Some Infectious and Non Infectious Eye Affection Syndrome in Fish

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Abstract: Fish eye syndrome affection is a nonspecific clinical sign of either primary local or systemic diseases; thus not considered diagnostic for any specific disease. The syndrome should be associated with various etiological factors such as bacterial, viral and nutritional**.** Therefore, eye diseases are more prominent among cultured than wild fish. The most common syndromes affecting wild fish are exophthalmos (pop-eye) while those recorded in cultured one are exophthalmos and enophthalmos (sunken-eye). The syndrome is associated with various infectious causes including bacterial, fungal and viral or noninfectious including nutritional causes. The epidemiology of these syndromes depends on the cause of infection of the eye in both wild and cultured fishes of all species and ages. Also, the diagnosis of these syndromes depends on: case-history, behavioral abnormalities and clinical examination (clinical signs and laboratory diagnosis). Histopathological examinations of eye syndromes affecting wild and cultured fish are graded from inflammation in acute form (bacterial and traumatic causes) to cataracts and keratitis in chronic form (parasitic and nutritional causes), retinitis, uveitis and vacuoles (virus causes), retro-retinal gas bubbles (GBD) or neoplasma (unknown causes). Prevention and control of fish eyes syndrome depends on strict hygienic measures including the use of prophylactic treatment of parasitic, bacterial or fungal infections, specific vaccine and biological control. Treatment and removal of the causative agent are considered to be the most important factor in treating these diseases. Pathogeneses, prevention and treatment are described. The present review was planned to disseminate knowledge on fish eyes syndrome in wild and cultured fish to stimulate further explanatory research that contribute in establishing a new effective strategy for prevention and control.

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1. Introduction

Fish eye considers a very important organ, and adapted for vision in air as well as water and do display some differences to the mammalian eyes **(Noor El –Deen *et al*., 2012).** Ocular diseases of fish are common and represent a significant problem within the aquaculture industry and ophthalmic diseases may be off food and leading to retard of growth **(Noor El- Deen, 2007).** The most common septicaemic bacteriasuch as *Aermonas hydrophila, Vibro, Pseudomonas fluroescens*, *Streptococcus sp,* and *Staphylococcus sp.*, fungal such as *Saprolegnia sp., Ichthyophonushoferi*and *Candida tropicalis* and viral infections such as *Lymphocystis virus, noda virus, viral haemoragic septicemia, Spring viremia of carp, and Sleeping* disease are causing eyes exophthalmia and pop-eye. The common causes are high levels of calcium, sodium, phosphorus, deficiency of vitamins (A, B, C and E) and deficiency of riboflavin, sulfer containing amino acids, tryptophan and zinc. **(El-Khatib, 1998,** and **Eissa*et al.,* 2010).** Cataracts were appeared with nutritional deficiency **(Deb *et al.,*1990** and **Bjerkas and Bjornestad,1999).** The pathogenesis differs according to the route of infection **(Eissa, 2004).**The use of traditional medicinal plants which control some bacterial and fungal pathogens **(Noor El- Deen and Razin, 2010** and **Noor El –Deen *et al*.,2011).** In Egypt, many studies reported the eye syndrome affections among wild and cultured Nile tilapia fish **(Eissa *et al*., 2000 and Ibrahim, 2000).**

2. Aeitology of eye syndrome affection

2-1-In wild fish:-

2-1-1-Infectious causes.

2-1-1-1- Bacteria infections.

Pseudomonas angulliseptica was isolated from Baltic herring *Clupeaharengus*sp causing hemorrhages in the eyes. This fish was caught from southwest coast of Finland **(Loennstroem *et al.,* 1994).** Also, *vibro hareyi* isolated from milk fish (Chanoschanos) observing an eye disease in the Philippines **(Ishemaru and Muroga, 1997).** Moreover, **El-Khatib(1998)**isolated *Aermonas hydrophila, Streptococcus sp,* and *Staphylococcus sp.*from Nile tilapia in River Nile showing exophthalmia. Also, *Yersinia ruckeri* isolated from eyes**.**

