Ovarian tumours in dogs- an overview

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Abstract

Most common ovarian diseases appears in animals are to be cystic or ovarian tumours. Both of these conditions affect health, fertility or even the life of the affected animal. Canine ovarian tumours are not common in dogs due to a practice of routine ovariohysterectomy in many countries of the world. It tends to affect older female dogs more often, especially female dogs that have not been already spayed. The overall prevalence of ovarian tumours is 0.5% to 1.2% but is as high as 6.25% in intact female dogs. Depending on the cell origin, they are broadly classified into four types: epithelial tumours, germ cell tumours, sex cord-stromal tumours and mesenchymaltumours.In most ovarian tumourcases, there are no symptoms until they grow to be noticeably large. Hormonal dysfunctions and presence of carcinogenic fluid in the abdomen are two signs of tumours. Granulosa cell tumours can cause hormonal imbalances due to the effect of the anti-mullerianhormone in the hypophyseal-gonadotropic axis. The diagnosis of canine ovarian tumours is usually complicated because of the discrete clinical symptoms and can be easily confused with other diseases. However, radiography, ultrasonography, histological examination of surgically excised tissue andimmunohistochemistry are commonly deployed diagnostic modalities all over the world. The management of ovarian tumour in dogs can be done using surgery, chemotherapy, combination of surgery and chemotherapy and radiation therapy. Treatment of ovarian neoplasia by ovariohysterectomy results in favorable prognosis, if there are no malignancies.

Keywords: female dog;ovary; treatment;tumour; surgery

Introduction

An ovarian tumor is a type of tumor that develops from the uncontrolled disordered growth of cells found within the ovary. The factors causing tumours in dogs are not well known, but epidemiological studies provides possible causes, and some known causes have been demonstrated by testing specific causative agents (Hardy, 1976), which include trauma, congenital factor, heredity, diet, viruses, hormones, irradiation, transplantation of intact tumour cells, parasites and carcinogens.Ovarian tumours are not common entity comprising 0.5-1.2% of all the canine tumoursKlein (2007) and their occurrence in female canine is reported to be up to1-6 % Yotov et al. (2005). Ovarian tumours are almost uncommon in dogs. However, they can be categorized based on their cell origin. According to cell origin, they are epithelial tumours, germ cell tumours and sex cord stromal cell tumours. Sex cord stromal tumoursand epithelial tumourstogether account for 80-90% of all canine ovarian tumours. Mesenchymaltumours (originated from cells surrounding the skin, connective tissues, fat, nerves and blood vessels) like fibromas and primary ovarian hemangiosarcomahave also been reported.

Classification of ovarian tumours

The classification of ovarian tumours in female dogs based on cell origin can be done as following(Kennedy et al., 1998; Abraham and Ravindran, 2012).

1.**Epithelial ovarian tumours (epithelial tissue**),e.g.adenomas (papillary/cystic), adenocarcinomas (papillary/cystic), cystadenomas, cystadenocarcinomas andundifferentiated carcinomas.
2. **Germ cell tumours (sperm and ova),**e.g.dysgerminoma, teratoma(mature/immature/monodermal) andteratocarcinomas.
3.**Sex cord stromal cell tumours (connective tissue),**e.g.granulosa-theca cell tumours, sartoli-leyding cell tumours, thecomas, luteomasandfibroma.
4.**Mesenchymaltumours,** e.g. hemangiosarcomaleiomyoma

Incidence

The highest incidence of epithelial tumours has beenseen between 4 to 15 years of age group. A predisposition among Pointer breed for epithelial tumours is found. The most commonly identified germ cell tumourslike teratomashave been reported in dogs between 20 months to 9 years. Granulosa cell tumour, a sex cord stromal cell tumours has been reported in dogs between 14 months to 16 years. Some studies have found breeds like German Shepherds, Terriers, Yorkshire, English Bulldogs and Boxers to be at an increased risk for granulosa-theca cell tumours, a type of sex cord stromal cell tumour. Ovarian neoplasms except teratomas, are found in middle age to older animals.Ovarian neoplasias capable of producing estrogen include tumours of epithelial origin (adenocarcinomas and cystadenomas) as well as tumours of gonadal-stromal origin (granulosa-theca cell tumours). Ovarian tumours tend to occur unilaterally or, less commonly, bilaterally in female dogs over 5 years of age.

