# Ovarian teratoma in the mare: a review and two cases

*Ovarieel teratoma bij de merrie: een overzicht en 2 casussen*

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**ABSTRACT**

A 4-year-old Belgian Warmblood mare suffering from pelvic flexure impaction was diagnosed with a teratoma of the left ovary. The enlarged ovary was identified several days after treatment of the impaction. Surgical removal of the affected ovary was performed and histopathological examination confirmed the presence of a teratoma. The features of another ovarian teratoma, which was an accidental finding at slaughter, are also described.

SAMENVATTING

Bij een vier jaar oude Belgische warmbloedmerrie met flexura pelvina impactie werd een teratoma van het linkerovarium vastgesteld. Het vergrootte ovarium werd pas na het verdwijnen van de impactie opgemerkt. De therapie bestond uit het chirurgisch verwijderen van het aangetaste ovarium bij de staande merrie. Het histopathologisch onderzoek bevestigde de diagnose. Tevens worden de kenmerken van een tweede teratoma dat toevallig bij een geslachte merrie gevonden werd, besproken.

## INTRODUCTION

Ovarian enlargement is common in mares (Westermann *et al.*, 2003) and can have a neoplastic or non-neoplastic origin (Nie and Momont, 1992). Anovulatory follicles are the most common cause of non-neoplastic enlarged ovaries (Frazer and Threlfall, 1986). Other non-tumoral causes of enlarged ovaries are the presence of an ovarian abscess (Ramirez *et al.*, 1998; Lefebvre *et al.*, 2005), an ovarian hematoma (Curtin, 2003; Lefebvre *et al.*, 2005) and/or an ovarian torsion (Sedrish *et al.*, 1997; Lefebvre *et al.*, 2005). Equine ovarian tumors are uncommon (Sundberg *et al.*, 1977). These tumors consist of about 5% of all equine neoplasms (Pugh *et al.*, 1985). Neoplastic enlargement can be due to tumoral transformation of any tissue type located within the ovary or can be due to metastasis in the ovary of tumors that originate in other body locations (McCue *et al.*, 2006).

To diagnose an ovarian neoplasm, it is important to perform a physical examination of the mare including a rectal palpation and an ultrasonographic examination of the ovaries. Observation of the mare's behavior and a hormone analysis can be very helpful. If an ovarian tumor is diagnosed, a surgical intervention is generally required (Montavon, 1994; McCue, 2000). Histopathological examination of the removed ovary or an ovarian biopsy gives the final diagnosis.

## OVARIAN TUMORS

Ovarian tumors are rarely observed in domestic animals (MacLachlan, 1987; Sforna *et al.*, 2003). In the mare, the cow and the ewe, ovarian tumors appear usually unilateral and they are most frequently of a gonadal-stroma type, whereas ovarian tumors in the bitch are usually bilateral and of an epithelial type (Sforna *et al.*, 2003). Of all genital tumors in the mare, the ovarian tumors and tumors of the external genitalia are most common. Tumors of the mammary gland, the vagina, the cervix, the uterus and/or the oviducts are uncommon (McCue, 1998). In general, the incidence of reproductive tract neoplasia in the mare increases with advanced age (McCue, 1998).

The most common neoplasia of the equine ovary is a granulosa cell tumor (Panciera *et al.*, 1991; Montavon, 1994; McCue, 2000; McCue *et al.*, 2006). Several other ovarian tumors have been reported as well as metastases of tumors in the ovary and associations of different types of ovarian tumors (Table 1).

Ovarian teratomas are often named dermoid cysts (Hertzberg and Kliewer, 1996; Caspi *et al.*, 2002; Oliveira *et al.*, 2004). Fujimoto and Sakai (1955) refered to dermoid cysts as a simple form of teratoma that can occur in almost any place, but most commonly in the ovary. The term dermoid cyst, or originally named kyste dermoid, was first used by Leblanc in 1831 to describe an ectodermal cyst in an equine skull