Streptococcosis affects *Oreochromis* sp. as well as greymullets (*Mugilcephalus*and *Liza ramada*), silvercarp andcoldwater reared rainbowtroutcausing haemmorhagic lesions on the body, exophthalamus,corneal opacity, some macroscopic changes in the liverand spleen, and ascites (dropsy) with mucoidinflammation of the gut(**Abowei** and **Briyai, 2011).**

Eye lesions are usually observed in most of systemic bacterial diseases. *Vibro anguillarum* was isolated from wild herring in Norway which appeared inflamed eyes **(Hastein,1977).***Vibro harveyi* isolation of from an ocular lesion of a short sunfish *(Maki inola)*The lesion was due to biting by common seabream *(Sparta auriga)* and blue spotted seabream *(Sparuscaeruleostictus)*. **(Hispano *et al.,* 1997, Kraxberger-Beatty *et al.,* 1990).**Also, *Aeromonas hydrophila* and *Pseudomonas fluroescens* causing peticeal hemorrhage of the skin and fin and oedema around eyes **(Eissa *et al*., 2000 and Stojanove *et al*., 2010).**

2-1-1-2-Fungal infections.

Fungal infection eye causes cornal opacity or cotton wall tuft and pope eye.

Fungal infections of the eye give rise to severe ocular morbidity and blindness include keratitis, orbital cellulites, endophthalmitis and corneal blindness **(Nayak, 2008).** Cottony growth on the eye of Nile tilapia was infested with Saprolegnia sp or pop-eye on *Oreochromis niloticus*was infested with *Ichthyophonushoferi***(El-Khatib, 1998).**

Saprolegnia sp., Ichthyophonus hoferi and *Candida tropicalis* causing skin, fin and eye affections. Tilapia and *Mugil* fingerlings infected with *Saprolegniosis* showed cotton tuft on fins and skin **(Noor El-Deen *et al.*,2011)**.

2-1-1-3-Viral infections.

Lymphocystis virus, nodavirus, viral haemoragic septicemia, Springviremia of carp, and Sleeping disease are reported viruses which incriminated in eye affections in wild fish.

Lymphocystis cell were found behind or in one or both eyes and cornea or adjacent shin surfaces. A retrobullbar mass produced extreme exophthalmos **(Dukes** and **Lawler, 1975).**

A nodavirus isolated from the brain and eye tissues of Juvenile cod *Gadusmorhua* in Nova Scotia. These fish showed the classic signs of viral encephalopathy and retinopathy and exophthalmia may be seen in one or both eyes in atlantic salmon infected with Viral haemoragic septicemia and can be haemorrhage around the eye orbit **(Woo, 2006).**

External signs of Spring viremia of carp in commen carp, include swollen belly, exophthalmos and petechial haemorrhage in anterior eye chamber **(Noga, 2010).**

2-2- in cultured fishes:-

2-2-1- Infectious causes.

2-2-1-1- Bacteria infections.

One type or combination of bacterial species were responsible for eye affection syndrome in cultivated fishes. They included *vibrio harveyi*and *unidentified vibrio sp., Aeromonas hydrophila* and *A. Salmonicida, Staphylococcus aureus, Mycobacterium neoaurum, corynibactrium aquaticum, Flexibacter psychrophilus, Pseudomonas sp., unidentified Rhodococcus sp.* and other unclassified bacteria.

Streptococcosis caused by different genera and species capable of inducing suppurative exophthalmia ("pop-eye") **(Evans *et al.* (2000)**.Staphylococcus aureus isolated from 13.5 and 38.8% of cultured *Oreochromis niloticus* showing complete and incomplete eye cataract respectively. Meanwhile, Streptococcus sp. was recovered from 1.35, 5.55 and 8% of fish having complete and incomplete eye cataract and exophthalmia in that order. Moreover, Corynebacterium sp. was obtained from 1.35 and 36% of fish suffering from complete eye cataract and exophthalmia respectively **(El-Khodary 1995).** *Vibrio harveyi* isolated from an ocular lesions in a short sunfish (*Molamola*) (Hispano *et al.,* 1997). *Flexibacterpsychrophilus* isolated from Ontario fish having bilateral exophthalmia and intraocular hemorrhage **(Ostland*et al.*, 1997).***A.hydrophila, Staphylococcus sp. and Streptococcus sp*. isolated from cultured *O.niloticus* showing pop-eye **(El-Khatib, 1998** and**Austin and Austin, 2007).**

