

## Severe Bilateral Microphthalmia in a Holstein Calf

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**Abstract :** This report described a severe bilateral microphthalmia in a young Holstein calf. The anomalous calf with wry tail showed normal vigor, appetite and normal body weight except for eye defect. The orbits were shallower and smaller than normal. The orbit bilaterally contained a white small mass suspected as eyeball. A spot-like remnant of eyeball (REB) was buried in the mixture of vestigial extraocular muscles and adipose tissue of the bilateral orbit. Histologically, the REB was composed of irregularly arranged elements of ocular wall such as sclera, retina and ciliary body. But any destructive changes in the central nervous systems were not detected. This case of eye defect was defined as severe bilateral microphthalmia. The cause of this ocular defect is unknown.

**Key words :** microphthalmia, ocular defect, eye, Holstein calf.

### Introduction

Microphthalmia, an abnormally small globe, has been described in all species and has the highest described incidence in pigs and dogs (10,13). Microphthalmia-anophthalmia in cattle has been considered as a congenital anomaly, the incidence of which has been estimated to be low some variations according to breeds (6,10). Incidence of congenital defects among all calves ranged from 0.2 to 3.0 percent, with 40 to 50 percent of these animals being still-born (5). Frequency of anophthalmia-microphthalmia has been estimated for all breeds of cattle in the United States to range from as low as 1 in 50,000 births to as high as 1 in 7,500 births (5). This defect has been associated with maternal vitamin A deficiency, intrauterine bovine virus diarrhea - mucosal disease (DVD-MD) infection, hereditary etiology, and an unknown etiology (2,3,6,7,13). The incidence and detailed information on its morphological changes has been reported in Japan, German and USA (1,6,8), however, any reports involved it except human (4) was not available in Korea. In this paper, bilateral microphthalmia in a Holstein calf was morphologically examined and discussed.

### Case

The calf was born at full term with normal body weight (45 kg) at National Institute of Animal Science in Jan 2007. The newborn calf had normal vigor and appetite, but this

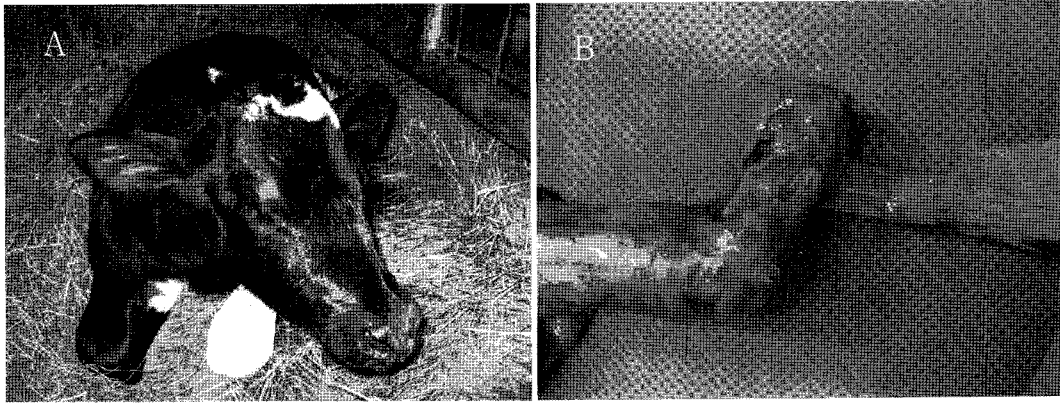
male calf couldn't stand by himself owing to eyes defects. The abnormality was associated with wry tail (Fig 1). The right eyelids were significantly smaller both horizontally and vertically compared to the normal size. Also, the distance between the lid lashes and the brow was proportionally reduced. The lacrimal glands were normally developed but the nictitating membranes did not detectable. The palpebral fissure was closed and contracted (Fig 2). The diminished palpebral fissure made the examination of the cavity very difficult.

By autopsy, the orbits were shallower and smaller than normal. The sizes of right and left orbit were 2 cm × 1.2 cm and 2.5 cm × 1.5 cm, respectively. The orbit bilaterally contained a white small mass suspected as eyeball. A spot-like remnant of eyeball (REB) was buried in the mixture of vestigial extraocular muscles and adipose tissue of the bilateral orbit (Fig 3). REB is recognized as an irregular mass of black pigment and right REB was smaller than left one. The REB was histologically composed of irregularly arranged elements of ocular wall such as sclera, retina and ciliary body (Fig 4). Destructive changes in the central nervous systems were not detected.