Incidence of all types of ovarian tumour was found to be 1-6 % by Yotovet al.(2005), 0.5-1.2 % by Klein(2007), 1 % by Abraham and Ravindran(2012), 0.5-1.2 % by Banco et al.(2011), 1.04 % by Sfornaet al.(2003) and 1-6 % by Khaki et al.(2014) whereas epithelial tumourswere 40-50 % by Itoh et al.(2007). The incidence of ovarian dysgerminoma, germ cell tumour, leiomyoma, papillary/cystic adenocarcinomas, teratomas andsex cord tumours were found to be 6-12 % (Klein, 2007), 2 % (Sfornaet al., 2003), 28.8 % (Sfornaet al., 2003), 1.04 to 2.7 % (Greenlee and Patniak, 1985; Sfornaet al., 2003) and 80-90 % (Yotovet al., 2005), respectively.

Symptoms

Symptoms depend on the cell origin.Most epithelial cell tumours may produce malignant effusion.Ovarian adenocarcinomas develop ascites & pleural effusion associated with widespread metastasis (Olsen et al., 1994). Teratomas,Granulosa cell tumours and dysgerminomas have been associated to malignant abdominal effusions (Sforna et al., 2003). Teratomas commonly show areas of calcification observedin routine abdominal radiographs.Sex cord tumours have the ability to produce steroid hormones (Diez-Bruet al., 1998). However, most ovarian tumours are asymptomatic until clinical symptoms referable to a space occupying mass occur (Klein, 2007).Certain common symptoms are anoestrus, persistent estrous, nymphomania, masculinisation, hyperadrenocorticism, alopecia, rapid exhaustion, fever, anorexia, rapid growth rate of tumorus mass, abdominal distension/enlargement/palpable abdominal mass, vulval/vaginal swelling & bloody sanguineous vaginal discharge/pyometra, cystic endometrial hyperplasia/pyometra complex,polyuria/polydipsia, emesis, diarrhoea, acute weakness or collapse, malignant ascites and pleural effusions. Certain non-specific symptoms are also observed likeanemia, lethargy, inappetance, weight gain/loss, gynecomastia and receptivity to male dogs(Diez-Bruet al., 1998; Klein, 2007; Novotny et al., 2011; Abraham and Ravindran, 2012).

Diagnosis

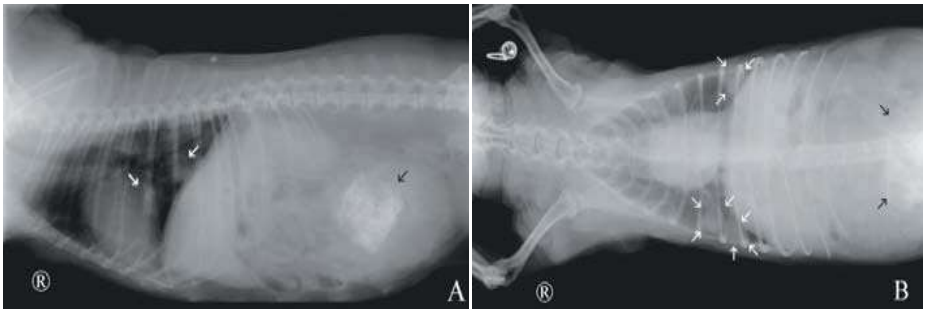
Diagnosis of ovarian tumours is done by clinical, radiographic, ultrasonographic or histological examination, immunohistochemistryor a combination ofabove techniques.Biomedical imaging in clinical canine practice is still in infancy in India. This is partly due to high costs, limited access to such technology, too little expertise and experience of emerging technology and insufficient exposure to image reading. Non-invasive imaging modalities prove to be extremely valuable tools in diagnosis and have created recent peak in small animal imaging.A clinician generally picks an imaging modality that is price effective, readily accessible, effortlessly performed and accurately interpreted in a timely manner. Until recent times radiography was the lone tool for imaging diagnostic techniques but now digital radiography, scintigraphy, CTand MRI scanning are accessible to the companion animal clinician to a restricted extent.

