



Pulse Doppler Analysis in External Ophthalmic and the Long Ciliary Ophthalmic Arteries in the cat

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Abstract

Objective- Analysis of the PSV (peak systolic velocity), EDV (end diastolic velocity) and RI (Resistant Index) in external ophthalmic and the long ciliary ophthalmic arteries in the cat by pulse Doppler.

Design- Descriptive study

Animals- 12 short haired "Tomcats" weighted about 3.9 ± 0.9 Kg no e general and optic disease in clinical, paraclinical and ophthalmoscopic examinations.

Procedure- Two-dimentional and pulsed-doppler ultrasonography was performed by using a multi-frequency linear transducer, 6-12 MHz. The cornea was coated with sterilized ultrasonography gel and the transducer was horizontally fixed over the eye. The PSV, EDV and RI in external ophthalmic artery and the long posterior ciliary artery were measured on the right and left eyes.

Results- The results about the experimented arteries showed no significant difference about "EDV, PSV and RI" factors between the Left and Right eyes of the Cats ($P > 0.05$).

Conclusion and Clinical Relevance- It is found that in two-dimentional Doppler method, these arteries could be easily identified in ultrasonography and had the most repeatability rate in all experimented eyes and these two arteries could be used as a reference to diagnose optic diseases in future studies.

Key words- Eye, pulse doppler, artery, cat.

Introduction

Although, the Ultrasonic medical imaging was first experienced in 1950s, but the application of this method in serious medical purposes was developed at the end of 1960s. Following the achievements in the world of technology, considerable progress and developments were seen

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in medical imaging.^{1,8} For the matter of existing liquids in anterior and posterior structures of the eyeball, proper echogenicity is available for diagnosing related diseases through ultrasonography, whilst the application of general ultrasonography, 3Dimensional Doppler and color Doppler has been progressed a lot in ophthalmic disease diagnosis in medical sciences. Besides, in most of cases, direct ophthalmic examination with ophthalmoscope is very difficult or somehow impossible, while the anterior structures like cornea or lens are crashed.⁸ Systemic diseases like Toxoplasmosis, feline leukemia virus, fungus disease, lupus, deficiency of Vitamin E and Tumors are the problems which involve eyeball and its arteries, and it is essential to use general and Doppler ultrasonography for medical diagnosis.¹³

Materials and Methods

12 short haired “Tomcats” weighted about 3.9 ± 0.9 Kg were selected. These cats were not showing any evidence of general and optic disease in clinical, paraclinical and ophthalmoscopic examinations. Then, the cats were laid down to inject Ketamine with 10mg/Kg dosage, and corneal ultrasonography method was handled for the experiment in which direct contact of transducer with cornea is done. To prepare two-dimensional and pulse Doppler imaging, it is used a multi frequency linear transducer with the capacity of 8-12 MHz. In this method, the object cornea was coated with sterilized ultrasonography gel and the transducer was horizontally fixed over the eye. Ultrasonography machine (GE, PRO 730 Voluson) and linear probe were used. Doppler box was located over the eye and the structure behind eyeball, Peak Systolic Velocity (PSV), End Diastolic Velocity (EDV) and the Intravenous Resistance Index (RI), were analyzed in external ophthalmic artery (EOA) and the long posterior ciliary artery (LPCA) by Pulse Doppler ultrasonography of the right/Left eyes (Fig1, 2, 3 & 4). Average blood flow in external ophthalmic artery and the long posterior ciliary artery was investigated by T-Test statistical method and the parameters middle, Standard deviation and Standard error were measured in left and right eye. (Table 1 and 2)

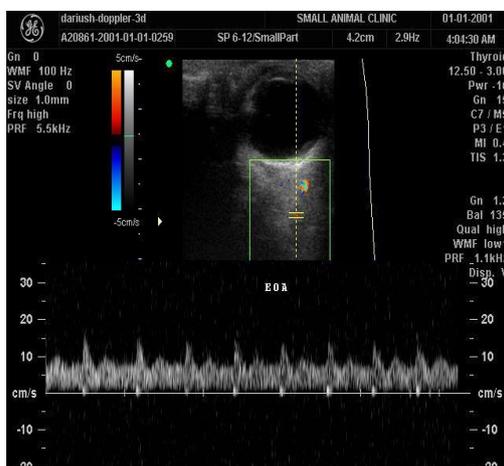


Figure 1. Pulse Doppler Analysis on external ophthalmic artery (EOA) of the Right eye

