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ACANTHOCEPHALAN INFECTION IN *RACHYCENTRON CANADUM* FISH IN RED SEA

By

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ABSTRACT

This study was carried out on 70 *Rachycentron canadum* (Cobia) collected from Red Sea to investigate the presence of acanthocephalans parasites and their deteriorated effect on fish. The clinical picture of naturally infested cobia showed no pathognomonic signs except slight emaciation or abdominal distension in some fishes. Postmortem lesions were manifested as congested internal organs, hemorrhages in the viscera and paleness in the liver with presence of many acanthocephalans parasites in body cavity either adhering or encysted in the viscera of fish. The total prevalence rate of infested fishes with acanthocephalans was 100% and intensity rate was 3-30/fish. The isolated Acanthocephalans were identified as *Serrasentis sagittifer*. The morphological characters of isolated parasite were described. The obtained results of the histopathological alteration of the affected fishes showed loss and severe sloughing of intestinal villi and lining epithelia with decrease in mucosal layer thickness and complete detachment of lining mucosa. Some muscle bundles revealed hyaline degeneration. Moreover, the damages associated with the tissue affecting its functional efficiency and the overall health status of the fish.The public health importance was discussed according to published records.

Key words:

Marine fish - Rachycentron canadum - acanthocephalan - Serrasentis sagittifer - prevalence- Red sea - histopathological lesions.

INTRODUCTION

The cobia has a wide distribution in Tropical and warm temperature water. It is very good food fish, very popular among sports fishermen, but is not otherwise commercially important. It grows to a large size at least to 68 kg. Other known names are ling, black salmon, black kingfish, black bonito, lemonfish, crabeater, prodigal son, and aruan tasek. **Margaret Smith**

and Heemstra (2012) and Eschmeyer *et al.*, (2019). The cobia is traded commercially with a fairly high price on behalf of having firm texture and good taste. Though, no designated wild fishery is present as it is a solitary species. It has been grown in aquaculture. The flesh is commonly sold fresh and served as grilled or poached fillets. It can be one of the most essential marine fish for future aquaculture production due to its fast growth pattern and the very good quality of the flesh. **Kaiser and Holt (2004), Liao *et al.*, (2004), Nhfirst *et al.*, (2011) and Eschmeyer *et al.*, (2019).**

The high quality of the flesh of Cobia could make it one of the most important marine fish for future aquaculture production and increase national income. It must be studied due to its presence in the Red Sea and the lack of research on it in Egypt.

Arendt *et al*. (2001) stated that Cobia mainly feeds on benthic and epibenthic prey substances, especially Portunid crabs.

Four classes of fish (definitive hosts) could be infected with Adult acanthocephalan these classes are Palaeacanthocephala, Archiacanthocephala, Polyacanthocephala and Eoacanthocephala **Weber *et al.*, (2013).** Acanthocephalans are a group of endoparasitic helminths present frequently in freshwater and marine fishes and consume their food using their teguments. They have complex life cycle as their intermediate hosts are arthropods and their definitive or paratenic hosts are vertebrates. They affected many fishes causing several pathological changes **Nickol (2006).**

The attachment of the armed proboscis resulted in permanent mechanical damage which disrupted the intestinal tissue architecture, digestion and absorption in fish causing pathological changes. Loss/degeneration of the intestinal villi, formation of granular tissues and capsule formation accompanied by host immune reactions extremely disturbed the digestive and absorptive competence of the animal. In heavy infections they could result in obstruction of the intestine and invasion/migration of the parasites into unusual sites have also been stated **Sanil *et al.*, (2010) and Sakthivel *et al.*, (2014).**

The sequence of events within the intermediate host's is rather well known, what occurs in paratenic hosts has not been fairly studied. The host-parasite interactions depend on the systematic affiliation of the parasite in addition to the host and on the depth of penetration of each acanthocephalan species in the intestinal wall of the host. The mechanism of attachment also affects the microhabitat preference within the gut. Fish looks as if it withstands large number of worms severely penetrating their intestinal wall without showing marked signs of

disease **(Taraschewski,2000).Smales (2014) and Barton *et al.* (2018)** stated that, the volume of fish eaten by cobia enlarged with total size; so, the smaller cobia that are frequently caught in Australian waters can get infections of *S. sagittifer* directly from the intermediate host. The role of paratenic hosts possibly becomes more significant with increasing the size of individual cobia.