Clinical examination

The apparent clinical findings of ovarian tumours are because of space occupying nature of the intra-abdominal mass, metastatic spread, and may be associated with hormonal disturbances (Itoh et al., 2007).Trans-abdominal needle biopsies of ovarian masses are not recommended due to the risk of hemorrhage and propensity of subsequent tumour cell seeding (mainly of epithelial origin) to readily implant and grow on peritoneal surfaces (Klein, 2007).Abdominocentesis and thoracocentesis in a 10 yr old female Shih-Tzue dog with abdominal enlargement revealed a blood-tinged cloudy transudate with a number of clusters of mononuclear cells suggesting malignancy (Itoh et al., 2007). Various diagnostic modalities like radiography, ultrasonography, histology, immunohistochemistryor a combination thereof are preferred by physicians in a routine practice.

Radiography

Radiographic examination of the dog is mandatory in cases shows clinical signs associated with ovarian tumours (Greenle and Patnaik, 1985).Abdominal radiography, ultrasonography and intraoperative fine-needle aspirates are important tools to a predictive diagnosis of ovarian mass(Silva et al., 2014). Ovarian adenocarcinoma was diagnosed using radiographic examination as presence of severe ascites and moderate pleural effusion with no evidence of pulmonary metastasis (Itoh et al., 2007). Abdominal radiography in 13 yr old Poodle bitch revealed two solitary pulmonary masses approximately 3 cm in diameter associated with mammary gland tumour and a large, round mass with mineralization in the caudo-abdominal region associated with papillary ovarian adenocarcinoma removed surgically (Sontaset al., 2009).



(Radiographs of female dogs;black arrows-large opaque intra-abdominal mass,white arrows-pulmonary masses, courtesy:Sontas*et al.*, 2009)

Radiography as an indicative imaging modality proved in German Shepherd dog with ovarian cystadenocarcinoma (Yotovet al., 2005),Spitz bitch with Ovarian adenoma (Moruet al., 2008), Cocker Spaniel female dog with ovarian dysgerminoma (Park et al., 2009), Chihuahua female dog with metastatic right ovarian dysgerminoma (Kang et al., 2017), boxer bitch confirmed as ovarian dysgerminoma (Novotny et al., 2011), Pomeranian bitch with large ovarian tumour (Abraham and Ravindran, 2012),pointer bitch with ovarian tumour (Demirel and Ergin, 2016), Boxer bitch with ovarian dysgerminoma (Novotny et al., 2011) andspitz female dog with ovarian adenoma (Moruet al., 2008).

Ultrasonography

Ultrasonography is considered more important diagnostic tool because it reveals information on organ architecture and relationships with soft tissue structures. Ultrasonography is helpful in establishing the relative size of the tumours to a clinician. Small abdominal massesare easily identifiable as benign tumours but bigger

massesusually turn in to cancerous overgrowths. Clear and well differentiated cystic masses are benign in nature.A definitive diagnosis can be made by evaluating abdominal or pleural fluid cytology.However, histological examination of the resected tissue mass is mandatory to obtain a nature of tumour.

Ultrasound is extensively used in small animals clinical practice to evaluate reproductive disorders. Due to small size, normal canine ovaries are not detected by ultrasonography during anestrous, however, it has been used to detect ovarian masses in dogs. (Diez-Bruet al., 1998; Olsen etal.,1994).Ovarian adenocarcinomas appear as irregular-shaped masses with heterogeneous echogenicity or with multiple anechoic cysts (Itoh et al., 2007; Singh et al., 2016).

