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Original Article

First time recording of seasonal prevalence of *Cysticercus tenuicollis* among small ruminants at Matrouh city, Egypt

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Abstract As first time recording, the purpose of this study was to estimate the monthly and seasonal prevalence of *Cysticercus tenuicollis*, (*C. tenuicollis*); identify factors that can influence its occurrence and to assess the distribution of the cyst in the visceral organs of sheep and goats slaughtered at Matrouh city abattoir in Allam Elrom- Marsa Matrouh governorate, Egypt. A total of 4216 animals (1400 sheep and 2816 goats) were examined during the period from 28 November 2019 till 27 November 2020 at the abattoir. The overall prevalence of *C. tenuicollis* was 17.7%, and 21% and 11% in goats and sheep respectively. There was significant variation in the prevalence of *C. tenuicollis* between sheep and goats and other animal species was considered as a risk factor as goat had a 2-time chance of infection more than sheep (X2 = 64.501a and P = 0.000). There was no significant variation in the prevalence of *C. tenuicollis* between male and female. The cyst was found most frequently attached to omentum, liver, lung, and diaphragm in both sheep and goats. Concerning seasonal dynamics of *C. tenuicollis* was found to increase during Autumn season (19.1%) to reach its maximum during Winter (20.7%) and started to decrease during Spring (17.1%) to be the lowest in Summer season (15%).

In conclusion, the presence of *C. tenuicollis* at a higher prevalence and the consequent effect on small ruminant signify the need for the control of stray dog population, deworming of dogs, and avoidance of backyard slaughter and proper disposal of infected viscera to curtail the problem.

Key words: Prevalence, *Cysticercus tenuicollis*, sheep and goats. - Marsa Matrouh**.**

Introduction *Taenia hydatigena* is an adult parasite of dogs with the metacestode (*C.tenuicollis*) stage residing in ruminants and pigs. The metacestode infection due to *C.tenuicollis* is important because it causes huge economic losses due to condemnation of infected offal or meat

(Flisser *et al.* 1982; Eckert *et al.*, 1984; Thompson and **Lymbery 1995).** Additionally, the cysticerci of *T. hydatigena* are responsible for production losses and mortality in livestock **(Singh *et al.*, 2013).** The meat produced by sheep and goats were about 135,000 tons in 2010 **(FAO, 2015).** The cyst is found attached to the omentum, liver, peritoneum, mesentery, diaphragm, pelvic cavity, lung **(Mekuria *et al.*, 2013),** Migration of cysticerci can lead to formation of hemorrhagic and fibrotic tracts, serofibrinous peritonitis in the liver **(Soulsby 1982**; **Blazek *et al.*, 1985)** with heavy infections leading to traumatic hepatitis and death in young lambs **(Soulsby, 1982)**. The cyst is round with a glowing wall. It contains a scolex, neck, and a fluid-filled sac. When carefully squeezed the head and neck emerged in front of the bladder, **AbouLaila, *et al.*, (2020).** The presence of the cyst leads to the rejection of affected organs and subsequent economic losses (**Scala *et al.*, 2016**). Diagnosis in livestock is usually based on the host and the location of them metacestode when identified at meat inspection or necropsy **(WHO and OIE, 2001)**. Size of the cysts (*C.tenuicollis*) varies from one cm up to 6–7 cm, and the scolex has a long neck. They are found attached to the omentum, mesentery and occasionally on the liver surface, particularly of sheep **(OIE, 2008)**. The biotic potential of *T. hydatigena* is high and

estimates suggesting that *E. granulosus* has about 1/100th and 1/30th the biotic potential of *T. hydatigena* and *T. ovis* **(WHO** and **OIE 2001).**

El-Alfy *et al.*, 2017), and Sohage and Qina (**Omar *et al.*, 2016**).

Aim of the study

In Egypt, *C. tenuicollis* was detected in slaughtered sheep and goat in Sharkia (**El-Azazy** and **Fayek, 1990**), Aswan (**Dyab *et al.*, 2017**), AlGharbia (**Sultan *et al.*, 2010**), Benisouf (**El-Dakhly *et al.*, 2012**), AlDakahlia (**Abu-Elwafa *et al.*,2009** and

The infection rate of *C. tenuicollis* in sheep and goat at Matrouh city, Egypt and its prevalence and morphological characterization were recorded for the first time.

2. Materials and methods

2.1. Animals and the study area (N" 13' 12 31° & E" 14' 14 027°)

All goat and sheep were slaughtered in general Matrouh city abattoir in Allam Elrom- Marsa Matrouh governorate, Egypt (N" 13' 12 31° & E" 14' 14 027°). 1400 sheep and 2816 goat (total of 4216) were examined for the presence *of C. tenuicollis* in the period from 28 November 2019 till 27 November 2020.