**Table 1. Overview equine ovarian tumors.**

| Tumor | Author |
| --- | --- |
| Teratoma | Fujimoto and Sakai, 1955; Frazer and Threlfall, 1986; Panciera *et al.*, 1991; Montavon, 1994; McCue, 2000; Catone *et al.*, 2004; Lefebvre *et al.*, 2005; McCue *et al.*, 2006 |
| Teratocarcinoma | Frazer *et al.*, 1988 |
| Dysgerminomas | Frazer and Threlfall, 1986; Chandra *et al.*, 1998; McCue, 2000; McCue *et al.*, 2006 |
| Thecoma | Raoofi *et al.*, 2006 |
| Fibroma | Nielson *et al.*, 1976, Meinecke, 1986 |
| Fibrosarcoma | Nielson *et al.*, 1976 |
| Leiomyoma | Nielson *et al.*, 1976; Meinecke, 1986 |
| Leiosarcoma | Nielson *et al.*, 1976 |
| Hamartoma | Rhyan *et al.*, 1988 |
| Cystic and papillary adenoma | Fujimoto and Sakai, 1955; Hinrichs *et al.*, 1989; McCue, 2000; McCue *et al.*, 2006 |
| Cystic and papillary adenocarcinoma | Morris *et al.*, 1985 |
| Arrhenoblastoma | Mills *et al.*, 1977 |
| Hemangioma | Nielson *et al.*, 1976; Schlafer and Miller, 2007 |
| Hemangiosarcoma | Nielson *et al.*, 1976 |
| Metastases of an lymphosarcoma in the ovary | Neufeld, 1973; Lock and Macy, 1979; McCue *et al.*, 2006 |
| Metastases of an sarcoma in the ovary | McEntee, 1990 |
| Metastases of an carcinoma in the ovary | McEntee, 1990 |
| Metastases of an melanoma in the ovary | Liu, 1983; McCue *et al.*, 2006 |
| Associations of different types of ovarian tumors | Fujimoto and Sakai, 1955; Panciera *et al.*, 1991 |

(Matz, 1961). The application of the term dermoid or "structure which contains only ectoderm elements" for a tumor originating from all 3 germ layers is incorrect and was already outdated in 1961 according to Matz (1961). Smith *et al.* (1972) refered to dermoid cysts as a special kind of teratoma in which cystic cavities can be found lined with skin and filled with hair. Nezhat *et al.* (1999) used the word dermoid cyst as a synonym for a benign cystic teratoma. In human literature dermoid cysts are often used as a synonym for mature cystic teratomas but according to Outwater *et al.* (2001) it is more appropriate to use the term mature cystic teratoma. The word teratoma is derived from the Greek words teraton, meaning monster, and onkoma meaning swelling (Hamilton *et al.*, 2006; Adkins *et al.*, 2008). According to Hamilton *et al.* (2006), teratoma or 'monstrous tumor' was first used by Virchow in 1863.

## Etiology

There have been a number of theories of the origin of (ovarian) teratomas (Smith *et al.*, 1972). The cell(s) causing a teratoma are dedicated to its/their special purpose at an extremely early stage of the fetal or embryonic development. This can be concluded because teratomas are usually composed of tissues derived from more than one of the primary germ layers and they are generally discovered in young individuals. The fact that teratomas are usually located in tissues of the embryo close to the median axis might be the result of an abnormal development in the germinal streak (Smith *et al.*, 1972). An other theory is that ovarian teratomas are caused by an abnormal development of a primary oocyte that is retained inside the ovary (Deka *et al.*, 1990).

The most accepted theory in human literature to explain the presence of an ovarian teratoma is the parthenogenetic activation of oocytes (Linder *et al.*, 1975; Oliviera *et al.*, 2004). Parthenogenesis or 'procreation without the immediate influence of a male' was introduced and defined by Richard Owen in 1849 (Mittwoch, 1978). According to Gurfield and Benirschke (2003) this theory about parthogenesis can also be implemented on equine teratomas. Several other modes of origin have been postulated, such as mitosis after the fusion of germ cells (Joseph and Vogt, 1973), failure of meiosis I or fusion of the first polar body with the oocyte, failure of meiosis II or fusion of the second polar body with the ootid, endoreduplication of the genome of a mature ovum, failure of meiosis I and II in a primordial germ cell, fusion of two ova (Chakravarti *et al.*, 1989), incomplete twinning, derepression of totipotent genetic information in the nuclei of somatic cells and neoplastic proliferation of primordial germ cells and sequestered totipotent blastomeres (Scully, 1979; Gonzales-Crussi, 1982).