(Ultrasonographic images of ovarian tumour with distinct echogenicity, right-ovarian dysgerminoma, courtesy: Sfartz et al.,2015; left-bilateral ovarian leiomyoma, courtesy: Pecile et al., 2017)

The ovarian tumourcan be visualized radiographically as a soft tissue mass or ultrasonographically as a mass, with complex echogenicity posterior to the kidney. Naket al. (2012) reported an ovarian mass as a cystic component, posterior to the left kidney which was imaged ultrasonographicallyhelpful to diagnose the origin of ovarian masses and for checking abdominal metastasis.Ultrasonogram of Akita and Siberian Husky crossbred bitch with dysgerminoma in a right ovary showed heterogeneous hyperechoic mass measuring 4 cm in diameter with irregular small cystic areas and granulosa cell tumour in a left ovary showed an anechoic structure measuring 2.3 cm in diameter with echogenic points (Oliveira et al., 2016).A mixed-breed withpurulent vaginal discharge and mammary lumps and German shepherd bitchwith abdominal enlargement and anorexiarevealed ovarian neoplasm ultrasonographically, and later on histologically confirmed as ovarian dysgerminoma (Sfartzet al., 2015) and ovarian leiomyoma (Pecileet al., 2017), respectively.

Histological Examination

Apart from radiography and USG, the definitive diagnosis is only obtained by histological examination (Silva et al., 2014). Histological examination of ovaries in a 9 year old ND female dog revealed multibranched papillary projections with cuboidal to columnar epithelium and uterus showed endometrial hyperplasia representing bilateral papillary adenocarcinoma (Murugavelet al., 2010). On histological examination, dysgerminomas are composed of a uniform population of polyhedral cells arranged in sheets, cords or alveoli, highly vascularized scant fibrous stroma, while mitoses are numerous and sometimes with an aberrant appearance (Novotny et al., 2011). Majority of dysgerminomas are clinically benign, despite the presence of a high mitotic rate, necrosis and hemorrhage.Histology should be carried out before selecting a treatment protocol for ovarian neoplasms (Demirel and Ergin, 2016). Histopathological examination of surgically removed right ovary identified leiomyoma, composed of interlacing bundles of spindle cells characterized by a moderate amount of eosinophilic cytoplasm and elongated basophilic nuclei (Pecileet al., 2017).

A Dobermanfemale dog with ovarian cystadenocarcinoma examined histopathologically showed papillary projections and tubules lined by pleomorphic, cuboidal to columnar epithelial cells (Ajadiet al., 2011). Histologically,granulosa cell tumour of German shepherd female dog ovary showed neoplastic cells proliferated in a variety of patterns like follicular, sertoli cell-like and diffuse sheets with polyhedral cells and call-exner bodies consisting of a small central round to oval space with eosinophilic follicular fluid surrounded by a collar of radially arranged granulosa cells (Tavasoli and Solati, 2011). A confirmed diagnosis made as granulosa cell tumour of the surgically removed ovarian mass by histological examination showing central population of proliferating granulosa

cells with interposed irregular fibrovascular septa and "call-exner" body formation (Naket al., 2012). Histopathologically benign cystic teratoma was diagnosed due to the occurrence of the well differentiated components of ectoderm, mesoderm and endoderm germ layers (Gulcubuket al., 2012) and well-demarcated, un-encapsulated solid neoplasia surrounded by ovarian tissue (Headelyet al., 2006; Rota et al., 2013).Bilateral ovarian neoplasms are not common with different cell origins and distinct histological patterns in each ovary.However, a six-year-old Akita and Siberian Husky crossbred female dog with dysgerminoma in a right ovary and granulosa cell tumour in a left ovary had been placed on record (Oliveira et al., 2016). A typical serous borderline tumour of a surgically excised ovarian mass confirmed by histopathology revealed a multi-cystic mass with solid papillary projections lined by stratified cuboidal to columnar epithelial cells and hyperchromatic nuclei with prominent nucleoli (Demirel and Ergin, 2016).