In addition most of fish get infected with *S. sagittifer* cystacanths directly from the first intermediate host at a minor size. *Serrasentis sagittifer* is a cosmopolitan species that has previously been reported encysted or sheathed in mesentery, viscera or the body cavity of infected fish. **Barton *et al.* (2018).**

Acanthocephalans have received little attention in the fields of human and veterinary medicine. Human cases of acanthocephalosis are only frequent in certain parts of Mainland China and remain sporadic elsewhere **Taraschewski, (2000).** Cases of severe disease or high death rate caused by acanthocephalan infections in fish were rarely stated because of the considerable lesser infection intensity in comparison with other helminth parasites.

Human acanthocephaloses are acquired through the consumption of raw or uncooked seafood **Adams *et al.*, (1997).** For these reasons, the aim of this study was undertaken *Rachycentron canadum* marine fish from Red Sea infected by acanthocephalans as well as its prevalence, intensity rate and public health importance. The clinical picture with the information about morphological characters of the detected acanthocephalan and their effects were also recorded. Finally, the histopathological alterations of naturally infested cobia were described.

MATERIAL AND METHODS

Fish:

A total number of 70 alive marine fishes *Rachycentron canadum* were collected randomly from Red sea at South Siani Governorate. They were transferred to the laboratory in plastic bags partially filled with their natural water and adequate amount of oxygen in a short period of time according to **Langdon and Jones (2002).**

Clinical picture:

Clinical and Post-mortem examinations of fishes were carried out to detect any abnormalities by naked eyes. Internal organs were thoroughly examined with the help of a stereoscopic dissecting microscope according to **Noga (2010).**

Parasitologicalexamination:

The freshly recovered acanthocephalan parasites were refrigerated overnight to extend the proboscis.Then they were fixed in alcohol-formalin-acetic acid (AFA). The specimens stained with Semichon's aceto-carmine, dehydrated through an ethanol series, cleared in clove oil, then got rid of clove oil by xylene and mounted in Canada balsam **(Pritchard and Kruse, 1982).**

Histopathological examination:

From sacrificed infested fishes, intestine containing Acanthocephalan parasites were fixed in 10% neutral buffered formalin, dehydrated in ascending grades of ethyl alcohol, cleared in xylol and afterward blocked in paraffin wax. Tissue sections of 5-7 microns thickness were stained with Hematoxylin and Eosin (H&E) according to **Takashima and Hibiya (1995).**

RESULTS AND DISCUSSION

Clinical and Postmortem findings:

The naturally infested fish were apparently healthy with no pathognomonic signs except slight emaciation or abdominal distension in some fishes may be due to endoparasitic acanthocephalan infestation Fig. (1: A). The postmortem findings were congested internal organs, hemorrhage in the viscera and paleness in the liver with presence of many acanthocephalans parasites in in body cavity either adhering or encysted in the opened viscera of fish. Some cases showed congestion in the liver with petechial hemorrhage and others were enlarged liver with variable degrees of congestion, excessive mucus secretion and swelling intestine with hemorrhagic area in internal organs. In heavy infestation may cause blocking of the lumen Fig. (1: B, C&D), Fig. (2), Fig. (3). these postmortem findings are similar to that recorded by **El-Lamie (2007), Abdel-Mawla and Abo-Esa (2011), Salah Eldeen *et al.* (2014) and Abdel-Mawla and El-Lamie (2018).**

Parasitological finding:

Class: Palaeacanthocephala

Order: Echinorhynchida

Family: Rhadinorhynchidae

Genus: Serrasentis

Species:Serrasentis sagittifer

Serrasentis sagittifer was recovered from the intestine of infested *Rachycentron canadum*.