Vibrio parahaemolyticus, Vibrio anguillarum and Aeromonas salmonicida were the etiological agents of cataract and exophthalmia in the ornamental marine aquarium fishes from Andoman **(Shome*et al.,* 1999).***Staphylococcus aureus* isolated from 20% and 11% of cultivated *O. niloticus* displaying complete and incomplete eye cataract respectively **(Eisaa *et al.,*2000).** In addition, Streptococcus sp. was recovered from 4.05, 2.77 and 3.63 % of samples having complete and incomplete eye cataract and exophthalmia in that order. At the same time, Corynebacterium sp. was obtained from 4.05 and 18.2 % complete eye cataract and exophthalmia respectively. On the other hand, *Pseudomonas sp*. was recovered from red tilapia displayed exophthalmia disease **(Ji*et al.,* 2000).**

Some types of opportunistic and obligatory bacteria were incriminated in provoking eye disorders among other.

Pseudomonas anguilli septica were isolated from Baltic herring *Clupeaharengusmembras*L. Caught on the southwest coast of Finland and showing hemorrhages in the eyes. The major external sign of disease in affected herring was hemorrhages in the eyes. The cornea was punctured in some of the fish. Other clinical signs included hemorrhages in the fins and on the head. Accumulation of blood-stained ascites was seen in several of the fish examined **(Loennstroem*et al*., 1994).**

Moustafa*et al.* (2010) examined *Tilapia zilli* native to Qarun Lake at El-Fayoum governorate throughout the different year seasons. Gram positive and negative fish pathogenic bacteria were isolated from a total of 245 fish sample, among those samples S. *aureus* were determined and described the clinical signs in tilapia fish that include exophthalmia.

2-2-1-2- Fungal infections.

The causative fungi for the initial keratitis were *Fusarium* and *Aspergillus* species**(Kanal*et al.*, 2005).** *Saprolegnia sp., Ichthyophonushoferi*and *Candida tropicalis* were recorded from cultured fishes exhibiting eye lesions**.** *Saprolegnia sp***.** isolated from the eye of cultured fish at the Kainji Lake Research Institute in hatchery period **(Okaeme*et al.,* 1988).**

Ichthyophonus hoferi isolated from the eye of cultured *O. niloticus* showing pope eye **(El-Khatib,1998).**

Candida tropicalis isolated from cultured *O.niloticus* showing pope eye **(Eissa, 2000).**

Systemic infection with *Aspergillus flavus* is associated with eye affections and others in captive fishes.

The *Oreochromis niloticus* which fed *Aspergillus flavus* contaminated diet became inactive, dark and oedematous Also, exophalmia with corneal changes was common **(Olufemi** and **Roberts, 1989).**

2-2-1-3-Viral infections.

Lymphocystis is generally known as a benign, unique, giant cell disease fishes of silver perch *(Bardiellachrysura)* were captured from the estuarine waters of Mississippi Sound in Davis Bayou off Ocean Springs, Mississippi causing nodules on the skin and fins. It has been studied extensively because of the virus-host cell relationship that results in extreme size and lack of quick cellular destruction or stimulation to neoplasma caused by Lymphocystis virus. Lymphocystis cells were found behind or in one or both eyes and were also found on the cornea or adjacent skin surfaces. A retrobulbar mass produced extreme exophthalmos. Uveal (choroid and iris) masses were present in most cases. Optic nerve involvement was also seen. It is probable that the virus reached the eye by the blood with the resulting masses forming in situ rather than by direct extension from skin lesions**(Dukes** and **Lawler, 1975).**

Retinal lesions have also been described in juvenilesEuropean seabass where the eye has been examined **(Munday*et al.,* 2002).**Also, **(Grotmol*et al.*, 1997)**described an opthalmitis involving both theanterior and posterior chambers reared Atlanticsalmon*Salmosalar*.

