ABSTRACT

The dissertation entitled "CONTRIBUTIONS TO DIAGNOSTIC RADIOLOGY AND ULTRASONOGRAPHY OF THE URINARY TRACT DISEASES IN DOG" is structured into two main parts, in accordance with the present legal provisions:

- Part One, Library Research Study unfolding on 46 pages and representing 25.9 % of the whole thesis;
- Part Two, Personal Research, on a number of 133 pages, the equivalent of 74.1 % of the whole dissertation.

Part One, by its four chapters, is a short but concentrated data update of the specialised literature on renal anatomy, physiology and physiopathology and also contains general data about radiological and ultrasound techniques.

Part Two is structured on eight chapters and covers the purpose and the orientation of the research, the study material and the methods used, the results obtained and their interpretation, and it ends with the recommendations and the general conclusions.

The dissertation's purpose is to implement the modern technology, namely the echo graphic and radiologic one, in Romania's veterinary medicine from the desire to follow the line of the developed countries. The pathology of the urinary system, extremely frequent among the carnivores, unfolds a complex etiology and an intricate pathogenesis, together with a highly varied morphoclinic panel, which rely extensively on the clinician's experience. To set a correct and complete diagnosis of the urinary system's problems is difficult and needs a frequent usage of complementary image technology.

The present study centres on establishing extremely accurate diagnoses and solving difficult clinical cases using the echo graphic and radiologic examinations, all of them beyond achieving a few years ago. Once the modern technology was available, we were able to make evident progress in diagnosing, tracking the evolution and treating the renal and urinary pathology.

Echography, through its accuracy, speed, innocuousness and accessibility, rivals the other image methods. Apart from these qualities of echography, I have also examined the use of Doppler technique, both colour and pulsating, for emphasising

and evaluating the renal vascular structures or the secondary cardio- circulatory pathology.

Another aim of this paper is to analyse the radiologic examination using the contrastive substance as a highly accurate method to diagnose a number of rare illnesses of the urinary system.

The study was carried out during a period of four years and a half, between 2007- 2011, at the private veterinary clinics Salvavet and Marco Vet.

Chapters VI and VII of Part Two outline the way to carry out the research and systemise the obtained data, as well as the work organisation and the methods used according to the technology and protocols provided by the clinics in question.

The technology used as well as the radiologic and echo-graphic techniques are emphasised by introducing the new elements regarding the technology and the procedures destined to examine the urinary system and to obtain high quality results..

Chapter VIII displays the centralised data on the relevance of the radiologic and echo-graphic examinations in the dog's nephropathy. This chapter aims to evaluate comparatively and independently the results of the imaging investigations for the main groups of the kidney's ailments such as: congestive and inflammatory nephropathies, the chronic renal illness, lithiasis nephropathies, neoplasis, congenital and hydro-nephritis. If it was considered relevant, the results of blood hematologic and/or biochemical examinations were also presented comparatively.

The results analysis shows a significant heterogeneity of the para-clinic data, correlated with the diversity of the etiologic factors, as well as the dominance of the echo-graphic examination as the specific method to diagnose the renal complaints.

For congestive nephropathies, the bi-dimensional ultrasound proved an specific method with a high specificity degree. The colour ultrasound Doppler technique transform the blood flow into colour image, shaping the vascular architecture of the kidney and permitting a highly accurate reading of the congestive and/or inflammatory renal phenomena. The radio-graphic technique, due to its particularities and limits, was not appreciated as a specific imaging method to diagnose the dog's circulatory nephropathies.

The chronic kidney disease (CKD) received blood hematologic and biochemical analysis for all the patients as the para-clinical method to establish a diagnosis beyond any doubt. The ultrasound changes encountered, meaning the alteration of the specific parameters (dimension/volume, echo-structure, echogeneity)

can be correlated to the clinic and paraclinic changes, thus mostly explaining the lesion sub-stratus which is responsible for the kidney's functional degradation.

For the I-st and II-nd stages of CKD, due to the compensatory activation of the functional nephrons, the blood haematological and biochemical clinical manifestations were not constant and of reduced intensity. The ultrasound investigations identified discrete morphological changes, while the radiography (plain), mostly due to the limited character of the volume, shape and radio-density data, did not present any specificity for diagnosing CKD at these stages.

The kidney lithiasis, poorly outlined through the blood hematologic and biochemical results, receives highly specific echo-graphic and radiologic image.