Body was cylindrical, elongated with a narrow posterior end and creamy white in color, the proboscis was club-shaped, winder anteriorly, narrowed towards its posterior, and covered with various uniform spines arranged longitudinally. Spines were triangular, arrow shaped, the anterior hooks are the largest, the proboscis is trailed by a short spineless neck region followed by the body proper (trunk) which is supported by transverse cuticular numerous combs of spines (16 - 24 incomplete rows) on its ventral surface. The proboscis of the male was long. Trunk was spinose at its anterior part. Proboscis receptacle had double-walled with nerve ganglion at mid-level, which was followed by the point of attachment of two lemnisci which were long, thin, unequal and reaching the middle of the body testis were ovoid, tandem in position. Body of the female worm was larger than that of the male. Vagina was surrounded by two pairs of vaginal muscles with the uterus having a cone like shape Fig. (4, 5). This morphological description agrees with that described by **Abdel-Mawla and Abo-Esa (2011), Al-Zubaidy and Mhaisen (2012), Amin (2013), Abdel-Ghaffar *et al.* (2014), Sakthivel *et al.* (2014), Smales (2014), Barton and Smales (2015) Abdel-Mawla and El-Lamie (2018) .**

Barton *et al.* (2018) who reported that mature *S. sagittifer* appeared to be highly host specific to the cobia, *Rachycentron canadum*, in northern Australian waters, while cystacanths have been accounted for in a wide range of paratenic fish hosts from more than 30 families.

Prevalence of the isolated parasites:

The prevalence of acanthocephalan *Serrasentis sagttifer* in the examined *Rachycentron canadum* marine fishes was 100% (Table 1). This result coincided to that obtained by **Sanil *et al.*, (2010)** in which the percentage rate was 100% acanthocephalan *Tenuiproboscis sp.* from the mangrove red snapper (*Lutjanus argentimaculatus*) in India. While it was somewhat higher than that obtained by **Barton *et al.* (2018)** who recorded the prevalence of *S. sagttifer* from the same fish in Australian waters was 72.7%. The highly prevalence may be attributed to habitat and feeding of fish primarily on crabs, squid, and fish. This in agreement with **Barton *et al.* (2018)** who stated that many fish species are utilized as a paratenic host for the transmission of *S. sagittifer*, however the actual first intermediate host remains unknown. Meanwhile, the obtained result was significantly higher than that reported by some authors from different fish species **Abo-Esa (2007)** 35% *S. sagttifer* from *Mullus barbatus*, **El-Ashram and Shager (2008)** 25% *S. sagttifer* from *Scombermorus maculates*,

Abdel-Mawla and El-Ekiaby (2012) 7% *S. sagttifer* from Seabass fish and **Al-Zubaidy and Mhaisen (2012)** who recovered Juveniles of acanthocephalan *S. sagittifer* from the intestine, mesenteries, pyloric caeca, body cavity and some internal organs of the four fish species (*Thunnus tonggol*, *Sphyraena barracuda*, *Pomadasys argenteus* and *Lutjanus gibbus*) from Al-Mehwat fish market, Hodeidah, Yemen with the prevalence of 11.7%, 11.9%, 24% and 4.4%, respectively, and **Abdel-Ghaffar *et al* (2014)** 57.14 % *S. sagttifer* from gilthead Sea bream. Meanwhile, it was differed from that obtained by **Abdel-Mawla and El-Lamie (2018)** who recorded the prevalence of Acanthocephala (Echinorhynchus sp and *Serrasentis sagttifer***)** from *Mulloides flavolineatus was* 23.3%. The variation in prevalence may be attributed to difference of fish species, the locality from which fish samples obtained and unequal samples.