2-2-2- Non infectious causes.

2-2-2-1-Nutritional causes.

Many micro and macro dietary elements play an important role in the development of eye syndrome disorders. The common ones are high levels of calcium, sodium, phosphorus, deficiency of vitamins (A, B, C and E) and deficiency of riboflavin, sulfer containing amino acids, tryptophan and zinc.

The severity of cataracts were increased in hatchery rain trout *(Salmogairdneri)* fed diet with amixture of minerals (phosphate, calcium carbonate,sodium and potassium). Cataracts were diasapeared with supplement vitamins and zinc **(Deb *et al.*,1990).**

The detailed anatomy and histopathology of an asymmetrical degenerative condition of the eye of young rainbow trout *(Salmogairdneri)* held in stew ponds on the Zomba plateau, Malawi, Central Africa, is described. The condition begins as a grayish haze on the cornea progressing to cataract and ultimately the entire ocular tissue becomes phthisical, leaving an empty socket. No evidence for an infectious etiology was adduced, but in view of the irregular.Feeding regime with a high level of raw animal viscera in the diet, it was considered that the condition could well be similar to the nutritional cataracts described for other species on such diets, although in such an isolated population a genetic predisposition could not be ruled out **(Lee*et al.*, 1976).** Hypervitaminosis (A) in fish causes slow growth, blindness, exophthalmia and haemorrhages**(Hermann, 1995)**.Trace elements are important components of hormones, enzymes and enzyme activators. Unlike most aquatic organisms absorb inorganic elements from their external aquatic environment. An excessive intake of minerals through either the diet or gill uptake can cause toxicity, and therefore a fine balance between mineral deficiency and surplus is vital for aquatic organisms to maintain their homeostasis through either increased absorption or increased excretion **(Lall, 2007; Lall** and **Milley, 2007).**

3- Pathogenesis of eye affection syndrome

Histologically, corneal epithelial ulceration and heterophilic keratitis, disruption, mineralization, and detachment of Bowman's membrane, thinning, disorganization, mineralization and fibrosis of the corneal substantiapropria, and focal thinning and mineralization of mild heterophilic and mononuclear anterior uveitis was also present. Based on the present observations **(Borucinska*et al.*,1998).**A large mass of typical lymphocystis cells extended into the ocular muscles. Some muscle degeneration was evident. The mass was about the size of the globe and was entirely outside the scleral cartilage. Some of the lymphocystis cells were collapsed and extremely basophilic and mononuclear inflammatory cells were present at the periphery of the mass.**(Dukes** and **Lawler 1975).**The histopathology of the naturally developing granulomas characteristic for fish mycobacterial infections has been the subject of extensive research**.** Additional signs may include exophthalmoses (bulging eyes **(Astrofsky *et al.,* 2000).** Ocular enucleation, persistent corneal cataracts and supportive panopthalmitis are the dramatic sequel of GBD **(Woo, 2006)**. On the other hand, the ocular cataracts after seawater exposure of yearling salmonids seem to arise from structural damage of cortical fibers **(Iwataet *al.*, 1987)** as a result of exposure to hypertonic solution and defective osmoregulation is suspected **(Bjerkaset *al.*, 2003).** Finally, in pathogenesis of eye affection syndrome, whatever the scenario, eye disorders are still the most striking result

4. Diagnosis of eye affection syndrome

1- Case History:-

Such as recent stress exposure, uneaten food, single food item.

2- Clinical examination:-

Fish should examined firstly in situ for detection of any behaviour changes, then representative fish sample was taken and fish were inspected individually for detecting gross lesions.The exophthalmia as a result of an edema **(Austin and Austin, 2007** and **Sevki*et al.,* 2009). Russo *et al.* (2006)** recorded that affected fish with streptococcosis may exhibit one or more of the following clinical signs: unilateral or bilateral exophthalmia and corneal opacity. Haemorrhages were distributed in or around the eyes.