Immunohistochemistry (IHC)

Immunohistochemical study involves typically employed panels of antibodies to distinguish epithelial tumours from sex cord stromal tumours. Immunohistochemical staining is done using avidin-biotin-peroxidase complex technique on deparaffinized sections of the surgically removed ovarian neoplastic mass. This technique can be very helpful in distinguishing primary ovarian tumours from metastatic ones (Riccardiet al., 2007). Recent years have witnessed a significant development in immunohistochemistry for diagnostic ovarian pathology. Due to gross and histological similarities between ovarian leiomyoma and other spindle cell tumourslikethecoma and fibroma, an properimmunohistochemical test is to be performed to allow differential diagnosis. Inhibin-α (INHα) is a polypeptide hormone produced by granulosa cells and a specific marker that can confirm a diagnosis of granulosa cell tumours in dog ovaries (Riccardiet al., 2007). Cytokeratin 7 (CK7) is a selective marker for ovarian epithelial cell tumours(Riccardiet al., 2007).A cocker Spaniel dog with ovarian dysgerminoma diagnosed via immunohistochemistry using antibodies like monoclonal anti-CD3, CD79a, cytokeratin, alkaline phosphatase (ALP), vimentin, alpha-fetoprotein (AFP), inhibin-α and S-100 and reaction was observed by streptavidin-biotin method recorded that the neoplastic cells were positive for ALP and vimentin whereas negative for CD3, CD79a, CK, AFP, inhibin- α and S-100 (Park et al., 2009).The Immunohistochemical expression of vimentin, cytokeratinsand inhibin-α studied in 14 canine ovarian tumours for the differential diagnosis and found that markers like cytokeratin 7 and inhibin-α are useful to distinguish epithelial ovarian tumoursagainstgranulosa cell tumours (Riccardiet al., 2007).

Immunohistochemical antibodies like HBME-1 (Hector BattiforaMesothelialEpitope-1) react with epitopes on surface of microvilli on mesothelial cells and greatly expressed by ovarian mesotheliomas and adenocarcinomas (Banco et al., 2011). Immunohistochemical study for the differential diagnosis of 28 canine ovarian tumour using HBME-1 & INH (Inhibin) α antibodies used as markers (Banco et al., 2011).German Shepherdfemale dog showed ovarian neoplasia positive for desmin and α-smooth muscle actin and confirmed as ovarian leiomyoma (Pecileet al., 2017).Immunohistochemistry examination showed negative reactivity for CK20, while positive staining for CK7, leads to a diagnosis of papillary ovarian cystadenocarcinoma and metastatic ovarian tumour in a mixed-breed bitch (Khaki et al., 2014).German Shepherd and mixed-breed bitch showed ovarian neoplastic cells as positive immunoreactivityfor desmin and α-smooth muscle actin and confirmed as ovarian leiomyoma (Pecileet al., 2017) and positive staining for CK7, but negative for CK20, leads to a diagnosis of papillary ovarian cystadenocarcinoma alongwith metastatic ovarian tumour in a mixed-breed female dog (Khaki et al., 2014).

Management of ovarian tumour

Surgical Management

In ovarian neoplastic cases gonadectomyis one of the most preferred and frequently performed surgical procedure in veterinary practice.Ovariohysterectomy is the recommended treatment of choice in the majority of canine ovarian tumours and preferred based on the presumption that future uterine pathology could be prevented by excising uterus (Gulcubuket al., 2012). In general, chemotherapy and radiation therapy are not routinely recommended as an adjunct to surgery.Exploratory laparotomy can be done to establish a definitive diagnosis in many cases.Surgical removal of unilateral/bilateral necrotic ovarian mass (oophorectomy) or ovariohysterectomy by laparotomy using standard protocol is recommended (Klein, 2007; Ajadiet al., 2011; Novotny et al., 2011).An uneventful recovery was recorded using ovariohysterectomy in a ten year old female German shepherd dog with papillary adenoma, Akita and Siberian Husky crossbred bitch with dysgerminoma in right ovary and granulosa cell tumour in left ovary and German shepherd bitch with leiomyoma without any complication and signs of metastasis by Simon and Kumar (2012), Oliveira et al. (2016) and Pecileet al. (2017), respectively.

Following table shows various anaesthetic protocols and surgical sites used by various authors for ovariohysterectomy procedurein various breeds of dogs.

