CLINICAL AND IMAGISTIC CORRELATION IN PACIENTS WITH RENAL FAILURE

Bradea A, Codreanu M.D., Vlagioiu C.

Faculty of Veterinary Medicine Bucharest
bradea_adrian@yahoo.com

Abstract

Kidneys are organs that receive a large amount of blood, approximately 20% of the heart blood flow. Many renal diseases have an important vascular component, some systemic diseases, such as hypertension, are vascularly mediated through the juxtaglomerular component. The study has been carried out on a number of 25 cats and 18 dogs, inside the Faculty of Veterinary Medicine Bucharest, sedated and awake as well as with different renal, hepatic and heart diseases. The resistance index and pulsatility index have been appreciated in renal level from the renal arteries, interlobar arteries and arcuate arteries, with superior specificity in pathologic conditions (diagnosis and prognosis)
.
Key words: *Doppler ultrasonography, resistivity index, pulsatility index.*

INTRODUCTION

Kidneys are organs that receive a large amount of blood, approximately 20% of the cardiac blood flow. Many renal diseases have an important vascular component, some systemic diseases, such as hypertension, are vascular mediated through the juxtaglomerular component.
All of these characteristics make the kidney suitable for Doppler examination, because it is expected, in renal and renal vascular diseases, for vascular arterial and venous and micro vascular circulation to be modified.
Hemodynamic alterations that decrease renal perfusion are characterized by systemic vasodilatation. This systemic vasodilatation determines an increase in blood flow in the splahnic region that will determine compensatory increase of heart flow. In this moment, kidneys can't adapt due to mechanism of self regulation regarding renal circulation that becomes functional only in arterial pressures over 50-70 mmHg. Renin-angiotensin-aldosteron system is activated in order to compensate hypovolemic status.
In dogs and cats, chronic renal failure represents the most common cause in increased blood pressure. When present, hypertension can be inconstant in dogs to cats. Studies revealed that two thirds of a cat population and 50-93%

of dogs present hypertension associated with chronic renal failure (Ettinger and Feldman, 2010)

MATERIALS AND METHOD

This study has been carried out inside the Faculty of Veterinary Medicine, on a number of 35 cats and 27 dogs, sedated or awake, healthy or with renal, hepatic and cardiac affections. Sedation protocols have been selected regarding the affection, following the significant alterations of resistivity and pulsatility indexes.

Examination modalities used were colour Doppler, pulsatory emission Doppler. Fundamental information obtained by Doppler examination are: presence, way, speed and blood flow character and estimation of red blood cells that contribute in generating Doppler signal.

Preparation technique for ultrasonography examination were similar with standard abdominal examination. In some cases sedation was required and was correlated and adapted with the patients status based on blood analysis(hematological, biochemical, electrolytes), ECG and arterial pressure.

Systolic pressure has been determined 5 to 10 minutes prior to examination, in order to let the pacient relax. Systolic pressure has been determined with a high definition tensiometer, by applying a sleeve on the proximal tars in order to tighten the tibial cranial artery. For each patient, a number of three determinations were carried out, using the average value.

Resistivity and pulsatility indexes were obtained by average values of at least five waves, in three different levels/places. Examination was carried out by positioning the patient dorsal and lateral. Before Doppler examination, kidneys size was determined in transversal, sagittal and coronary sections.(Fig.1). Ecogenity of cortical reported with the spleen and liver was also determined, and the ratio of cortical and medullar.