Histopathological findings:

The affected viscera showed loss of intestinal villi and lining epithelia with decrease in mucosal layer thickness and complete detachment of lining mucosa and severe sloughing of lining epithelia associated with decrease in mucosal layer thickness Fig. (6). Intestinal mucosa revealed complete detachment of lining mucosa Fig. (7). Some muscle bundles revealed hyaline degeneration in some muscle bundles Fig. (8). These results nearly agree with **Sanil *et al.*, (2010)** who noticed that thickness in the surface of the intestine at the site of parasite attachment and the presoma penetrated the mucosal epithelium, lamina propria, muscle layers and deteriorated the architecture of the intestinal tissues. **Dezfuli *et al.* (2018)** who stated that intestinal occurrences of adult acanthocephalan were previously reported in Italian pike fish with mast cells infiltration as the most predominant host response. **Dezfuli *et al.* (2008)** also detected mast cells in the blood vessels and associated with fibroblasts of the muscularis layer and the stratum granulosum. Their migration toward the site of infection was suggested. Serious degranulation of mast cells in all intestinal layers particularly near the parasite's body represents normal host immune response. There was a significant increase in the number of proliferating cell nuclear antigen positive cells (mast cells and fibroblasts) at the site of parasite attachment when compared to the number of positive cells found in uninfected conspecifics and in tissue zones away from the point of parasite attachment **Dezfuli *et al.* (2010)**. Regarding to public health importance, people handling and consuming flesh of fishes, such as fishermen and sellers, or individuals who come into contact with fish for research or during daily and monthly care of aquarium and cage fishes are also at risk of

contracting some zoonotic diseases. A few parasites causing zoonoses are found in some fishes. **Schmidt (1971)** found some acanthocephalan in humans during necropsy and estimated that man was infected with it by ingestion of fish containing sub-adult worms that matured in man.

In addition, **Abo-Esa (1993)** reported for the first time in Egypt, that the acanthor (embryo of cystacanth) penetrated the musculature of Tilapia spp. caught from High Dam Lake, with great numbers which may facilitate the infection of man through consumption of uncooked or improperly cooked fish. Also, **Haustein *et al.*, (2010)** detailed for the first time the highly unusual finding of an immature acanthocephalan recovered from a patient's eye. Thusly, knowledge and consequently prevention and control of fish- born parasitic diseases must be put in consideration.

Table (1): The prevalence and intensity of the isolated acanthocephala from marine fish.

Fish species	Total No of Exam	Total No of infest.	% of infest.	Acanthocephala species	Intensity of acan. /fish
***Rachycentron canadum* (Cobia)**	**70**	**70**	**100**	***- Serrasentis sagttifer***	**3-30**

CONCLUSION

Conclusively, there was a noticeable increase in the prevalence of acanthocephalan infection in cobia which may affect the health of fish and could retard their growth and as well inducing mortality of fry or small one at higher rate. Due to its penetrating actions to the host intestinal wall using its hooked proboscis, causing extensive tissue damage, decrease intestinal absorption capacity and potential fatality in various vertebrates. The direct damage or detrimental effects by Acanthocephalan included loss and severe sloughing of intestinal villi and lining epithelia causing disturbance in absorption or blocking the lumen which influencing its functional efficiency and the general health status of the fish. Moreover, the presence of many visible parasite in body cavity either adhering or encysted in the fish gut may lead to rejection by consumers. Because of the importance of this fish economically, which can be cultivated for its advantages and rapid growth, it must be highlighted by further studies to elucidate possible management measures and control the infestation in different ways.

Fig. (1): A: Macroscopic appearance of adult *Rachycentron canadum* showing slight emaciation, **B:** slight abdominal distention in *R. canadum*, congested liver with petechial hemorrhage and viscera with presence of acanthocephalan in the abdominal cavity.

Fig. (2): A: *Rachycentron canadum* showing congested internal organs, hemorrhage in the viscera and paleness in the liver with presence of acanthocephalans parasites in the body cavity **B:** Blocking in the lumen of the fish gut by heavy infection of white creamy acanthocephalans parasites.

