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Clinical Report

Ultrasonographic Findings of Unilateral Clinical Anophthalmia in a Puppy

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ABSTRACT

Anophthalmia refers to the most severe ocular congenital malformation that results from inadequate development of the primitive forebrain and is always associated with blindness. The exact etiology of anophthalmia is not well understood; however, heritable and environmental factors may be involved. A 2-month-old Asian Shepherd puppy was presented with the absence of one eye. The puppy was alert, responsive, and had a good body score. The eyelids with eyelashes and palpebral conjunctiva were bilaterally present. However, in the right eye, the palpebral fissure was narrow, and the orbit was shallow without a distinct globe. Further inspection revealed no ocular structures, although the left eye was ophthalmoscopically quite normal. Also, there were no cytologic characteristics of conjunctivitis in either eye. Using the transpalpebral ultrasonography technique, a semi-oval anechoic area without any obvious ocular chambers or structures was observed in the right eye, and finally, unilateral clinical anophthalmia was diagnosed. General physical examination revealed no other malformation. The long-term prognosis is favorable for this pup. However, surgical strategies (e.g., implants and expanders) can be used to improve cosmetic appearance.

Case Description

An 8-week-old male Asian shepherd dog was referred to the specialized veterinary hospital of Urmia University with the owner's complaint about the absence of one eye. General physical examination showed ideal body condition, euhydration, and normal vital signs. Also, the CBC parameters were within the reference range (Table 1).

In the close inspection of the right eye, only the eyelids with cilia and palpebral conjunctiva were visible, and the superficial structures of the globe (such as the cornea and iris) were not present (Figure 1). The left eye was ophthalmoscopically normal. Palpation of the periorbital tissues did not reveal painful or swollen areas in both eyes. However, during digital palpation of the right eye residual tissue through closed eyelids, the intraocular pressure and the integrity of the globe structures (similar to the left eye) were not determined. Sterile swabs that were taken for cytological evaluation of the right eye conjunctiva revealed numerous noncornified squamous cells without any signs of conjunctivitis (Figure 2).

The transpalpebral technique was used to evaluate both eyes ultrasonographically, as previously described by Vali and Razeghi in 2019.[1] Using a 12 MHz

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transducer (Sonoscape, China), the eye chambers' depth and lens thickness were measured. The B-mode images of the right eye show a semi-oval anechoic area (axial length about 11.6 mm) without any distinct chamber or fibrous and vascular layers, which can explain why the semirigid shape of the eyeball is not preserved. However, a mispositioned lens-like echogenicity (diameter about 3.4 mm) was observed in the equator pole. In the left eye, the global shape was clearly preserved, and the anterior chamber depth, lens thickness and axial globe length were well-measured, as indicated in the Figure 3.

Finally, based on physical and ultrasonographic findings, unilateral clinical anophthalmia was diagnosed. Also, no further structural abnormalities were revealed in other body organs.

Table 1. Complete blood count parameters of the anophthalmic puppy.

Parameter	Value	Unit	Normal Range
White blood cells	9	$\times 10^{-3}$/ml	5.3-19.8
Red blood cells	5.7	$\times 10^{-6}$/µl	5.83-8.87
Hemoglobin	15.4	g/dl	13.3-20.5
Hematocrit	43	%	40.3-60.3
Mean corpuscular volume	66.8	fl	62.7-75.5
Mean corpuscular hemoglobin	26.3	pg	22.5-26.9
Mean corpuscular hemoglobin concentration	32.8	g/dl	32.3-36.3
Red cell distribution width	14.1	g/dl	13.2-17.4
Lymphocytes	1.3	$\times 10^{-3}$/ml	0.9-5.5
Monocytes	0.3	$\times 10^{-3}$/ml	0.1-1.4
Eosinophils	0.2	$\times 10^{-3}$/ml	0.0-1.6
Basophils	0.0	$\times 10^{-3}$/ml	0.0-0.1
Segmented neutrophils	7.9	$\times 10^{-3}$/ml	3.1-14.4
Platelets	221	$\times 10^{-3}$/ml	177-398