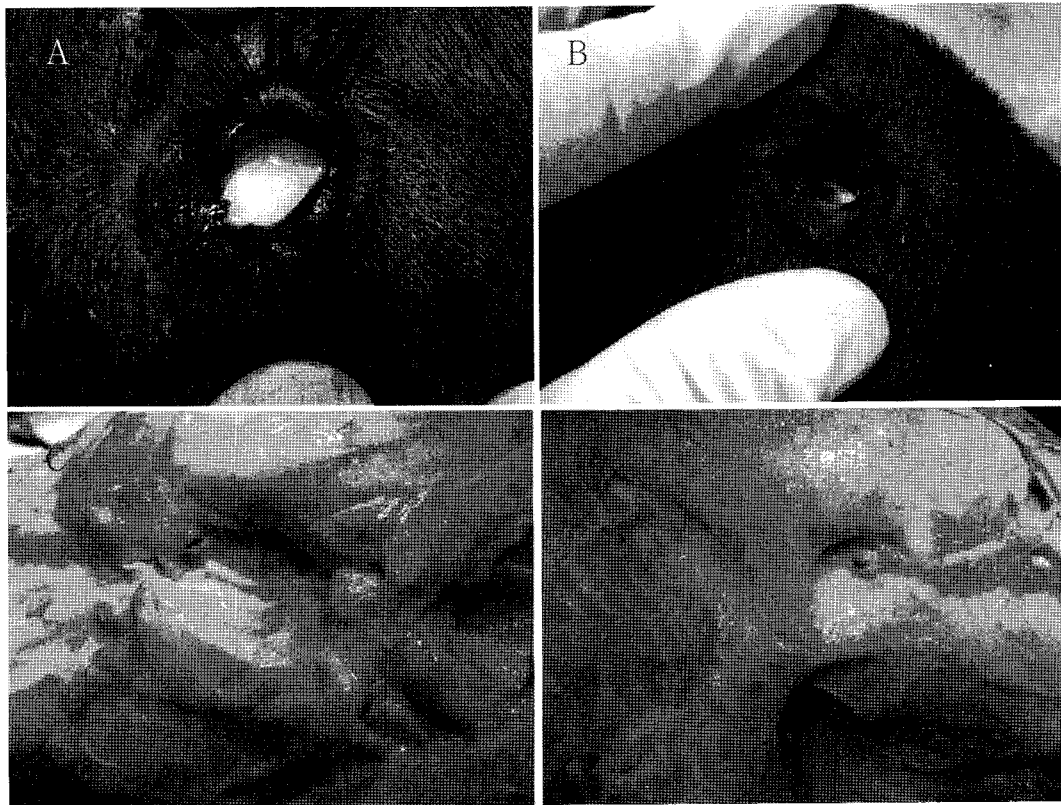
### Discussion

Microphthalmia is an abnormally small globe and has been described in all species (13). Phenotypic classification of microphthalmos divide into total and partial microphthalmos (2). Total microphthalmos is where both anterior and posterior segments are foreshortened. Partial microphthalmos is where either anterior or posterior segment is malformed. Total microphthalmos include congenital cystic eye, anoph-

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**Fig 1.** The blinded calf couldn't stand alone (A) and have a wry tail (B).



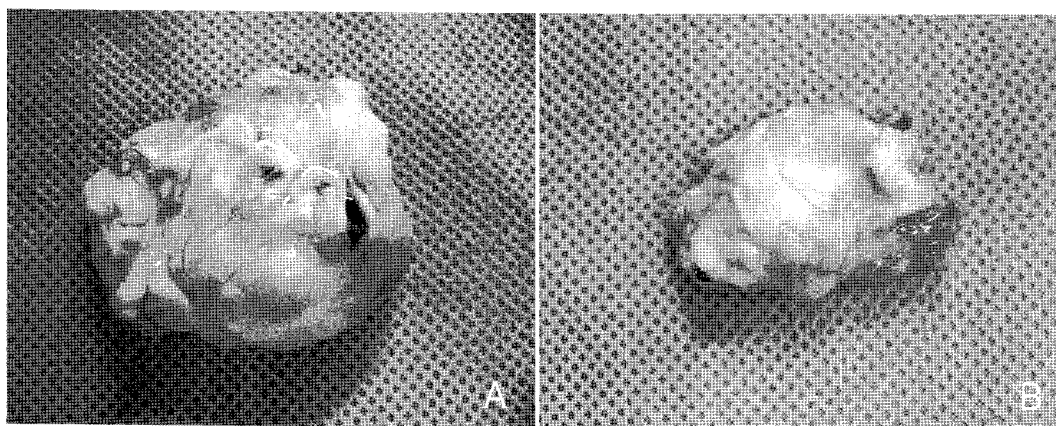
**Fig 2.** The eyeballs could not be observed in the eyes of the anomalous calf, left side (A, C) and right side (B, D). The eyelids (A, B) were undersized and palpebral fissure (C, D) markedly narrowed.

thalmos, simple microphthalmos without other major malformations, microphthalmos with intraocular malformation (congenital cataract, anterior chamber malformations, coloboma) and multiple ocular malformations.