Fig. (3): A: Heavy infestation of acanthocephalan adhering in the opened viscera of *Rachycentron canadum* and collected in petri dish (White arrow) with congestion of lining wall of intestine. **B:** Different lengths of isolated acanthocephalan parasite.

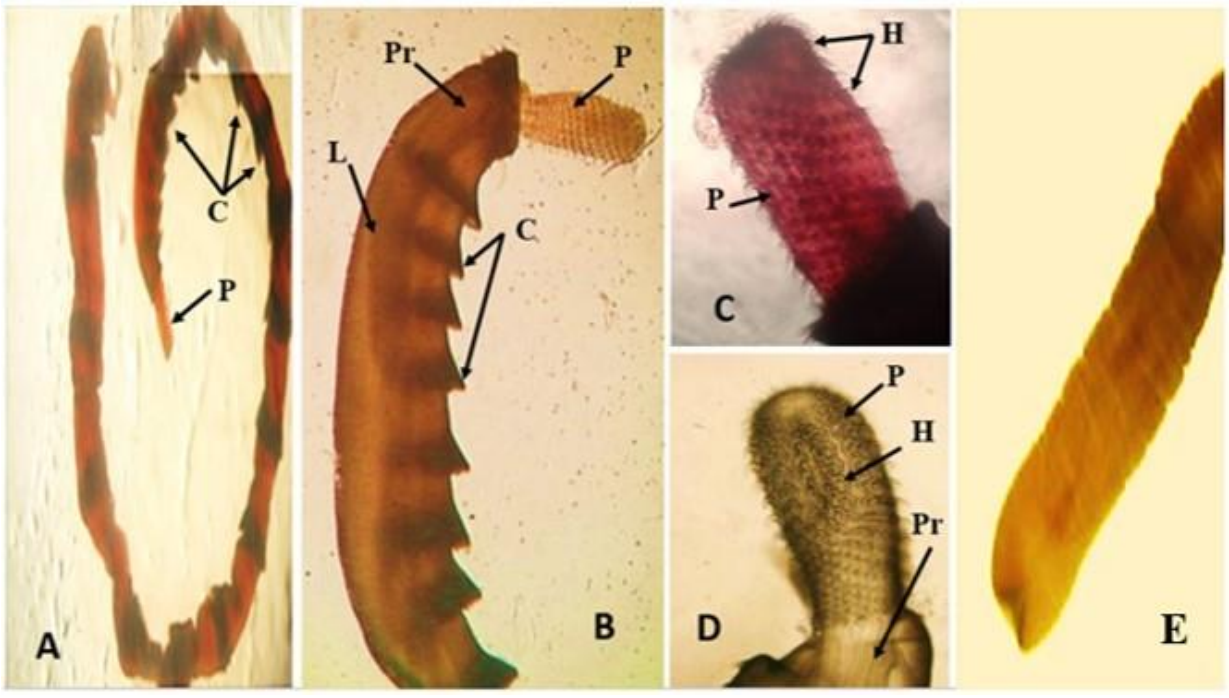

Fig. (4): A: Whole female *Serrasentis sagttifer*. **B:** Anterior part showed the two Leminisci and circular combs. **C:** high magnification of inverted thorny proboscis with hooks rows stained with Semichon's aceto-carmine. **D:** The anterior end showing the unstained proboscis with spine hooks profile. **E:** posterior end of female.