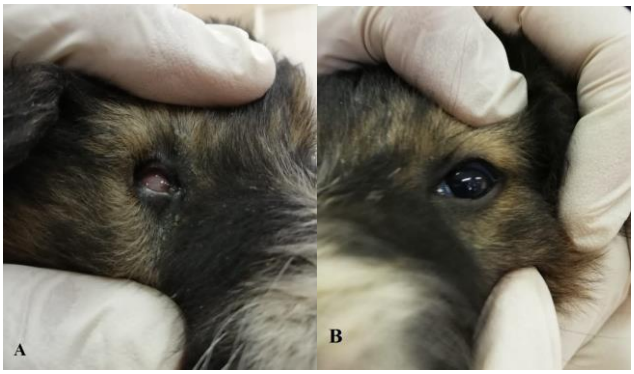

Figure 1. Anophthalmic (A) and normal eye (B) of the puppy.

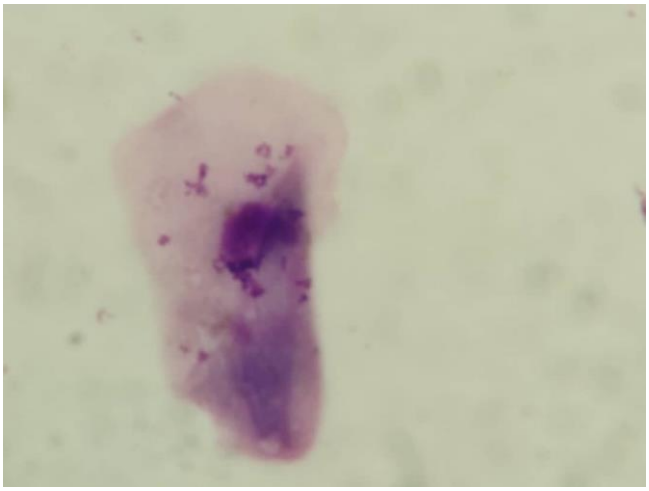

Figure 2. An epithelial cell containing melanin granules in the smear of the right eye conjunctiva (Wright stain, 1000×).