## Pathophysiology and occurrence

A teratoma can be qualified as a true tumor, because of its ability to grow in both malignant and benign direction (Willis, 1951). This tumoral expansion can occur fast or slowly, but in most cases teratomas

grow very gradually, resulting in a long pre-sympto-matic period (Smith, 1972).

Teratomas are composed of totipotential germ cells (Kennedy and Miller, 1993). These germ cells undergo somatic differentiation in 2 or 3 germinal or embryo-nic cell layers (Moulton, 1978; Kennedy *et al.*, 1998; Chen *et al.*, 2003), which give rise to multiple tissues foreign to the organ in which they arise (Frazer *et al.*, 1988; McEntee 1990; Kennedy *et al.*, 1998). Terato-mas are benign, hormonally inactive (Frazer and Threlfall, 1986; Frazer *et al.*, 1988; McEntee, 1990; Montavon, 1994; McCue, 1998) and they can be com-posed of a great variety of tissues, such as cartilage (Moulton, 1978; Panciera *et al.*, 1991; Vortmeyer *et al.*, 1999 ; Chen *et al.*, 2003), bone (Moulton, 1978; Panciera *et al.*, 1991 ; McCue, 2000; Chen *et al.*, 2003), hair (Moulton, 1978; McCue, 2000; Chen *et al.*, 2003), skin (Moulton, 1978) with sebaceous glands (Vortmeyer *et al.*, 1999), respiratory mucosa (Panciera *et al.*, 1991), teeth (Moulton, 1978; Panciera *et al.*, 1991; Chen *et al.*, 2003), nervous tissue (Panciera *et al.*, 1991) and muscle (Moulton, 1978; McCue, 2000).

In veterinary literature, teratomas are considered to be solid or cystic (Montavon, 1994; Moulton, 1978). In human literature, teratomas are divided into immature teratomas, mature cystic teratomas (dermoid cysts) and monodermal teratomas (Outwater *et al.*, 2001). Chen *et al.* (2003) use another classification. They divide te-ratomas into mature (benign/solid or cystic) or imma-ture (benign or malignant/predominantly solid) terato-mas with a subdivision of teratomas which are predo-minantly composed of endodermal or ectodermal ele-ments.

Teratomas in domestic animals are non-secretory and seldom malignant (Nielsen *et al.*, 1976; Monta-von, 1994; Lefebvre *et al.*, 2005). Van Camp *et al.* (1989) and Frazer *et al.* (1988) presumed that an equine ovarian teratoma could lead to the development of an adenocarcinoma or a teratocarcinoma of the ovary and metastasize to several organs.

Some veterinary authors put forward that in con-trast to teratomas in domestic animals, teratomas in humans tend to be malignant (Nielsen *et al.*, 1976; Cantone *et al.*, 2004). In human medicine literature malignant transformation is rare with a rate of 0.17% to 2% (Matz, 1961; Rose *et al.*, 1993; Comerci *et al.*, 1994; Griffith *et al.*, 1995). According to Surti *et al.* (1990) benign ovarian teratomas are accounting for ap-proximately 11% of all human ovarian tumors.

In mares, teratomas are the second most common ovarian tumors (Pugh *et al.*, 1985) although most of the equine teratomas are noticed in males (Moulton, 1978).

In the mare, a teratoma normally occurs unilaterally with a normal contralateral ovary (McCue, 1998).

According to Moulton (1978) teratomas are most commonly seen in horses of 1 to 5 years old. However, Clark (1975) and Frazer *et al.* (1988) reported the oc-currence of teratomas in mares aged between 3 and 18 years old.