The kidney tumours, due to their important morphological changes, such as the volume modifications and the loss of the kidney shape, are easy to outline using the imaging techniques. The ultrasound examination allowed finding kidney tumours (primary or metastatic) of small dimensions in the incipient stage (which are not usually accompanied by any clinical signs or any change in functional parameters-biochemical and/or hematologic). The plain or contrast radiograph permits the suspicion of neoplasm when renal shape and volume changes occur and it is used complementarily for identifying the bone or lung metastases.

The hydronephrosis and uretero-hydronephrosis, due to their complex aetiology, need no only a diagnosis, but also identifying the primary cause and in this case both the echo-graphic and contrast radiologic examinations proved extremely useful. Ultrasound technique made easy to appreciate the kidney dilatation degree and implicitly the one of the parenchimatos substratus decrease (atrophy by compression) at the patients with hydronephrosis/ uretero-hydronephrosis, as well as the connected changes at the urinary or systemic level. The intravenous urography, by appreciating the dilatation degree and localising the interrupting element of the urinary flow, proves an useful method to establich highly specific diagnoses.

The congenital kidney pathology displays a large morphological and functional variety, being correlated at the imagistic and conduct level to the similar acquired illnesses.

Chapter IX describes the characteristic diagnosis ways and image features encpuntered in the complex of urethra illnesses, such as urethra tumours, urethra lithiasis and ectopic urether.. For this extremely delicate anatomy, the echographic and radiologic examinations are complementary techniques which successfully

diagnose beyond any doubt. Obtaining outstanding results on the diagnosis and therapy of various urether illnesses was possible only due to the medical progress and it depends on the experience of the medical personnel.

The echo-graphic examination allows emphasing urethra dilatation (and/or of the kidney pelvis), its location and degree, together with the identification of the cause of pathologic process (frequently originating in lithiasis and/or scars or tumours).

The complementary ultrasound techniques, like colour Doppler, permit identifying and tracking the urethra tract, outlining it against the blood vessels, as well as emphasing the newly formed vascularisation.

The contrast radiologic examination permits diagnosing unilateral or bilateral urethra hydronephrosis, extremely rarely involving the visualisation of the tumour formation in the shape of a blank zone in the contrast space on the ureter.

Chapter X emphasises the imaging techniques along with other complementary diagnosing methods used in the dog's bladder pathology. The bladder is the abdominal organ which is the most suitable for being investigated by echography and radiology. Due to its cavity structure and its place, it can be easily examined following the anatomy rapports , size, shape, parietal and content changes. For bladder's correct evaluation a certain quantity or urine is necessary so that to produce a satisfactory distension of the organ.

The echoographic examination is the top technique in diagnosing the inflammatory and neoplasic processes, as well as those of bladder lithiasis, urine retention and bladder rupture.

In the inflammatory and neoplasic desease, echography and cistography identify the parietal modifications underlined by uniform (cystitis) or irregular thickening, by the modification of the surface structure and of the parietal strata (tumour processes).

In urine retention, the echograpy permits diagnosing and differentiating the three types (mechanical, spastic and paralytic) according to the characteristic alterations. In an initial phase, all three retention types are accompanied by the bladder's distention, under the shape of a bladder globe without any change of the bladder's wall and content. In an advanced phase, due to the prolonged urine stasis, the parietal reaction and the urine sediment appear. The paralytic urine retention is

accompanied by the characteristic “plied” aspect of the bladder’s wall after the bladder’s having been emptied.

As for the case of bladder’s rupture, echography permits identifying the presence of the fluid (urine) within the retroperitoneal space and allows harvesting (to establish its nature) and emptying it safely (in normal conditions, the parietal breach cannot be visualised). For confirming this illness it is recommend to introduce physiologic serum under pressure in the bladder and to track the dynamic of the place used by it to flow out of the lumen. The positive contrast cistography permits localising the parietal breach through the diffusing at that level the radiopaque environment out of the urinary tract

Bladder’s lithiasis is easy to diagnose, both using the ultrasound technique and the radiologic one, by identifying the characteristic elements of the bladder’s calculi.