2.2. Collection of cysts and the laboratory examinations

All goat and sheep were examined by naked eyes for all carcasses parts to fine *C.tenuicollis* cyst then daily were collected the larval stage cysts, the cysts were collected in cooled bags contain Formalin 5% and transported to the laboratory of Parasitology at the Faculty of Veterinary Medicine, Alexandria University for the further parasitological examinations. Samples were fixed in 10% buffered formalin, stained with alum-carmine and mounted on glass slides for the morphological identifications **(Kaufmann, 2013; Soulsby** and **Mönnig, 1982).** Measurements and identification of the collected cysts were performed (**Pritchard** and **Kruse, 1982**). Also, the age of the examined animals was arranged into two groups, more than 3 years and less than 3 years.

2.3. Data collection

Data was collected through:

2.3.1. Questionnaire

A questionnaire was designed to collect the data it included the animal types, animal sex, animal age, daily recorded of number of the total small ruminants were infected out of the total number of small ruminant's animal were slaughtered in general Matrouh city abattoir.

2.3.2. Laboratory study

Laboratory examination using light microscope 10 x to predict and confirm the *C.tenuicollis* scolex its contains (sucker, hooks, vitality fluid).

2.4. Statistical analysis

After a complete collection of the data, the data enrolled in statistical analysis using SPSS Version 24. The Chi-square test was used to detect the difference between different age and sex groups. The results were considered significant at $P \leq .05$.

3. Results

3.1. Infection rate

The total infection rate with *C.tenuicollis* in sheep and goat was 17.7%, **(Table 1).**

The infection rate in goat was 21% and in sheep was 11%. Animal species was considered as a risk factor as goat had a 2-time chance of infection more than sheep (X2 = 64.501a and P = 0.000) **(Table 2).**

The infection rate in male (17.8%) was close to female (17.3%) groups (Table 1) nonetheless, there was no critical contrast between the two groups (X2 = 0.196a and P = 0.658) **(Table 3).**

The distribution of the *C.tenuicollis* in slaughtered sheep and goat was 64 (9.11%) in the liver, 647 (86.72%) mesenteric membrane, 28 (3.75%) liver and mesentery, 1 (0.14%) lung, 1 (0.14%) liver, mesentery and large intestine and 1 (0.14%) for diaphragm **(Table 4).**

3.2. Prevalence of the cyst

The Monthly prevalence of *C.tenuicollis* in the infected animals was shown in the **(Table 5)** the highest infection was noticed during December, January and February (26.9% ,23.1% and 20.4%) followed by May and June (19.8% and 19. 1%). October show a moderate level of infection with 16.8%.

The low infection rate was observed in July, August and September (15.8%, 15.3% and 14.3%). April recorded the lowest infection rate by 13.5%.

Seasonal dynamics of *C.tenuicollis* **(Table 6)** was found to increase during Autumn season (19.1%) to reach its maximum during Winter (20.7%) and started to decrease during Spring (17.1%) to be the lowest in Summer season (15%).

3.3. Cyst habitat

The omentum (mesentery) had the highest infection frequency between the organs in this study **(Fig.2).** 86.72% followed by liver 9.11% **(Fig. 3)** then liver and omentum by 3.75 % **(Fig. 1).**

3.4. Cyst structure

The results showed that the external cyst wall was semi-transparent, white in color, some with yellowish. The wall of the bladder was transparent, faint and contained clear water fluid. The head which appeared as a white dot when carefully squeezed the head and neck emerged in front of the bladder **Fig. (5).** The fluid is clear, transparent and fills the cyst cavity. The present results showed that the size of the cysts was different between slaughter sheep and goats, ranging between small cyst 2- 3.5 cm **Fig. (5)** and large cyst 6.5 cm in diameter.

4. Discussion

Infections of sheep and goat with larval stages of *T. hydatigena* is important because it causes economic losses due to condemnation of infected organs and carcasses (**Bekele et al. 1992**). Our study showed high prevalence 17.7% of these parasites whose occurrence adds to the economic losses due to presence of *C.tenuicollis*. However, although massive

infections with these cysts can cause severe disease and mortality in sheep (**Gånheim *et al,*.1998**), there are few indications that latent cysticercosis has obvious effects on the productivity of sheep and goats.

In our study areas, dogs are kept by the animal owners, and believed that the dogs are useful for the community in preventing predators from their livestock. In the area, especially in rural, treating dogs for parasitic diseases is not practiced. Backyard slaughter of small ruminants and disposal of viscera and trimmings on open field is common. All these are very important for the life cycle to continue between the final and intermediate hosts.