Generally, teratomas occur at the midline and pa-raxial regions of the body. Only few are found in the retroperitoneal region and anterior mediastinum, but most often they are diagnosed within the testicle or ovary because of their germ cell origin (Smith *et al.*, 1972; Crum, 1999; Lefebvre *et al.*, 2005). Testes and ovaries develop in a similar way until about the fourth month of the embryonic life. Therefore it is common to see tumors in testicular tissue also appearing in the ovaries and vice versa (Chen *et al.*, 2003). Teratomas are the most common testicular neoplasm in young stallions of 1 to 2 years old. Testicular teratomas are mostly associated with cryptorchid testis and are usually the cause of a retainment of the testis rather than the result of it (Stick, 1980; Pratt *et al.*, 2003). A teratoma and even a teratocarcinoma have been repor-ted in the placenta of a horse (Gurfield and Benirschke, 2003; Allison *et al.*, 2004). Teratomas are considered to be extremely rare in other animals than the horse (Nielsen and Kennedy, 1990; Kennedy and Miller, 1993), even though some cases of teratomas have re-cently been published in dogs (Headley *et al.*, 2006; Wong *et al.*, 2007), cats (Basaraba *et al.*, 1998) and even in a giraffe (Murai *et al.*, 2007).

## Symptoms

Generally, an ovarian teratoma in the mare does not interfere with the general health status, and in particu-lar with the fertility status, of the mare (Montavon, 1994) because teratomas are not hormonally secretory. Therefore the contralateral ovary remains functional and the mare shows normal estrus cycles (Panciera *et al.*, 1991; Montavon, 1994; Lefebvre *et al.*, 2005).

Nevertheless symptoms can develop as a result of an expansive growth of the ovarian tumor resulting in pressure symptoms, abdominal pain (colic) and adhe-sions of the tumor to surrounding structures;  it can even affect fertility indirectly (Abraham, 1968; Hovell and Hignett, 1968; Pugh *et al.*, 1985; Frazer and Threl-fall, 1986).

## Diagnosis

The majority of ovarian abnormalities require a mi-nimum of clinical non-invasive examination and tests to diagnose and differentiate these ovarian abnormali-ties and/or enlargements (McCue, 2000).

Most of the time, teratomas in horses are diagnosed coincidentally during a routine rectal palpation, at slaughter or during a routine physical examination (Hovell and Hignett, 1968; Pugh *et al.*, 1985; Panciera *et al.*, 1991; Montavon, 1994). Transrectal palpation can reveal a change in ovarian size and/or changes in consistency (Catone, 2004).

An equine ovary of more than 10 cm or less than 2 cm may be pathological and should attract the atten-tion of the clinician (Bosu and Smith, 1993).

An ultrasonographic examination is necessary to differentiate between ovarian tumors and other large non-tumoral structures (Montavon, 1994; Basaraba *et al.*, 1998). Ultrasonographic characteristics of terato-

mas may mimic those of granulosathecal cell tumors, unless the tumor contains highly echogenic components, such as bone or teeth (Blanchard *et al.*, 2003). Teratomas, in comparison with granulose theca cell tumors, are tumors with a variety of mature tissues arranged at random throughout the tumor (Kennedy and Miller, 1993; Lefebvre *et al.*, 2005).

To make a final and accurate clinical diagnosis, it is important to have a complete reproductive history of the mare together with a series of transrectal and ultrasonographic examinations. They are necessary to evaluate ovarian changes during a certain period and to prevent the removal of a healthy ovary in the first place (Frazer and Threlfall, 1986; Lefebvre *et al.*, 2005). Laparoscopic or exploratory laparotomy has also been reported to be useful in the diagnosis of ovarian tumors (Fischer *et al.*, 1986; Basaraba *et al.*, 1998).

After the removal of the affected ovary, it is important to perform a histopathological examination of the ovarian tissue for a final, accurate diagnosis (Lefebvre *et al.*, 2005).

Ultrasound, computer tomography and magnetic resonance are the imaging tools in human medicine to differentiate and to diagnose ovarian teratomas (Buy *et al.*, 1989; Hertzberg and Kliewer, 1996; Outwater *et al.*, 2001).

**Treatment**

The recommended treatment for ovarian tumors is surgical removal (Bosu *et al.*, 1982). Surgical removal in equines consists of ovariectomy (Tseng *et al.*, 1996; Ayhan *et al.*, 2000). Unilateral or bilateral ovariectomy is a relatively common surgical procedure in the mare with various surgical approaches, such as the ventral midline approach, the paramedian approach (standard or oblique), the paralumbar approach, colpotomy and the laparoscopic techniques through a flank approach in standing or recumbent mares (Slone, 1988; Loesch and Rodgerson, 2003; Gomez *et al.*, 2006). The surgical approach generally depends on the size of the affected ovary, the surgical equipment available, the surgeon's preference and the temperament and size of the mare (Ragle *et al.*, 1996; Loesch and Rodgerson, 2003, Gomez *et al.*, 2006).