A- Behaviour abnormalities:-

Fish floating to water surface **(Karvonen*et al.*, 2001),** reduced feeding rates and amounts **(Midtlyng*et al.*, 1999),** increase in time devoted to feeding **(Crowden**and **Broom, 1980),** random swimming into objects **(Karlsbakk*et al.*, 2002)** andsluggish movement **(Ness** and **Foster, 1999).**

B- Clinical signs:-

Stunted growth **(Ersdal*et al.*, 2001),** acute or chronic mortality **(Sogma*et al.*, 1999),** sunken eye, endophthalmos, **(Noor El -Deen, 2007)**,unilateral or bilateral eye protrusion, exophthalmos, **(Vaszuez-Gombo*aet al.*, 2001)**Fig (1), hemorrhages in the eyes **(El-Khatib 1998),** inflammation of the eyes (Panophthalmitis) **(Backman *et al.*, 1990),** haemorrhages around the eye **(Kocan *et al.*, 1997).**

A **B**

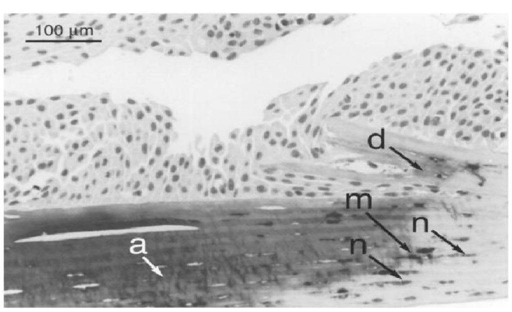
Figure(1): A- *Lactococcusgarvieae unilateral exophthalmos* **B-** *Aeromonashydrophila-Bilateral exophthalmos- In A yellowtail*

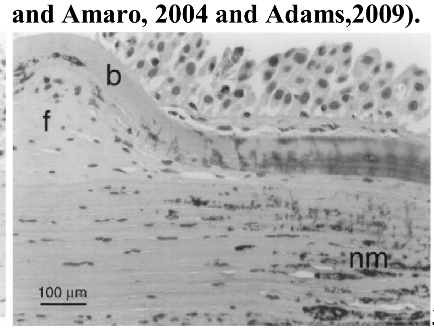
3- Laboratory diagnosis.

Depend on bacterial, fungal and viral examination **(Noga., 2010).**

Commercial diagnostic kits based on slide agglutination or an ELISA test for a fast diagnosis of vibriosis and *A.hydrophila* are available **(Sanjuan and Amaro, 2004 and Adams,2009).**

2

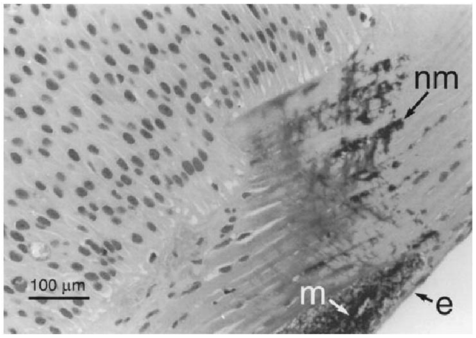




3

Figure(2): The cornea (cross-section) of a Greenland shark within the focus of opacity. Note the epithelial disorganization, and the reepithelialization, disruption and hyalinization of the stromal fibres (d), the accentuation of the suturalfibre complex (a), and the necrosis(n) and mineralization (m) of the keratinocytes **(Borucinska *et al.*,1998)**.