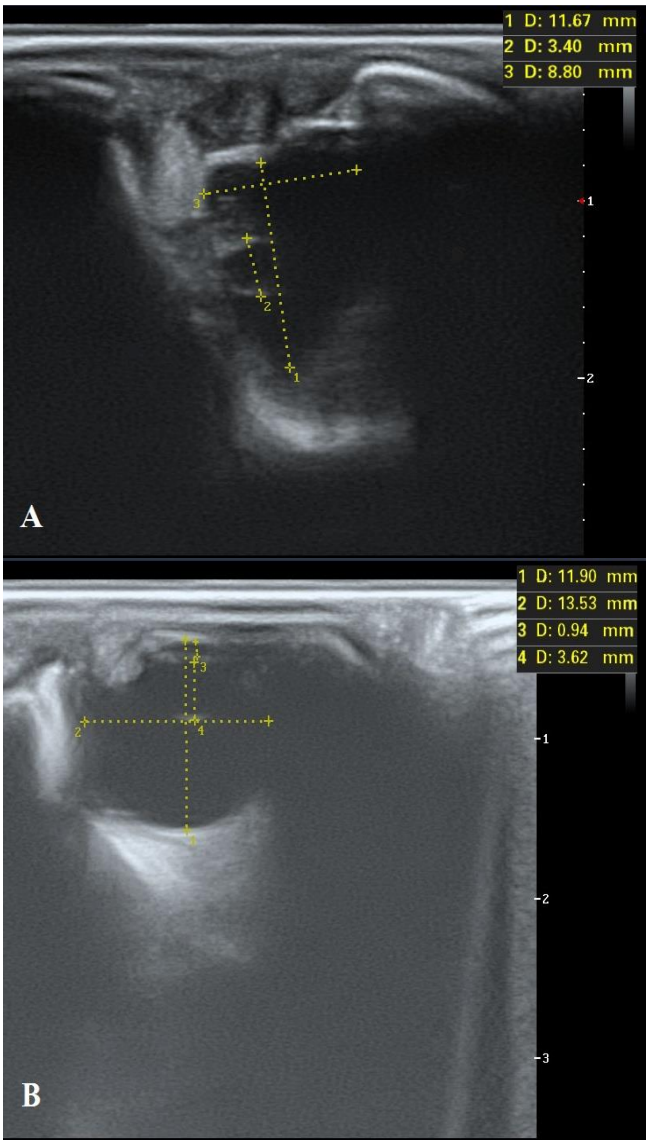

Figure 3. Transpalpebral ultrasonographic image of anophthalmic eye (A) and normal eye (B) of the puppy.

Treatment and outcome

Clinical congenital anophthalmia usually has a negligible visual performance and is a challenging malformation to manage. Surgical management can be the cornerstone of anophthalmia treatment. The goal of treatment is to improve cosmetic appearance rather than visual performance. In human ophthalmology, reconstructive strategies (such as implants and prostheses) are considered from the first weeks of life.[2] In veterinary ophthalmology, orbital prostheses have been associated with a high success rate; however, the client refused due to the costs related to surgery and emotional resistance to enucleation. Although this structural abnormality causes blindness, even animals with bilateral anophthalmia can have quality life and welfare.[3] Therefore, the prognosis of this puppy can be favorable. However, periodic examinations were recommended, as other possible associated malformations may not be detected during the neonatal period.

Clinical Relevance

Anophthalmia is an extremely rare congenital ocular malformation that can be unilateral or bilateral (more commonly) and represents the absence of the globe in the presence of ocular adnexa (conjunctiva, eyelids, and lacrimal apparatus). The estimated incidence of anophthalmia is 0.18 to 0.4/10000 births. Complete anophthalmia is uncommon, and some residual ocular tissue may often be identified through post-mortem examination.[4-6]

Canine ocular development begins around the third week of pregnancy, and there are many opportunities for occurring developmental malformations in the fetal period. Three fetal tissues are involved in the normal development of the eyes: surface ectoderm of the head, mesenchymal tissue of neural crest origin, and neuroectoderm of the forebrain. These tissues' continuous development and interaction lead to normal ocular growth.[5,7]

Anophthalmia usually occurs associated with other congenital malformations, especially involving the musculoskeletal, cardiac, and central nervous systems. Despite the clinical importance of anophthalmia, its exact etiology is complex and poorly understood.[7] However, chromosomal, monogenic and environmental causes are recognized in some human and laboratory animal studies.[2] The most common chromosomal syndrome related to anophthalmia is trisomy 13.[8] Clinically relevant genes related to anophthalmia include SOX2, PAX6, VSX2, OTX2, BMP4, STRA6, SMOC1, and HCSS. Currently, mutated SOX2 represents the most commonly involved gene.[4,9] Proven environmental causes include maternal infections such as toxoplasmosis, rubella, cytomegalovirus, varicella, parvovirus, and influenza, as well as noninfectious ones such as vitamin A deficiency, folate deficiency, hyperthermia, exposure to X-rays, and use of NSAIDs.[10,8,2]

Anophthalmia is diagnosed based on clinical and imaging findings, and confirmed according to post-mortem histopathologic examination.[2] The term "true anophthalmia" should only be used when there is a histopathologic confirmation; however, "clinical anophthalmia" indicates the absence of a recognizable globe on examination and ultrasonography.[11,4]

Ultrasound, as the most accurate tool for diagnosing this congenital malformation, can be useful for evaluating the intraocular structures and the presence of residual ocular tissues.[3,6] In this study, we used the transpalpebral technique because it is easier to perform than the transcorneal technique, and the possibility of corneal damage is less.[1] Further studies are needed to understand the underlying causes of this significant congenital malformation in veterinary medicine.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

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