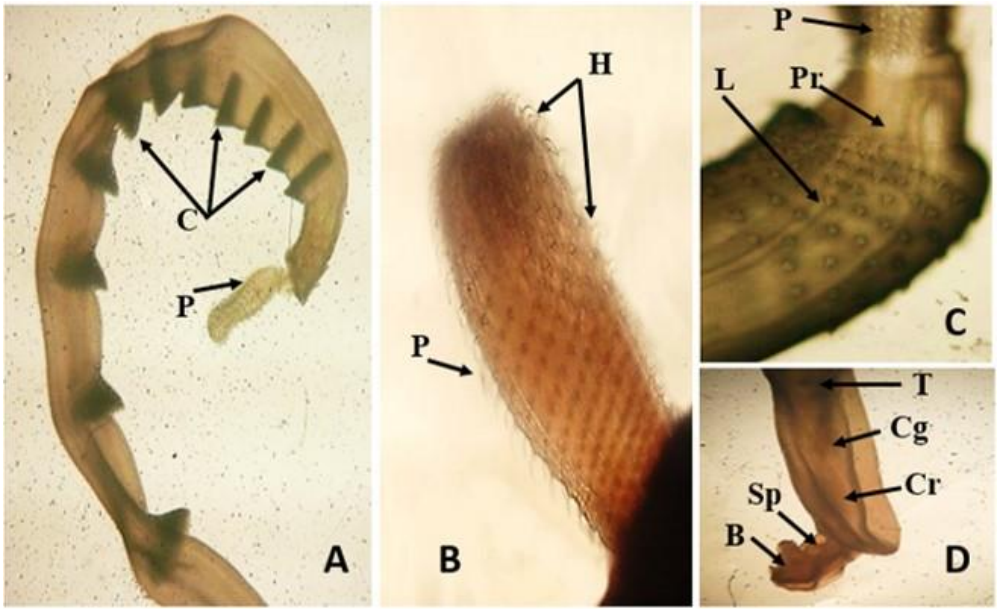

Fig. (5): **A:** Male *Serrasentis sagttifer* with circular combs along the body. **B:** High magnification of proboscis with multiple rows of spines stained with Semichon's aceto-carmine. **C:** Unstained anterior part showed the proboscis receptacle and two Leminisci. **D:** Posterior end of male *Serrasentis sagittifer* with cement glands and copulatory bursa.

P: proboscis, **C:** comb, **H:** hooks, **Pr:** proboscis receptacle, **L:** Leminisci, **T:** Testis, Cg: Cement gland, **Cr:** Cement reservoir, Sp: saefftigen's pouch and **B:** Bursa

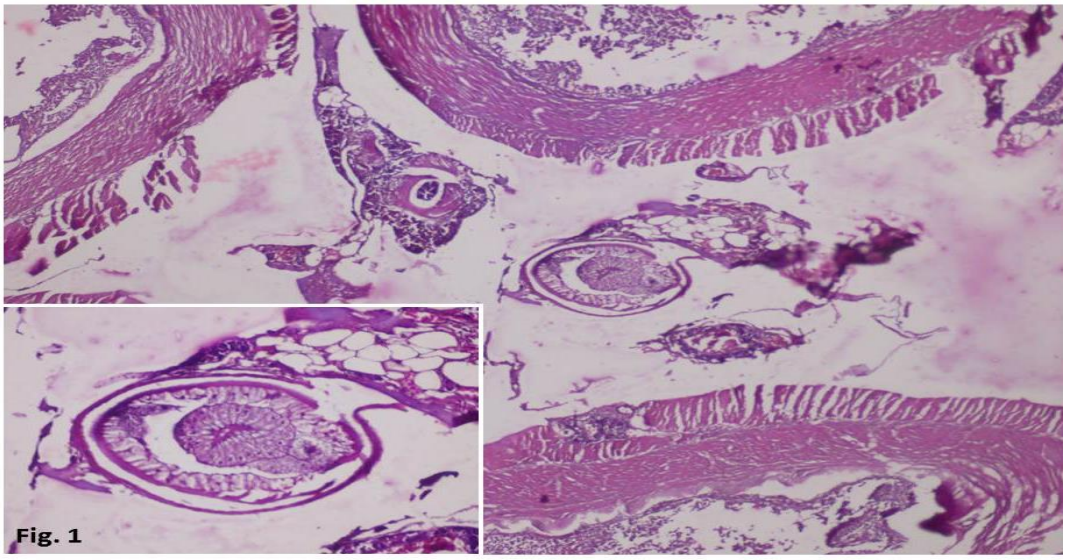

Fig. (6): Intestinal lumen of *Rachycentron canadum* revealing cross sections of acanthocephalans. There is marked loss of intestinal villi and lining epithelia. Intestinal mucosa revealed severe sloughing of lining epithelia associated with decrease in mucosal layer thickness. **H&E X200 (in set X400).**

