicatrization of the umbilical wound are the primary causes of the purulent urachitis. Purulent urachitis results in the urachal thickness and accumulation of the pus in the urachus (Salcı et al., 2007; Görgül et al., 2009). Umbilical hernia can be congenital or acquired (traumatic-incarcerated) (Görgül et al., 2009). Abnormal largeness of the hiatus is the congenital cause of the umbilical hernia. The causes of the acquired umbilical hernia include weakness of the hiatus umbilicalis, malnutrition, abdominal trauma, diarrhea, constipation, tenesmus, umbilical abscess and umbilical infections. Traumatic hernia umbilicalis results from the sudden intraabdominal pressure changes, cicatrization problems of the umbilical wound, short cutting or rupture of the umbilical cord and umbilical infections (particularly omphaloarteritis). In incarcerated umbilical hernia, a bovel segment passes the umbilical hiatus. Umbilical hiatus sometimes constricts and their intraluminal air distention (usually microfloral activity) prevents the intraabdominal reposition of the bovells (Dirksen et al., 2002; Anderson, 2004; Fubini and Durcharme, 2004; Nuss, 2006).

It is concluded that umbilical hygiene, anatomo-physiological involution and etiopathogenesis of the umbilical lesions should not be overlooked by farmers to prevent the umbilical lesions in calves.

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