Recently, equine laparoscopic techniques in standing or recumbent mares have become common procedure (Fischer, 1991; Ragle *et al.*, 1996; Hanson and Galuppo, 1999; Smith *et al.*, 2005; Lee and Hendrickson, 2008). Different laparoscopic techniques have been described for hemostasis and ligation of the mesovarium after ovariectomy. In the first case report, Hand *et al.* (2002) used a vessel-sealing device (LigaSure Atlas®, Valleylab, Colorado, USA). However, the removal of large ovarian tumors (> 10cm) can be difficult because of multiple problems as, problems with the exposure of the ovarian tumor, pain associated with traction and/or manipulations and increased blood supply (Doran *et al.*, 1988; Ross, 1991). Standing, hand-assisted, laparoscopic ovariectomy (Rodgerson *et al.*, 2002; Gomez *et al.*, 2006), aspiration of

cystic fluid to reduce the size (Gomez *et al.*, 2006), the sterile plastic bag technique or ovarian removal under general anesthesia (Seltzer and Yarbrough, 1998; Gomez *et al.*; 2006) can help to overcome some of those problems.

**Prognosis**

The prognosis of a teratoma is generally good because of the benign characteristics of the tumor. However it is advisable to remove the affected ovary (Bosu *et al.*, 1982; Pugh *et al.*, 1985). Ovariectomy in the mare has a good prognosis although some complications may occur, such as ligature slippage (Rodgerson and Hanson, 2000), hemorrhage (Slone, 1988), infection (abcedation) of the wound as described in the first case, wound dehiscence, herniation, hematoma or seroma formation, peritonitis, post-operative diarrhea, shock, death and general problems in relation to general anesthesia and recovery in horses (Meagher *et al.*, 1977).

Laparoscopic ovariectomy in standing mares has a good prognosis with few reported complications (Hanson and Galuppo, 1999; Hand *et al.*, 2002; Lee and Hendrickson, 2008). The advantages of this laparoscopic technique are small surgical incisions (Cokelaere *et al.*, 2005; Lee and Hendrickson, 2008), a reduction of complications as a result of the improved visualization of the operative field (Hanson and Galuppo, 1999; Rodgerson *et al.*, 2001), a tension-free ligation (Rodgerson *et al.*, 2001), no need for general anesthesia (Dechant and Hendrickson, 2000), decreased surgical and postoperative morbidity (Smith *et al.*, 2005; Dechant and Hendrickson, 2000) and a shortened post-operative recovery time (Sutter and Hardy, 2004). Disadvantages of the laparoscopic ovariectomy are the requirement and the cost of special equipment and an appropriate surgical training (Hanson and Galuppo, 1999; Rodgerson *et al.*, 2001; Smith *et al.*, 2005).

CASE 1

A 4-year-old Belgian Warmblood mare suffering from colic was presented to the clinic. The day before, the mare received a spasmolytic agent (Butylhyoscine Bromide, Buscopan® compositum ad us. vet., Boehringer Ingelheim, Brussels, 0.2 mg/kg BW IV) which improved her condition and appetite. The following morning the mare developed symptoms of colic again after being fed. The mare went through a general health examination. The temperature of the mare was 37.9 °C, the pulse rate was 44b/minute and the respiratory rate 24/minute. The mucosae were pink with a normal capillary refill time (< 2 seconds). The body condition and skin turgor were normal and no swelling of the lymph nodes was noticed. The auscultation of the heart, thorax and lungs was normal. The auscultation of the abdomen revealed reduced borborygmi at the left side and normal borborygmi at the right side. She responded normally to the lumbar reflex test. A