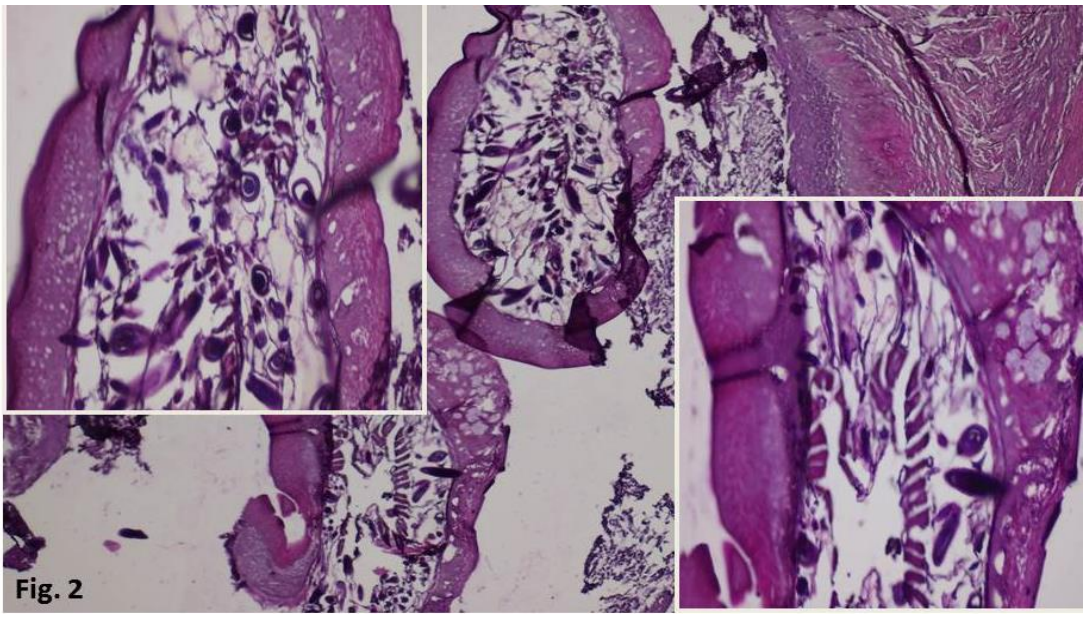

Fig. (7): Intra-luminal section of *Rachycentron canadum*'s intestine revealing longitudinal sections of acanthocephalans. Intestinal mucosa revealed complete detachment of lining mucosa. **H&E X200 (in set X400).**