Figure (3): The cornea (cross-section) of a Greenland shark within the focus of opacity. Note the thickening of Bowman's membrane (b) over an area of severe stromal fibroplasia (f). Stromal necrosis and mineralization (nm) extend into Descement's membrane **(Borucinska*et al.*,1998).**

4 

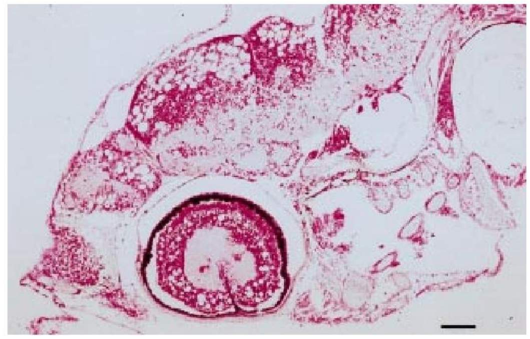
 5

Figure (4): The cornea (cross-section) of a Greenland shark within the focus of opacity. Note the severe stromal lesions including mineralization within Descement's membrane (m) separating the latter from the corneal endothelium (e): (n) stromal necrosis; and (m) mineralization **(Borucinska*et al.*, 1998)**.
Figure (5): Barramundi larva with anodavirus infection. Notesevere vacuolation of the brain and retina (H & E, bar =100 gm) **(Munday*et al.*, 2002).**

5. Prevention and control of eye syndrome affection

Quarantine of new fish and good sanitation practices should be used at all times. Tanks and culture facilities should be kept clean and free of any unnecessary wastes. On suspension of nutritional deficiency as a cause of eye lesion, it is advisable to change the diet **(Noga, 2010).**Stress factors must be avoided with added to the feed anti stress substances such as ascorbic acid **(Taoka*et al.*, 2006)** or injection in cultured trout (Scophthalmusmaximus L) suffering from granulomatous tyrosinemia rapidly lead to reduced eye lesions **(Messager, 1986).**Aerating the water sources in a reservoir to allow it to equilibrate with air or stripping of excess gas by using vaccum degassers were also recommended **(Colt *etal*., 1986).**Dealing with eye affection associated with bacterial infections, numerous antibiotics were recommended for controlling of this condition. An oral antibiotic OxytetracyclineHCl (150 mg/kg body weight) for one week were effective for forVibriosis curing in the flounder Paralichthysadspersus in capacity **(Miranda** and **Rojas, 1996).**Terramycin contains the antibiotic oxytetracycline which used for fish in a sinking feed and should be fed for 10 days. Also sulfonamide which contains two drugs, sulfadimethoxine and ormetoprim which used for fish in a floating feed and should be fed for 5 days. The isolates were also sensitive for flumequine and oxolinic acid **(Peggy and Ruth, 2009).**The short sunfish showed a complete recuperation of the infected lesion when the oral antibiotic treatment was changed to trimethoprim+sulfa (6 mg/kg/day of trimethoprim plus 30 mg/kg/day of sulfadimethoxine) for 10 days, followed by 5 days of rest and then 7 more days of treatment. Additionally, a topical administration of gentamycin (3 mg/g) plus sodium phosphate dexamethasone (0,5 mg/g). The control of ornamental marine aquarium fishes suffering from eye diseases by intermuscular injection of chloramphenicol (50 mg/kg body weight) for 5 days **(Shome *et al.*,1999).**The eye lesions associated with Mycobacterium sp. and Nocardia sp. are very difficult to resolve **(Berzins** and **Greenwell, 2001).**Vaccination studies are already being underta-ken by a number of researchers and need to be fostered. In particular, the use of passive immun-ization of brood fish with homologous and heterogonous, high-titre antisera is worthy of inves-tigation. The drug is approved for use with pond fishes, channel catfish, and salmonids. It is administered in feed at a daily rate of 50 to 75 mg/kg of fish for 10 days. **(Stojanove *et al.*, 2010).**

Conclusion

1- Prevention of microbial diseases can be best done through good farm management, environmental stresses and associated disease problems are minimized by excellent nutrition.
2- Quarantine and health certificate form for the control microbial diseases.
3- Pay attention for eradication of any bacterial disease in fish farm, it may be more appropriate for further developed necessary laboratory tools such as screening tests for practical protective measures.
4- Antibiotics, Sulphamerazine sodium and medicinal plant as medicated food.
5- In cultured fish, prevention and control of eye affection problem could be achieved by poor nutrition.
6- Application of vaccination programs for fish, or using medicinal plant extracts which are the alternatives to the antibiotics for preventing and controlling the infectious diseases in fish farms.

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