4.1. Infection rate

The present study of the prevalence of *C. tenuicollis* found the infection rate to be the highest in goat (21%), compared with sheep (11%). The rate infection of goat was higher than that of sheep because most sheep develop protective immunity early in life and this immunity regulate the parasite population, while goat develops the immunity more slowly **(Pathak and Gaur 1982).**

These results within the range recorded by **Omar *et al.,* (2016)**, they reported a mean prevalence of *C. tenuicollis* in goat (19%) and in sheep (16%) in Upper Egypt, **El-Azazy** and **Fayek (1990)** who reported 26.4% in goat in Al-Sharkia, Egypt, and Aswan, Egypt 13.3% in sheep **Dyab *et al.,* (2017**). The obtained results were lower than that recorded by **Aboulila *et al.,* (2020)** (18%) in sheep in Minoufiya governorate, Egypt and 20% in sheep **Abu-Elwafa *et al.,* (2009**). But infection rate was higher than those from Benisuf, Egypt 1.6% in sheep **El-Dakhly** *et al*., **(2012**).

Our results were with the same range with **Samuel** and **Zewde (2010)** with prevalence of 18.04% and 12.87% in goats and sheep in central Ethiopia, respectively; Iran 12.87% in sheep **Radfar *et al.,*(2005**) and lower than study investigated in Mbeya district; Tanzania **Braae *et al.,* (2015)** who recorded prevalence of *C. tenuicollis* in goats and sheep with 45.7 % and 51.9 %, respectively; also, study from eastern Ethiopia which reported 79% in sheep and 53 % in goat by **Sissay *et al.,* (2008)**, and 35.41 % in goat and 32.5% in sheep from Iraq (**Haddawee *et al.,*2018**). But, it was found that our results were higher than that obtained from Palestine 2.2% in sheep by **Adwan *et al.,* (2018).**

These variations in the prevalence mainly accounted to the grazing behavior and management system prevailing in the local areas **(Senlik, 2008**) and to high contamination of the environments.

The results reveal that males had a higher infection rate than females, but non-significantly different (p) values were 0.960 (0.801-1.151) which revealed no effect of sex on the prevalence of the disease among the examined sheep and goat.

4.3. Cyst habitat

The omentum (Mesentery) had the highest infection frequency between the organs in the examined carcasses (86.72%) followed by liver (9.11%).

This is may be due to the presence of large amount of lipid, carbohydrates and other essential elements which absorbed by the parasite, so that, *C.tenuicollis* prefer omentum, as organ of supplying essential elements for their nourishment. The least infection rate was recorded in lungs and diaphragm (0.14%).

These results in agreeing with **(Abu-Elwafa *et al.*, 2009, Braae *et al.*, 2015; Dyab *et al.*, 2017; Omar *et al.*, 2016; Radfar *et al.*, 2005, Samuel** and **Zewde (2010)** and **Senlik (2008)** they reported that omentum is the predominant predilection sites for *C. tenuicollis*. While liver was the predilection site in several previous studies **(Mekuria *et al.*, 2013** and **Wondimu *et al.*, 2011).**

4.2. Prevalence of the cyst

Increasing of *C. tenuicollis* during Winter 20.7% followed by Autumn season 19.1% being identical to **Pathak** and **Guar, 1982;** increased in rainy seasons, **El-Masry, 1986;** increased in Autumn and within range with **Abu-Elwafa *et al.*, 2009,** who detected high prevalence in Autumn followed by Winter. While the result disagreed with **El-Alfy, *et al.*, 2017** decided that Spring was the highest prevalence (28.26%)**.**

In conclusion, this study presented the infection rate, monthly prevalence, and cyst habitat of *C. tenuicollis* in sheep and goat, from Matrouh city, northwestern of Egypt.

Therefore, the following recommendations should be taken in consideration while rearing sheep:

(1) Sheep and goat stocks must be reared away from dogs (the final host of dog`s Taeniids) in order to prevent metacestode infections with subsequent avoidance of economic losses especially these larval stages are usually diagnosed after slaughtering, at meat inspection.

(2) In this regard, we have to emphasize the important role of meat inspection to offer a healthy meat for human consumption, free from public health hazards, especially in the absence of specific treatments of metacestode infections.

Ethical statement

No experiments were conducted on the experimental animals in this study.

Declaration of Competing Interest

No conflict of interest

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(Table 1): Total infection rate with *Cysticercus tenuicollis* in the examined animals.

Non-infected animals		Infected animals		Total	
No.	**%**	**No.**	**%**	**No.**	**%**
3470	82.3	746	17.7	4216	100

(Table 2): Total infection rate and risk factors associated with *Cysticercus tenuicollis* infection in sheep and goats.