Chapter XI contains the imaging diagnostic methods used in the dog’s urethras complaints (frequent in male individuals). This pathology, no matter the primary cause, implies interrupting the normal urinary flow and installing an evident and suggestive simptomatology. Due to the urethra’s place and special morphology, the eco-graphic examination is easy only on its intra-abdominal portion and is valuable for the diagnosis of the urethra lithiasis and tumours, urethral diverticul and its traumatic lesions (urethra rupture). The plain urethra-graphy but especially the double contrast one, proves useful and highly specific for examining the extra-abdominal urethra identifying the changes in the urethra lumen (calculi, tumours, breaches).

The synthetic and objective analysis of the clinical and imagining results on the 2160 patients allowed drawing highly significant medical conclusions, outlined in the final chapter of this dissertation, entitled General Conclusion:

8.1. Renal congestion has been recently diagnosed as a component of some kidneys disorders or other organopathies (85%) with systemic conditions. Correlated to the degree and type of the circulatory nephropathy, the bidimensional echography (classical) permits the appreciation of the vascular stasis and of the inflammatory phenomena (the inflammatory nephropathies) which are dominated mainly from the echographic point of view by increasing dimensions (kidney volume) and alterations of the specific echogenity which is decreasing (hypoechogenity direct proportional to vascular stasis). Within ultrasonography, Doppler colour technique has a high

specificity degree through highlighting the intrarenal vascularisation, and the ectasia of the arcuate and interlobe arteries in colour images. As for the radiographic technique, due to its particularities and limits, cannot be considered an elect image technique in diagnosing the circulatory nephropathies of the dog.

8.2. The confirmation of the diagnosis of a chronic kidney disease and its standardisation were established as a result of the correlated analysis of the blood and bio-chemical investigations (blood and urine). The ultrasound alterations registered are extremely varied often justifying the lesion substrata responsible for the kidney function deterioration. When the echographic aspect of the kidneys looks normal, RI (resistance index) can be calculated for finding as soon as possible some possible kidney diseases. The intravenous urography offers information on diuresis, by means of the kidneys radiodensity and of the speed of the contrast substance excretion.

8.3. The image diagnosis of nephrolithiasis , due to the particularities of the calculi, was made possible in 100% of the cases (n=128). The high specificity degree within the echographic exam is given by evidentiating the hiperechoic areas (focal or difuse), associated to the characteristic artefactual phenomenon.- the posterior shadow. These characteristic elements permit the identification of the very small calculi, usually over 1.5 mm. The radiographic technique allowed a high fidelity appreciation of the number, shape and location of the calculi with dimensions of over 5 mm at the kidney level.

8.4. The kidney neoplasm can be diagnosted using image techniques, together with the results of the cytological/histopathological exam and the urinary sediment, which permits the confirmation of the presence of the kidney neoplasm and the type of it. The echography allows finding kidney tumours (primary or metastasis) of small dimensions., in the incipient stage (which usually is accompanied by clinical signs or alterations of the functional parameters - biochemical and/or haematological), as well as the organic or lymphonodal metastatic lesions. The Doppler technique makes the vascularisation of the solid mass evident, supporting the hypothesis of a neoformation tissue. The intravenous urography has a decisive role in setting the diagnosis of urotelial tumour by emphasising the alterations from the kidney basinet.

8.5. By its accuracy, relevance and fidelity in emphasising and counting the echostructure alterations, the echographic exam proved an easy and non-invasive election method in HN/UHN diagnosis (hydrophrenosis/ureterohydrophrenosis). This allows the appreciation of the kidney dilatation degree, and implicitly the reduction of

the parenchimatos stratus (atrophy through compression) at the patients suffering from HN/UHN, of the connected alterations at the level of the urinary system or the systemic ones, as well as the identification of the cause or the inducting pathogenetic complex (the presence and the place of the obstruction, its cause and the sudsequent modifications). The intravenous urography, by evidentiating the degree of dilatation of the pielo-caliceal system (the basinet) and the localisation of the interrupting element of the urinary flow, proves to be a diagnosis method with a high specificity degree.

8.6. From the congenital nephropathies, all over the course were diagnosed: kidney agenesis (24 %, n = 12), kidney hypoplasia (36 %, n = 19), the polycystic kidney (22 %, n = 11), hydronephrosis (10 %, n = 5) and the kidney (renal) pseudocyst (8 %, n = 4). The echographic exam, by emphasising the characteristic elements, permits the early diagnosis of these diseases, in 100% of cases. The urography, by the data it offers related to the volume, shape, radioopacity of the kidney structures, has a high specificity in diagnosing the agenesis, hypoplasia and congenital hydronephrosis (70 %, n = 36).