blood gas analysis (venous) revealed a BE (base excess) of 0.5 meq/liter and packed cell volume of 38%. Transabdominal ultrasound of the abdominal cavity could not visualize any abnormality. Rectal palpation revealed the presence of dry feces and a firm flexura pelvina impaction. The mare was treated with paraffin oil and sulphates. She was kept under surveillance. During the night, the mare became colicky again and was treated with flunixin meglumine (1.1 mg/kg, intravenously (IV), Finadyne®, Schering Plough, Belgium). The next day the feces passage returned to normal. The impaction resolved by the third day, but rectal palpation at that time revealed a large solid mass central in the abdomen. Initially, the mass was presumed to be a remnant of the impaction or an enterolith and therefore paraffin oil was administered again. Two days later, the large solid mass was still present and was clearly originating from the left ovary. The right ovary appeared normal in size and consistency. Transrectal ultrasonography (7.5 MHz, MayLab30®, Esaote Pie Medical, Zaventem, Belgium) of the left ovary revealed a large anechogenic cyst with large blood supply to the wall and a capsule like structure. With a presumptive diagnosis of an ovarian tumor, a laparo-scopic ovariectomy in the standing mare was recommended.

*Operation*

The mare was fasted for 48 hours before surgery and neomycine sulfaprocaïne penicillin G (1 ml/20kg, intramusculary [IM], Neopen®, Intervet, Belgium) and flunixine meglumine (1.1 mg/kg IV) were administered 12 hours before surgery.

The mare was prepared for surgery and a 12-gauge-IV-catheter (Intraflon 2 catheter 12G/80mm) was placed in the jugular vein. The mare was sedated with detomidine hydrochloride (10 µg/kg, IV, Domosedan®, Pfizer A.H., Belgium) and methadone (0.1 mg/kg, IV, Mephenon). During surgery she received a continuous detomidine (6 µg/kg.hr) and hemofiltration infusion (1-2 drops/sec). The mare was placed in stocks and the left flank was clipped and aseptically prepared for surgery using hibitane (Hibiscrub®) and alcohol (Antiseptische oplossing Stella®, Laboratoires Lohmann & Rauscher s.a., Liège). The left paralumbar fossa was locally infiltrated with 20 ml of 2% mepivacain hydrochlorid (Scandicaine, Astra Zenecan, Belgium) before surgical draping.

Three portal sites (10-15 mm) were made. The first dorsal to the crus of the internal abdominal oblique muscle, midway between the last rib and tuber coxae, the second about 9 cm distally and a third portal site more proximally between the 17th and 18th rib. In each portal site a 10-mm-diameter and 20-cm-long laparoscopic cannula (Laparoscopic cannula, Wolf Richard, Drongen-Ghent, Belgium) was inserted and the most cranial portal site was used for the laparoscope. After insufflation of the abdomen with carbon dioxide gas, the severely enlarged left ovary (> 30 cm diameter) was visualized. The insufflation was stopped when sufficient visualization was achieved or when the mare

began to show mild signs of abdominal discomfort. A self-made laparoscopic injection needle was inserted through an instrument portal to infiltrate the ovarian pedicle with 30 ml 2% xylocaïne. While waiting for an effective local anesthesia of the pedicle, ca. 3.5 liters of serosanguinous fluid were retrieved from the ovarian cysts, thus reducing the volume of the tumor. Even though the ovary was still too large to allow normal laparoscopic dissection, the flank incision was enlarged to perform a hand-assisted laparoscopy.

After local anesthesia, the mesovarium was coagulated and cut by use of a bipolar vessel-sealing device (LigaSure Atlas®). The ovarian tumor was removed through the enlarged flank incision. The skin incisions were closed in several layers using absorbable sutures.

**Post-operative treatment**

After surgery, the mare was treated with 60 ml gentamicin sulfas (Emdogent®, Emdoka, Hoogstraten) and 10,000,000 IU benzylpenicillinum natrium (benzylpenicillinum natrium, Kela) during 5 days. Post-operative monitoring included the assessment of the appetite, the measurement of the rectal temperature, respiration rate, pulse rate and the inspection of the wound once a day.

The following days the mare was treated with 30 ml Procain Penicillin G - Neomycin (Neopen®, Intervet, Mechelen). She also received analgetics (Finadyne®, Schering Plough, Heist-op-den-Berg).