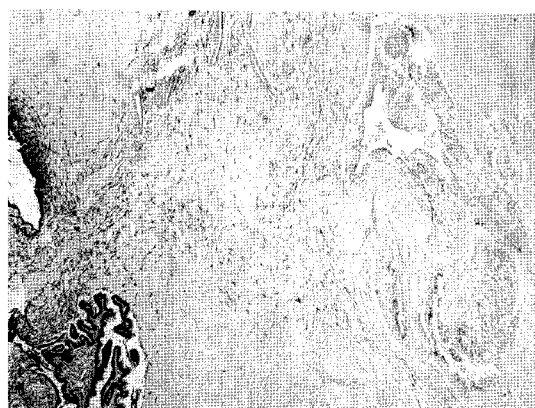
Generally, microphthalmia is accompanied by other defects or anomalies of the ocular structures, and retinal detachment is a commonly associated defect (12). In cases of mild to moderate microphthalmia the orbit, eyelids, and conjunctiva are well formed, but in cases of severe microphthalmia and congenital anophthalmia, body orbit growth can be considerably retarded. Anophthalmia is total absence of ocular tissue

and is a very rare lesion. Anophthalmia is the clinical term for extreme microphthalmos where ocular structures can be found only by serial histopathological sections (12). Therefore, almost all cases described with anophthalmia are more correctly termed severe microphthalmia. The usefulness of distinguishing between the two is questionable, and many authors (8,9,11) have adopted the term "clinical anophthalmia" for all such cases.

Anophthalmia and microphthalmia may occur secondary to the arrest of development of the eye at various stages of growth of the optic vesicle (6,12). Anophthalmia occurs



**Fig 3.** The orbit had a spot-like remnant of eyeball in the mixture of vestigial extraocular muscles and adipose tissue, left eye (A) and right eye (B).



**Fig 4.** Histological section of the region of spot-like remnant of eyeball. Microphthalmic globe with multiple ocular anomalies, including retinal dysplasia and iris hypoplasia. Hematoxylin-eosin (H&E) stain, magnification  $\times 30$ .

when the neuroectoderm of the primary optic vesicle fails to develop properly from the anterior neural plate of the neural tube during embryological development. The more commonly seen microphthalmia can result from a problem in development of the globe at any stage of growth of the optic vesicle. Moritomo (8) suggested that the development of error of the eye might be concomitantly accompanied by the hypoplasia of the optic tract and chiasma in the brain, narrowing of the orbit, constriction of the optic groove and patency of the optic foramina in the cranium, diminution of the eyelids, and narrowing of the palpebral fissures. Some cases of clinical anophthalmia are degenerative in type because optic rudimentals are present early, but these degenerated animals are born with clinical anophthalmia. Histologically, complete absence of ocular tissue is uncommon because some rudiments can usually be recognized. The recent reports in anophthalmia Japanese Brown calves with caudal vertebral anomalies (9) and unilateral anophthalmia in a Holstein calf (9) also could be seen a recognizable rudimental globes. In this case, we defined as clinical anophthalmia

because the eyeballs were not seen in an anomalous calf. But small white masses were found in the orbit space by autopsy. The REB was buried in the mixture of vestigial extraocular muscles and adipose tissue of the bilateral orbit. Histologically, there is almost always a mass of pigmented neuroectoderm, reminiscent of ciliary processes, and some effort at retinal differentiation. There is frequently some remnant of lens, a finding that suggests regression of an embryonic globe that had reached at least the stage of optic cup (12,13). Any destructive changes were not detected in the central nervous systems in this case. Thus, the state of the eye defect in calf was defined as severe bilateral microphthalmia.

In calves ocular defects may be associated with vertebral defects from the lumbar to the sacral areas or high ventricular septal defects (5). The defects of the vertebral body and the caudal portions of the spinal column including taillessness have been observed in Japanese Brown calves and several dairy and beef cattle breeds (6,9). In this case, ocular defect calf only showed wry tail.

An etiological class of microphthalmos are genetic (monogenic and chromosomal), prenatally acquired (teratogenic disruptive causes and deformations), and associations (12). The causes of congenital anophthalmia-microphthalmia syndrome in cattle is not known. However, many researchers suggested that anophthalmia-microphthalmia syndrome has been associated with maternal vitamin A deficiency, intrauterine BVD-MD infection, and an unknown etiology (2,6,7), but others supposed that microphthalmia and ocular disease caused by hereditary etiology (1,3,11). In this case, the mother of anomalous calf had never delivered abnormal calves. She was good in health condition and didn't receive any medical treatment during pregnancy. Destructive changes in the central nervous systems and cerebellar hypoplasia were not identified, or mother of anomalous calf was vaccinated against BVD-MD and Akabane virus infection. Thus it was impossible to relate the morphological changes in the examined case to these viral infections. However, the cause of this ocular defect was unknown.

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