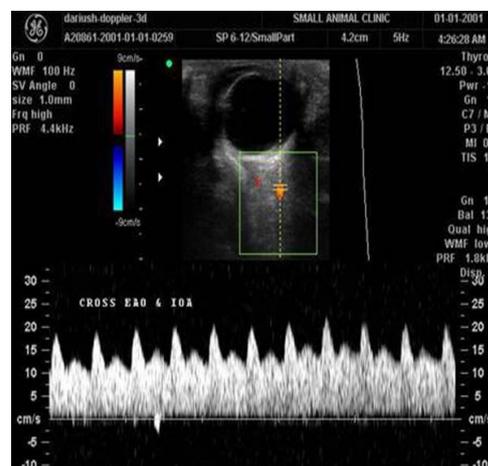


Figure 2. Pulse Doppler Analysis on external ophthalmic artery (EOA) of the Left eye



Figure 3. Pulse Doppler Analysis on Long Posterior Ciliary Artery (LPCA) of the Left eye



Figure 4. Pulse Doppler Analysis on Long Posterior Ciliary Artery (LPCA) of the Right eye

Results

The recorded amounts of Peak Systolic Velocity, End Diastolic Velocity and Vascular Resistance Index obtained from pulse ultrasonography analysis of the Right/Left eyes, are shown in Tables 1 and 2.

The results of the experimented arteries showed no significant difference about “EDV, PSV and RI” between the Left and Right eyes of the Cats ($P>0.05$). It is found in the experiment that these arteries could be easily identified in ultrasonography and had the most repeatability rate in all experimented eyes and they could be used as reference arteries in ophthalmic diseases.⁵

Table 1. Measured parameters regarding the *Left* eye of 12 Cats

Name of vessel	parameter	middle (CM/S)	max (CM/S)	min (CM/S)	Standard deviation (CM/S)	Standard error (CM/S)
EOA ¹	EDV ³	12.6	15.4	10.2	1.67	0.681
	PSV ⁴	17.6	20.6	14.9	1.83	0.747
	RI ⁵	0.279	0.285	0.128	0.098	0.040
LPCA ²	EDV ³	7.7	9.5	6.8	0.977	0.399
	PSV ⁴	16.4	20	13.8	2.029	0.828
	RI ⁵	0.523	0.62	0.312	0.108	0.039

1. External Ophthalmic Artery
2. Long Posterior Ciliary Artery
3. End diastolic Velocity
4. Peak Systolic Velocity
5. Resistant Index

Table 2. Measured parameters regarding the *Right* eye of 12 Cats

Name of vessel	parameter	middle (CM/S)	max (CM/S)	min (CM/S)	Standard deviation (CM/S)	Standard error (CM/S)
EOA ¹	EDV ³	12.3	14.7	10	0.523	0.621
	PSV ⁴	17.9	21	14.6	2.08	0.849
	RI ⁵	0.305	0.462	0.145	0.121	0.049
LPCA ²	EDV ³	7.2	8	5.2	1.033	0.421
	PSV ⁴	17.1	20.6	13.6	2.225	0.908
	RI ⁵	0.569	0.748	0.456	0.096	0.039

1. External Ophthalmic Artery
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Discussion

Recently, the use of Doppler imaging has been reported in dogs, both clinically normal and with intraocular disease.⁵ Since the posterior eyeball problems cannot be diagnosed through ophthalmoscope, so the Doppler ultrasonography is dominantly utilized for observing the interior and posterior structures of Eyeball using ultrasonic waves without any aggression. Reliable imaging and comfortable process for human beings and animals are the two main reasons for increasing diagnosis applications of Doppler method.^{4,11} Nevertheless, the necessity of applying modern and up to date techniques for quick and accurate diagnosis of ophthalmic diseases, as well as diagnosing complicated problems which are impossible to be cleared through current methods, is completely felt. One of the common usages of Doppler ultrasonography is the examination of main artery. It should be noted that Peak Systolic Velocity, End Diastolic Velocity, mean diastolic velocity, vascular resistance index and the pulse strength index are the main parameters which are mainly used in Doppler ultrasonography method for diagnosing arterial disease in human beings as well as the animals.^{14,7} Pulse Doppler could be used in diagnosing interior and exterior problems of eyeball such as; arteries disease, eyeball interior inflammation, neoplasia, vascular systemic disease (raise of blood pressure), anemia, glaucoma and verification of post surgery damages improvements.