Five days after surgery, edema appeared declive to the incision. The mare received flunixin meglumine (Finadyne®, Schering Plough, Heist-op-den-Berg) 1.1 mg/kg BW IV. Two days later, the swelling was still present and the mare became febrile (38.3°C). An ultrasound of the wound was performed and 2 small abscesses (2-3 cm) were discovered. Serohemorrhagic fluid was punctuated out of the abscess and brought to the laboratory for analysis. The results showed a white blood count (WBC) of > 100 000 WBC/mm³ and the presence of a DNAase negative staphylococcus with bacteriological resistance against penicillin. Incisional complication is a common sequela to a hand-assisted laparoscopy (Rodgerson *et al.*, 2002; Cokelaere *et al.*, 2007).

The following days, the mare was treated with trimethoprimum + sulfadiazinum natricum (Emdotrim 60% mix, Emdoka, Hoogstraten) 30 g per os. Another rectal examination was performed but no adhesion or hernia could be found, only a strong reaction of the abdominal muscles was observed. The wound healing improved only 4 days later. During a control ultrasound examination of the wound, a large abscess was found. It was punctuated and sutures were removed. The abscess was drained and flushed.

After 14 days, the wound healed almost completely and the mare went home. She was kept under trimethoprimum + sulfadiazinum natricum (Emdotrim 60% mix, Emdoka, Hoogstraten) 30 g orally for 7 days. A total rest of six weeks after the operation was advised.

## Gross pathology

The removed ovary was irregular, ovoid and grayish-white colored with yellow zones. The ovary weighed more than 2.7 kg and measured about 30 cm in diameter after fluid drainage. After overnight freezing, several macroscopic tumor slices were made. They allowed the differentiation of hair, cartilage, cyst-like structures filled with a viscous dark red, almost black fluid and other less definable soft tissues (Figure 1).

## Histopathology

Several samples were randomly taken and fixed in formaldehyde 4% for histopathological examination. The presence of connective tissue, mucinous stroma, degenerating fibroblasts and multiple cavernous holes surrounded by a cubic epithelium and filled with eosinophilic material containing cholesterol crystals were found together with multiple cartilage-islands and tissue analogous to dermis covered by a stratified squamous epithelium (analogous to the epidermis). Hair follicles, sebaceous glands, sweat glands and musculi arrector pili could also be identified in the dermis-like tissue. The underlying tissue, which resembles subcutaneous tissue, contained a piece of cartilage (Figure 2).

## Radiology

Radiography revealed a soft tissue mass containing calcified areas (Figure 3).

## CASE 2

The second teratoma described in this paper was found by accident in the ovary of a slaughtered mare. The mare's ovaries were gathered for oocyte collection.

## Gross pathology

The ovary was ovoid and had a yellow-beige color; It felt very solid and was of normal size (9 x 5 cm). The ovary was sliced lengthwise in 3 equal parts. Bone or cartilage-like structures were seen in the entire ovary (Figure 4).

## Histopathology

Four samples of the ovary were taken at random. Each sample was fixed in formaldehyde 4% and sent for histopathological examination.
The tumor consisted of well-differentiated dense collagen fibers containing large arteries with sclerotic walls and poor to strong mineralized bone trabecles, tissue composed of accumulated spindle cells with spindle shaped nucleus and eosinophilic cytoplasm, excrescence of epithelium giving shape to lobuli and tubuli containing a central accumulation of a fluid rich in protein.
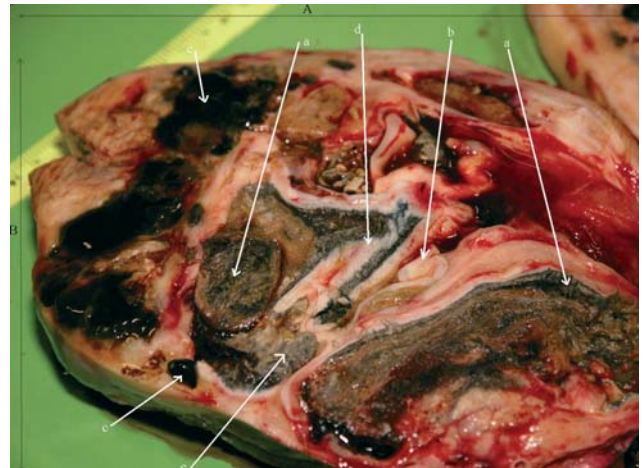