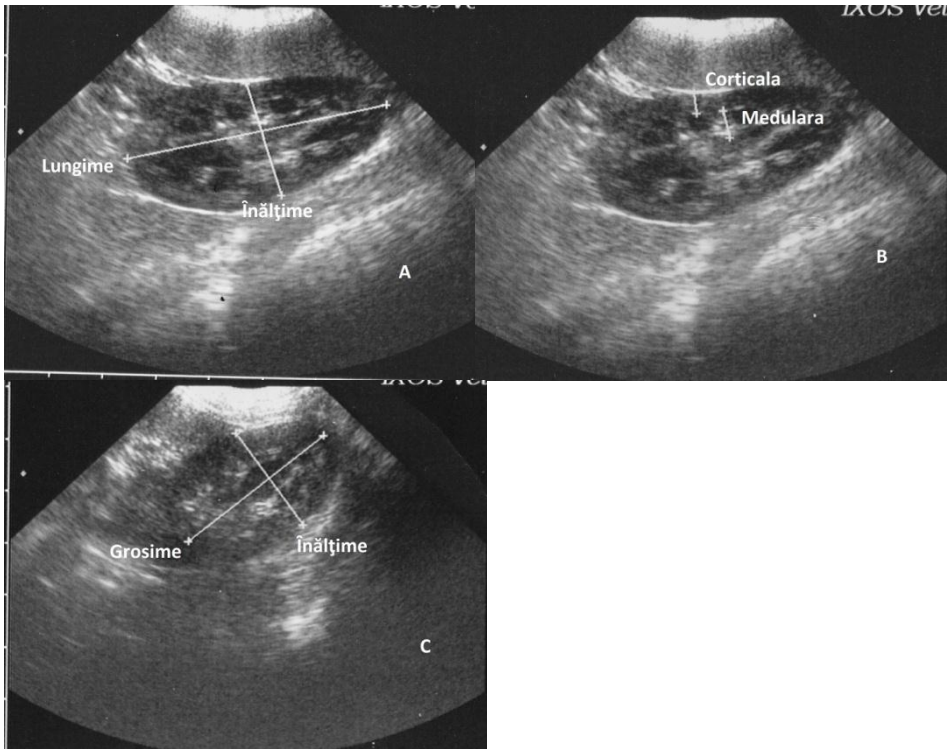

Fig.1 Appreciation of renal size (A. Transverse, B. Transverse, C. Sagittal)

Blood flow along the renal arteries has a pulsatile character due to permanent forwarding in the form of successive accelerations and decelarations. This pulsatile character is influenced by two main factors: rhythmic contraction of the heart and arterial walls elasticity. At venous level, blood forwarding has a continuous character depending on cardiac and respiratory function.

Vascular ultrasonography investigation begins with vascular anatomy appreciation and vascular hemodynamic appreciation. Anatomical evaluation is carried out with B mode and appreciates the anatomical position of the examined vessel, its pattern (linear or sinuous), wall and vascular diameter assessment. Doppler is used for vascular hemodynamic, following, in the first place, vascular flow presence, way of motion, determining blood flow speed(maximum, minimum and medium), evaluation of peripheral resistance and blood flow throughout the vessel.

Renal artery is identified by following the aorta medial related to the kidney and posterior to the cranial mesenteric artery. Both arteries are recognized fairly easy at this level due to the curve aspect and pulsatile blood flow

synchronized with the heart. Recordings are made throughout the artery length, following any variation of obtained parameters.
Evaluating resistivity and pulsatility indexes are very important in assessment of renal affections prognosis and for development and treatment management. In acute renal failure, internal medium homeostasis is disturbed and its capacity of eliminating metabolic residues. Chronic renal failure consists in permanent alteration of renal function, which contributes to the installment of disturbances regarding hydro-electrolytic homeostasis, metabolic residue discharge, hormone secretion(renin or erythropoietin), with irreversible evolution and character.
Resistivity and pulsatility indexes were calculated automatically by the ultrasound machine software after maximum systolic and diastolic value measures:

$$Pulsatility\ index = \frac{Maximum\ systolic\ speed - Maximum\ dyastolic\ speed}{Maximum\ speed}$$

$$Resistivity\ index = \frac{Maximum\ systolic\ speed - Maximum\ dyastolic\ speed}{Maximum\ systolic\ speed}$$

RESULTS AND DISCUSSIONS

Ultrasonographic values obtained regarding renal size in cats were:

Length (cm)	**Heigth (cm)**	**Thickness**
2,7 – 4,7 Average 3,5 cm	1,7 – 2,8 Average 2,1 cm	2,65

Ultrasonographic values obtained regarding renal size in dogs were:

Body/Weight	**Length(cm)**	**Height (cm)**	**Thickness**
Small 2 – 10 kg	5,1	3,2	2,9 – 3,2
Medium 10 – 30 kg	6,6	5,1	3,0 – 3,6
Large ≥ 30 kg	8,6	6,2	3,3 – 3,8

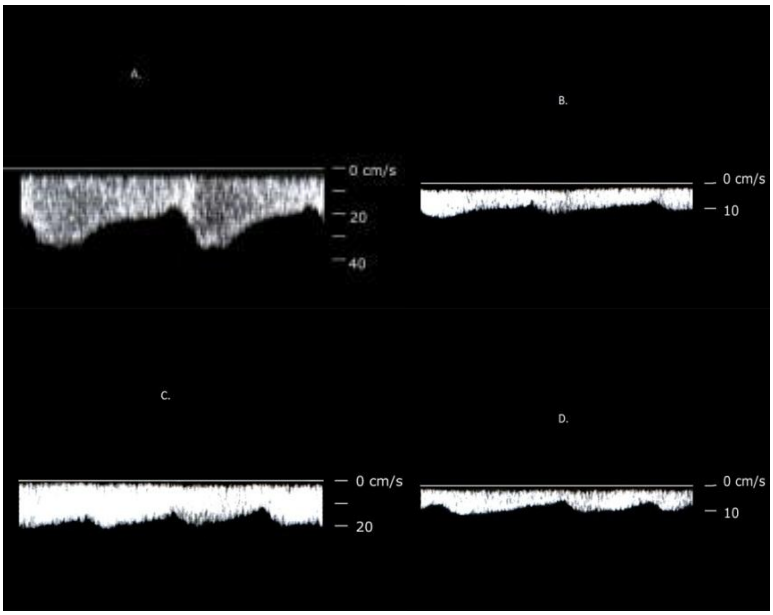

Fig.2 Doppler morphology of renal veins(A), arcuate veins(B), interlobar veins(C) and interlobular veins(D)