Breed	Anaesthesia	Surgical site	Author
Spitz	Triflupromizine-1 mg/kg, IV Atropine-0.04 mg/kg, SC, Thiopentone-10 mg/kg, IV	3 inch Ventral midline below umbilicus	Moruet al., 2008
ND	General anaesthesia	Right flank	Murugavelet al., 2010
Doberman	Atropine-0.03mg/kg, IM, diazepam-0.5 mg/kg, IM Maintanance-6% sodium Pentobarbitone,10mg/kg,IV	Ventral midline	Ajadiet al., 2011
Boxer	Butorphanol-0.1 mg/kg, diazepam-0.3 mg/kg Ketamine-4 mg/kg Maintainance-isoflurane	Linea alba	Novotny et al., 2011
Collie	Dexmedetomidine, 2.5 µg/kg IV Morphine, 0.1 mg/kg IV Induction-Thiopental, 7 mg/kg,IV, Propofol, 4 mg/kg,IV Maintainance-Isoflurane (2%)	Linea alba	Pichonet al., 2011
Pomeranian	Glycopyrrolate-0.4ml Xylazine-0.4ml Maintanance-1.6 ml Ketamine	5inches Midventral	Abraham and Ravindran, 2012
Anatolian Shepherd	Xylazine-2 mg/kg,IM, Propofol-4 mg/kg,IV, Maintainance-Isoflurane	Midline incision	Naket al., 2012
Alaska	Xylazine-2mg/kg Maintaine-Ketamine -5.5mg/kg + Diazepam-0.3 mg/kg,IV	Ventral midline	Ozalpet al., 2015
Pointer	Xylazine-2mg/kg	Ventral midline	Demirel and Ergin,2016

Chemotherapy

Malignant tumour with an advanced stage of disease can be controlled for several months by chemotherapies and rarely by ovariohysterectomy alone (Olsen et al., 1994). Based on their biochemical mode of actions antineoplastic drugs can be grouped asantimetabolites, alkylating agents, antineoplastic antibiotics, hormonal agents, mitotic inhibitors and other miscellaneous drugs.Chemotherapy is based on the use of intracavitaryplatinum compounds (cisplatin, carboplatin), usually administered with an alkylating agent may lead to systemic renal toxicosis(Olsen et al., 1994).Sodium thiosulfate given intravenously during and after intracavitarycisplatinadministration, has been used successfully to protect against renal toxicosis (Moore et al., 1991).Various drugs used in chemotherapy include platinum compound such as cisplatin and carboplatin, paclitaxel, altretamine, docetaxel, cyclophosphamide, capecitabine, etoposide, ifosfamide, irinotecan, gemcitabine, melphalan, doxorubicin, topotecan,vinorelbineandpemetrexed.

Combination of Surgery and Chemotherapy

A 1.5 yr old Doberman pinscher female dog affected simultaneously with ovarian teratoma and granulosa cell tumour on a same ovary with intra-abdominal metastasis, a 20 cm, smooth and intact mass from left ovary and multiple 1–2 cm irregular masses in the broad ligament surgically excised and treated by two cycles of carboplatin therapy resulted in to a complete recovery(Coggeshallet al., 2012). Primary surgery followed by paclitaxel and platinum based chemotherapy is the standard treatment approach in women currently (Kataria and Kumar, 2007). Thirteen times of carboplatin @ 10mg/kg, IV, every 4 weeks, found well-tolerated without metastasis of pleural and abdominal cavities for 431 days in a 10-year-old Chihuahua female dog with progressive abdominal distension due to large metastatic dysgerminoma on right ovary (Kang et al., 2017). Two intracavitarycisplatin chemotherapies can be performed at 4-week interval in dogs to treat ovarian tumours (Moore et al., 1991). In a dog with ovarian adenocarcinoma, intracavitarycisplatin chemotherapy after surgery led to an 8-month resolution of malignant effusion (Olsen et al., 1994). Successful treatment and control of malignant abdominal and pleural effusion of unknown origin associated with neoplasia in six dogs using intracavitarycisplatin chemotherapy at 50 mg/m^2 every 4 weeks is recorded without evidence of tumour growth (Moore et al., 1991).