CHAPTER IX

9.1. The diagnosis of the urethral affections at the dog, using the classical methods, is a difficult one due to the morphological (small dimensions) and placement particularities.

9.2. The urethral affections met and investigated, that is urethral calculi (n = 12, 38.7 %), urethral ectopia (n = 11, 35.48 %) and urethral tumors (n = 8, 25.80 %), had as a morphological expression the ureterohydronephrosis, successfully diagnosed by the echographical exam with high frequency transducer and by contrast radiologic exam.

9.3. The ascendant urography used in all 31 cases (100%) by its data offered, has a high degree of specificity in the case of lithiasis and neoplasic obstruction, being underlined the urethra dilatation (showing a sinuos aspect).

9.4. Apart the diagnosis, echography permits the evaluation of the cases in their dynamic, post-operation or within the specific therapy. The complementary echography techniques, such as the colour Doppler one, permits identifying and tracking the urethra course and differentiating it from the blood vessels.

9.5. In the present study there were diagnosed 11 cases of urethral ectopia, out of which 8 (72.7%) without the anatomic attachment and 3 cases (27.3%) with intramural urether, the most frequent symptom associated to the ectopic urether being

the urinary incontinence (at the females), easier to diagnose in the cases of bilateral condition (because of the clinical expression).

CHAPTER X

10.1. Due to the cavity structure and of a liquid contents, the image evaluation of the dog's bladder is extremely easy.

10.2. The classical bidimensional echography is enough for getting a clear diagnosis in inflammatory illnesses, by registering the parietal and contents alterations: uniform or localised parietal thickening, keeping the specific parietal architecture, associated in the chronic cases with phenomena of hypotonia/scleroatrophy, together with the presence of the urinary sediment or the corpuscular elements in suspension. Associated to image techniques, the urocultura and urinanalysis have an important role in establishing the therapy conduct.

10.3. In urinary retention, the echographic exam permits the diagnosis and differentiation of the three types (mechanical, spastic and paralytic), according to the characteristic alterations bladder distension in mechanical and spastical retension and the "plie" aspect/look of the parietal fold in empty bladder for the paralytic form.

10.4. In the case of bladder rupture, the echographic diagnosis evidentiates the presence of the fluid (urine) in the retro-peritoneal space and by introducing under pressure in the bladder physiological serum it can be watched the dynamic of the place in which the liquid leaves the lumen. The cistography with positive contrast permits the parietal breech to be localised using the diffusion at this level of the radio-opaque medium from outside the urinary tract.

10.5. The echographic exam is the technique of first intention in diagnosing the bladder neoplasm by identifying the focal or diffused alterations, frequently together with losing the parietal stratification. The cystography with positive contrast and the one with double contrast evidentiates the bladder tumours under the shape of a "filling flaw" and shapes the bladder lumen by the accumulation of the contrast medium at this level. Along with the image techniques, the cytological exam and/or the hystopathological one and the one of the urinary sediment allow the confirming the presence and establishing the type of bladder neoplasm.

10.6. Urolithiasis (bladder stones) is easy to diagnose using the ultrasound technique thanks to its characteristic elements of the bladder calculi: the total hiperechoic aspect or convex hiperechoic aria, acustic shadowing accompanying them and the tendency of gravitational sedimentation. The classical radiography permits the

appreciating the shape, dimensions and even the number of the calculi from the bladder, except the cases of the radiotransparent calculi (cystine, şi urate), which can be identified using the echography or the cistography with positive contrast or with double contrast.

CHAPTER XI

11.1. The urethral disorders, no matter their primary cause (3 cases of urethra neoplasm 4.22%; 18 urethra ruptures 25.35% and 47 cases of urethra lithiasis 66.19%) implies the interruption of the normal urinary flow and appearing an evident and suggestive symptomatology (urinary retention/ stranguria, tenesmus, abdominal distension, disuria, hematuria).

11.2. Thanks to the special placement and morphology of the urethra, the echographic exam is easy only on the intra-abdominal portion of it and has a value of diagnosis in urethral lithiasis and tumours, urethral diverticula and its traumatic lesions (urethral rupture).

11.3. The simple urography, especially the double contrast one, proves useful and having a high degree of specificity for examining the extra-abdominal urethra and for identifying the alterations of the urethral lumen (calculi, tumours, breeches).