**Figure 1. Close-up of the sliced teratoma (case 1). A= 30 cm; B= 20 cm; a= hair; b= cartilage; c= cyst-like structures filled with a viscous dark red, black fluid; d= bone; e= less definable soft tissues**
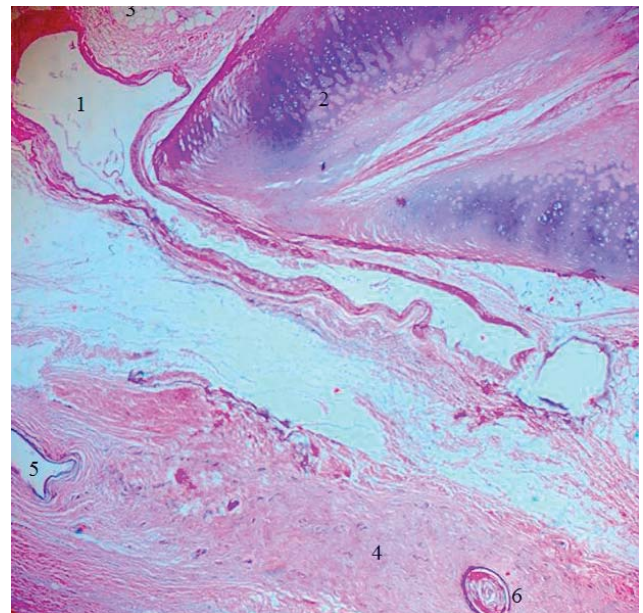


**Figure 2. Histological picture of the teratoma illustrating the presence of cell types originating from different embryonic germ layers. 1-4: mesodermal tissues (1. artery 2. cartilage 3. adipose tissue 4. connective tissue), 5-6 ectodermal tissues (5. glandular lumen, 6. hair follicle) HE-stain, 25x.**

## Radiology

Radiography revealed a soft tissue mass containing calcification areas (Figure 5).

## CONCLUSION

As second, most common equine ovarian tumor, an ovarian teratoma, has to be considered in the differential diagnosis of mares with ovarian enlargement(s) (Pugh *et al.*, 1985).
Even though ovarian teratomas are benign in

**Figure 3. Radiographic image of the sliced teratoma containing calcified areas (case 1).**



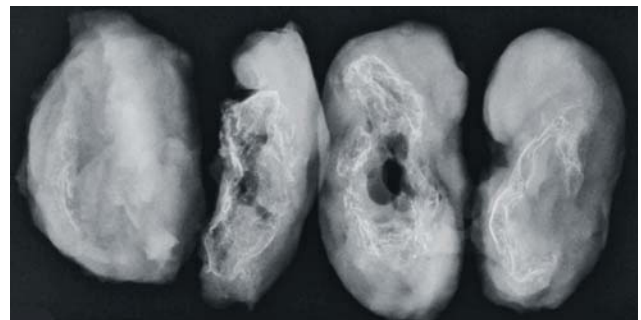**Figure 4. The sliced teratoma (case 2 - teratoma found at slaughter). A= 5cm; B= 9cm**



**Figure 5. Radiographic image of the sliced teratoma containing calcified areas (case 2 -found at slaughter ovary).**

horses, ovariectomy is the recommended therapy (Bosu *et al.*, 1982; Pugh *et al.*, 1985). Although the normal laparoscopic technique allows the removal of very large ovarian tumors with the aid of suction, electrosurgery (Ligasure Atlas®) and retrieval bags (Lloyd *et al.*, 2007), the ovary described in case report 1 was extremely large and heavy and in the surgeon's opinion, a hand-assisted technique would allow easier and faster surgery.

In the first case it's difficult to tell whether the presence of the flexura pelvina impaction and the colic symptoms on the one hand and the presence of the teratoma on the other were merely coincidental. It can be presumed that the teratoma had a very gradual growth and that its diagnosis was accelerated by the multiple rectal palpations because of the colic.

For an accurate diagnosis and treatment of ovarian enlargements it is important to take into account the temperament of the mare, the demands of the horse owner, the surgical accommodation and the type of tumor or enlargement.

For a final diagnosis, histopathological examination of different samples of the removed ovary is crucial.

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