Radiation Therapy/Radiotherapy

Radiation therapy is one of the most common treatments for cancer in both humans and animals. It is also called radioisotope irradiation, cobalt therapy or x-ray therapy. Radiotherapy can be used alone or in combination with other tumour therapies including chemotherapy and surgery. Dividing cancerous cells are most sensitive to radiation. Cancer cells can be controlled in three ways viz, cells damaged by ionizing radiation and killed directly, may later attempt to divide and then die and some cells remain functional, but do not divide. Radiation can be applied to the cancer tissueeither from the outside using a machine or from inside using implants (rarely used for animals). Radiation therapy is readily available inIndia, US, Canada, Australia and other European countries.In India, cancer-afflicted canines can be treated at the Advanced Centre for Treatment, Research & Education in Cancer (ACTREC), Tata Memorial Centre, Mumbai.Irradiation using 800 cGy fractions radiotherapy in 23 dogs given on days 0, 7, and 21 protocol as a palliative treatment with advanced malignancies and found complete relief in seventeen female dogs (74%) and partial relief in three female dogs (13%) (Bateman et al., 1994).In veterinary medicine a total radiation dose of 40 to 60 Gyis delivered in 9 to 20 treatments over 3 to 6 weeks (Frimberger and Moore, 2017). Despiteits proven curative role in the treatment of ovarian cancer, proper role and dose of radiation is not clearly established (Kataria and Kumar, 2007). To achieve a curative benefit of radiation, techniques that encompass the whole peritoneal cavity, rather than just the pelvis or lower abdomen alone, are likely to be most beneficial.

Radiation Delivery Methods

It includes external beam radiation therapy in which radiation is directed onto cancerous cells in a bodyusing a machine outside the body (e.g. intensity-modulated radiation therapy (IMRT), 3D conformal radiation therapy,tomotherapy, stereotactic radiosurgery, image-guided radiation therapy (IGRT)). Treatments are given five days a week (only a few minutes) for several weeks.Internal Radiation Therapy uses a catheter or other carrier radioactive material is placed as an implant directly into or near atumour(e.g. high-dose rate brachytherapy). In systemic radiation therapy a radioactive substance is swallowed or injected (i.v.) that travels through the blood stream to locate and destroy cancerous cells (radioactive iodine therapy).

Prognosis

The prognosis of ovarian tumours is good if single tumouris completely removed surgically. However, if there is evidence of metastasis, the prognosis must be poor (Klein, 2007).

Prevention and control

Lifestyle changes in female dogs should be frequently observed, such as better eating and getting plenty of rest, exercise, etc.Allow her to eat a healthy and balanced diet.Ovariohysterectomy at an early stage is helpful in prevention of ovarian tumour in female dogs.A routine check-up should be followed.Abdominal and chest radiography and ultrasonography should be routinely done.Since the cause of ovarian cancer is unknown there really is not any defined screening technique for ovarian cancer.Blood biochemical tests and pelvic ultrasounds are possible diagnostic means.Enough vitamin D reduces the risk of developing a number of cancers, including ovarian cancer.

Conclusion

Ovarian tumours are uncommon, though epithelial and sex cord stromal tumours are mostly found in middle age to older female dogs in breeds like Boxer, German Shepherd, Lhasa apso, Pomeranian, Yorkshire and English Bulldog.Radiography and ultrasonography are helpful to diagnose ovarian masses and metastatic abdominal/pleural effusion, however a definitive diagnosis can only be reached using histology and/or immunohistochemistry.Ultrasonography can be considered more diagnostic compared to radiography because it reveals information on organ architecture and relationships with soft tissue structures.Ovarian tumoursdiagnosedby clinical and echographic findings, even with malignant effusion, surgical removal of the ovary with a tumour or a complete ovariohysterectomy should be a choice of treatment.Treatment of metastatic ovarian tumour includes cytoreductive surgery in combination with chemotherapy as early as possible.It appears to be appropriate to further investigate the role of radiotherapy in detail, its doses and duration as a sole agent or as an adjunct of a multimodality treatment in the management of ovarian tumour in dogs.

Conflict of interest: The authors declare that there is no conflict of interest.

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