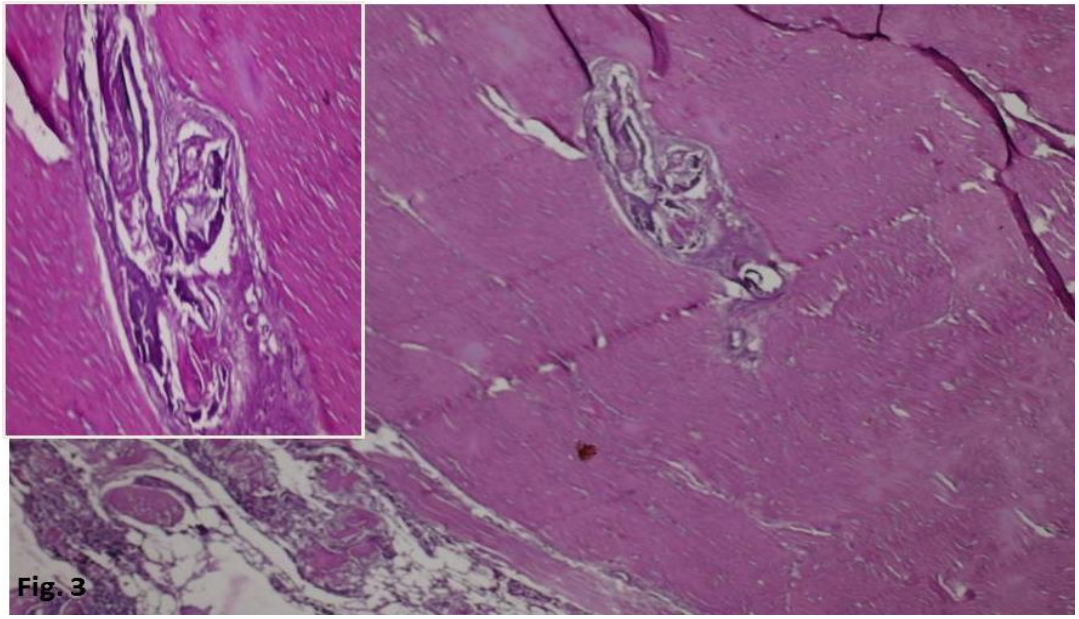

Fig. (8): Tunica muscularis of *Rachycentron canadum*'s intestine revealing encysted parasites and Some muscle bundles revealed hyalinization. **H&E X200 (in set X400).**

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الاصابة بالاكانثوسيفليس فى سمك السكل فى البحر الاحمر

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أمراض الأسماك - معهد بحوث صحة الحيوان معمل فرعي المنصوره *– الدقى** - معمل فرعى الإسماعيلية ***

الملخص

نظرا للجودة العالية للحم سمك السكل مما يجعله واحدا من أحد أهم الأسماك البحرية المهيئه لإنتاج الاستزراع المائي في المستقبل وزيادة الدخل القومي. لذلك كان لابد من دراستها نظرا لوجودها فى البحر الاحمر وعدم وجود ابحاث عليها فى مصر. لذا أجريت هذه الدراسة علي 70 سمكه من اسماك السكل , و التى تم تجميعها من البحر الاحمر لإستبيان وجود الديدان الرأس شوكية وتأثيرها الضار على الاسماك.

أسفر الفحص الاكلينكي للأسماك المصابة انها سليمة ظاهريا وعدم وجود علامات مرضيه مميزة بإستثناء هزال طفيف أو انتفاخ فى بعض الأسماك. الصفة التشريحية للأسماك كانت عباره عن احتقان الأعضاء الداخليه , نزيف فى الاحشاء و شحوب فى الكبد و مع وجود العديد من الديدان الرأس شوكية في التجويف البطنى اما ملتصقه او متحوصله فى أمعاء الاسماك. بعض الأسماك يظهر عليها احتقان فى الكبد مع نقط نزفية .وقد لوحظ إنسداد تجويف الامعاء فى الاصابه الشديده.

كانت نسبه الإصابة الكلية بالديدان الرأس شوكية 100٪ بمعدل 3-30/سمكه. وكانت نوع الأكانثوسيفيلا المعزولة من اسماك السكل هى سيراسينتس ساجيتيفير. كما نوقشت الصفات المورفولوجية للطفيل المعزول.

أظهرت النتائج التي تم الحصول عليها من التغيير الهستوباثولوجي للأسماك المصابة فقداً وانسلاخ حاداً في االخملات المعوية والنسيج الطلائي المبطن مع انخفاض في سمك طبقة الغشاء المخاطي وانفصال كامل للغشاء المخاطي البطني.

ووجد تحلل فى بعض حزم العضلات. علاوة على ذلك الأضرار المصاحبه للأنسجة تؤثر على كفاءتها الوظيفية والوضع الصحي العام للأسماك. وقد تم مناقشه الاهميه الصحية العامة من خلال الدراسات السابقة المنشورة.