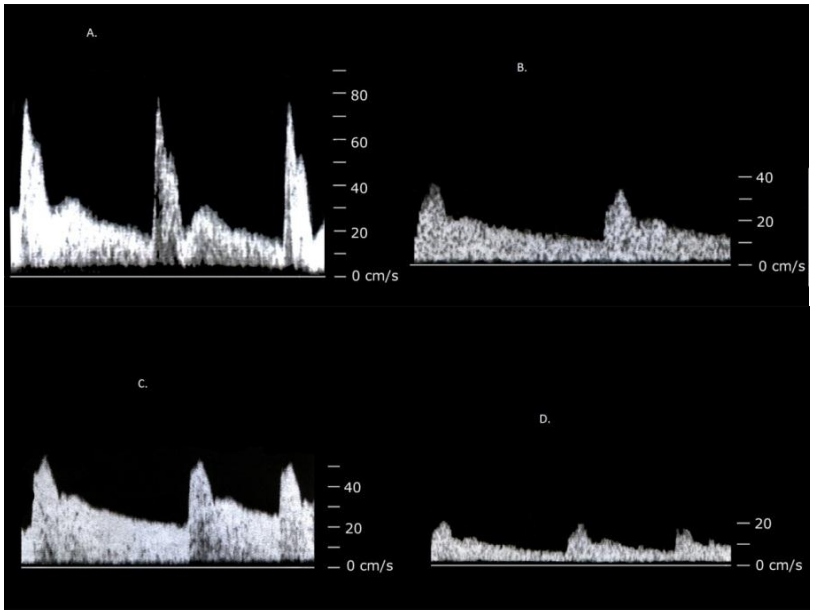

Fig.3 Doppler morphology of renal artery(A), arcuate artery (B), interlobar artery (C) and interlobular artery (D)

Resistivity and pulsatility indexes were calculated at renal, interlobar and arcuate artery.Diagnosis and prognosis relevance was determining those indexes at arcuate and renal arteries.Differences regarding resistivity and pulsatility indexes between the left and the right kidney were 2-3%.Pulsatility index at intrarenal arteries was approximately similar with renal arteries, but for peripheral arteries, recorded values were smaller, in some cases impossible to determine.
Resistivity index represents the ratio between systolic and dyastolic speed.Therefore, an increase in vascular resistance decreases dyastolic speed, any modification regarding resistivity index increase, by obstruction or vasoconstriction, reduces renal blood flow.If renal flow decreases, glomerular filtration rate also decreases.
Obtaining intrarenal resistivity index is useful in confirming renal diseases when, in B mode examination, kidneys look normal.Normal renal function is correlated with the degree of perfusion, resistivity and pulsatility index are used in evaluating vascular renal response to different degrees of hypovolemia.
In dogs, average resistivity index value was ≤1.55, and pulsatility index was≤0.66.In cats, average resistivity index value was≤1.09 and for pulsatility index was≤0.53.Obtained values were similar to those quoted in speciality literature.

CONCLUSIONS

In renal level, with high relevance in blood flow evaluation, resistivity and pulsatility indexes were appreciated in renal, interlobar and arcuate arteries, with high specificity in pathologic states for diagnosis and prognosis
Increase in resistivity index decreases systolic speed and is a precise indicator of renal blood flow reduction(indicating also the decrease of glomerular filtration rate)
Determining and appreciating resistivty index is useful in confirming renal diseases in cases where ultrasonographic modifications in B mode are reduced, inexistent or irrelevant.
Ultrasonographic evaluation has revealed, in chronic renal failure, superior resistivity and pulsatility values, associated with reduction of rena size, whereas in acute renal failure, resistivity and pulsatility values were normal in most patients.
In hypovolemic states, resistivity and pulsatility indexes are used in evaluating renal vascular response(directly correlated with the degree of renal tissue perfusion)

REFERENCES

Badea IR, Dudea SM, Mircea PA, Stamatian F (2007), Tratat de ultrasonografie clinică, Vol. I Principii, abdomen, obstetrică şi ginecologie, Editura Medicală, Bucureşti
Barr FJ, Holt PE, Gibbs C (1990), Ultrasonographic measurement of normal renal parameters., J. Small Anim. Pract. **31**, 180-184
Nautrup CP, Tobias R, Cartee RE (2001), An Atlas and Textbook Diagnostic Ultrasonography of the Dog and Cat, Manson Publishing Ltd.
Stephen J Ettinger; Edward C. Feldman(2010) Textbook of Veterinary Internal Medicine Vol.2, Saunders, Missouri