Avetisove, et al (2003) used Doppler three-dimensional ultrasonography in identification of ophthalmic capillaries in human beings.² Basic information about natural Doppler signals of physical arteries should be studied, because the Doppler signals of capillaries in human beings and animals are specific and the vascular diagram alteration might be important in pathological aspects in both human and animals.³

In the research handled by "Rooma, et al (2005)" about studying acute and intensive normovolumic anemia and the slight and chronic normovolumic anemia on the arteries of dog's kidney, it was found that the amounts of Peak Systolic Velocity and vascular Resistance Index would significantly increase in acute / intensive normovolumic anemia, while the

Velocity at the end of Diastole would considerably decrease for the same disease. But in slight and chronic normovolumic anemia, no change in the aforementioned amounts was experienced.¹⁵

In the study carried out by “Lee, et al (2002)” on 18 alert and seated dogs, it was reported that there was no significant differences in Resistance index values and the Right and Left eyes, sex and species of the dogs. And also the resistance index is not related to the weight of studied bodies.⁹ These findings are equivalent with the present study and the researchers reported by “Greenfield, et al (1995)” and “Leib, et al – (1991)”.^{6,10}

Novellas, et al (2007) verified the duplex Doppler analysis to find differences between vascular resistance index and pulse strength index of kidney arteries and the long ciliary ophthalmic artery of a beagle dog, before and after injecting sedative drugs. The sedative used in the study was a compound of “Midazolam” and “Butorfanol”. It was defined that the assessed vascular resistance index and pulse strength index would considerably increase after injecting the sedative.¹²

In this present study we measured the parameters PSV, EDV, RI which shows no significant difference between the left and right eye of the Cats.

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بررسی داپلر پالسی سرخرگ خارجی و سرخرگ مژگانی بلند چشم در گربه

داریوش وثوق

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هدف- بررسی و مقایسه شاخص های حداکثر سرعت سیستولی (psv) ، سرعت در انتهای دیاستول (EDV) و شاخص مقاومت عروق (RI) در سرخرگ خارجی و سرخرگ خلفی مژگانی بلند چشم با استفاده از اولتراسونوگرافی داپلر پالسی دوبعدی چشم راست و چپ.

طرح مطالعه- مطالعه توصیفی

حیوانات- ۱۲ قلاده گربه نژاد مو کوتاه اهلی نر با وزن متوسط $3/9 \pm 0/9$ کیلوگرم و سالم که در معاینه کلینیکی، پاراکلینیکی و افتالموسکوپی هیچگونه علائم بیماری عمومی و چشمی را نشان نمی دادند.

روش کار- داپلر پالسی دوبعدی چشم با استفاده از ترانسدایوسر خطی مولتی فرکانس ۶-۱۲ مگاهرتز انجام شد. پس از مفروش نمودن سطح قرنیه با مقادیر کافی از ژل اولتراسونوگرافی استریل، ترانسدایوسر در حالت افقی بر روی چشم قرار داده - شد. مقادیر حداکثر سرعت سیستولی (PSV)، سرعت در انتهای دیاستول (EDV) و شاخص مقاومت عروقی (RI) در سرخرگ خارجی چشم (EOA) و سرخرگ خلفی مژگانی بلند (LPCA) توسط اولتراسونوگرافی داپلر پالسی دوبعدی در چشم راست و چپ بررسی شدند.

نتایج- نتایج نشان داد که در هیچکدام از رگ های مورد آزمایش، تفاوت معنی داری بین چشم چپ و راست گربه از نظر EDV، PSV و RI وجود ندارد ($P > 0/05$).

نتیجه گیری و کاربرد بالینی- در این تحقیق مشخص شد که این عروق در روش داپلر دو بعدی از میزان تکرار پذیری بالاتری برخوردار بوده و به راحتی قابل تشخیص می باشند و می توان در بررسی عوارض چشمی از این دورگ به عنوان مرجع استفاده کرد.

کلمات کلیدی- چشم، داپلر پالسی، سرخرگ، گربه.