Type of carcasses	Cyst infection		Total	X2	Odds ratio
	Non-infected	infected		P	
Goat	2224 79.0 %	592 21>0 %	2816 100.0 %	64.501 a	0.464 (0384-0.562)
Sheep	1246 89.0 %	154 11.0 %	1400 100.0 %	0.00 *	
Total	3470 82.3 %	746 17.7 %	4216 100.0 %		

(Table 3): Prevalence of *Cysticercus tenuicollis* in relation to sex of slaughtered animals.

Animal sex	Animal cyst infection		Total	X2	Odds Ratio
	Non-infected	Infected		P	
Male	2559	556	3115		0.960 (0.801-1.151)
	82.2%	17.8%	100.0%	0.196a	
Female	911	190	1101	0.658	
	82.7%	17.3%	100.0%		
Total	3470	746	4216		
	82.3%	17.7%	100.0%		

(Table 4): Distribution of *Cysticercus tenuicollis* in the organs of infected animals.

Cyst habitat	Frequency	%
Liver	68	9.11
Mesenteric membrane	647	86.72
Liver+ mesenteric	28	3.75
Lung	1	0.14
Liver, mesenteric, large intestine	1	0.14
Diaphragm	1	0.14
Total	746	100.0

(Table 5): Monthly prevalence of *Cysticercus tenuicollis* in the infected animals.

Month	Animal cyst infection		Total	X2	Odds ratio
	Non-infected	infected		P	
November	230	41	271	40.606a	0.868 (0.562-1.340
	84.9%	15.1%	100.0%		
December	223	82	305	0.000	1.784(1.223-2.603)
	73.1%	26.9%	100.0%		
January	267	80	347		1.464(1.006-2.131)
	76.9%	23.1%	100.0%		
February	257	66	323		1.27(0.861-1.875)
	79.6%	20.4%	100.0%		
March	220	45	265		1.019(0.666-1.56)
	83.0%	17.0%	100.0%		
April	345	54	399		0.787(0.527-1.175)
	86.5%	13.5%	100.0%		
May	255	63	318		1.25(0.843-1.853)
	80.2%	19.8%	100.0%		
June	178	42	220		1.167(0.754-1.808)
	80.9%	19.1%	100.0%		
July	417	78	495		0.974(0.672-1.411)
	84.2%	15.8%	100.0%		
August	365	66	431		0.998(0.676-1.472)
	84.7%	15.3%	100.0%		
September	420	70	490		0.917(0.626-1.344)
	85.7%	14.3%	100.0%		
October	293	59	352		1.019(0.666-1.56)
	83.2%	16.8%	100.0%		
Total	3470	746	4216		
	82.3%	17.7%	100.0%		

(Table 6): Seasonal prevalence of *Cysticercus tenuicollis* in the infected animals.

season	Animal cyst infection		total	X2	Odds ratio
	non-infected	infected		P	
Autumn	765(80.9%)	181(19.1%)	946		1.343(1.078-1.674)
Winter	767(79.3%)	200(20.7%)	967	14.395	1.480(1.193-1.836)
Spring	780(82.9%)	161(17.1%)	941		1.172(0.935-1.468)
summer	1158(85.0%)	204(15.0%)	1362		1.122(0.835-1.868)
total	3470(82.3%)	746(17.7%)	4216	0.002*	

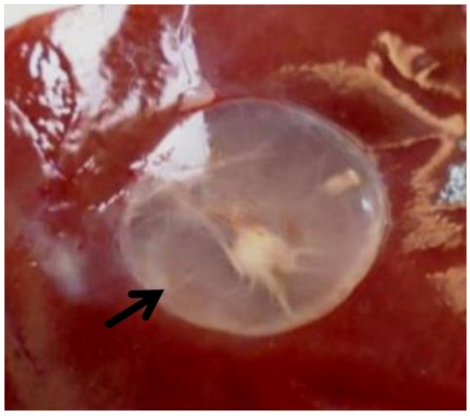

Fig. (1): *C. tenuicollis* attached to liver capsule of sheep, (arrow), The mean size 50 × 65 mm.

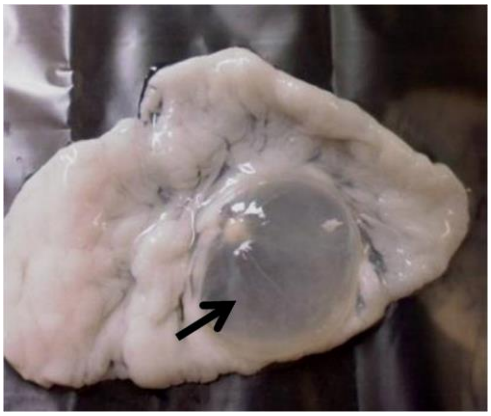

Fig. (2): *C. tenuicollis* attached omentun of sheep, (arrow), The mean size 50 × 65 mm.

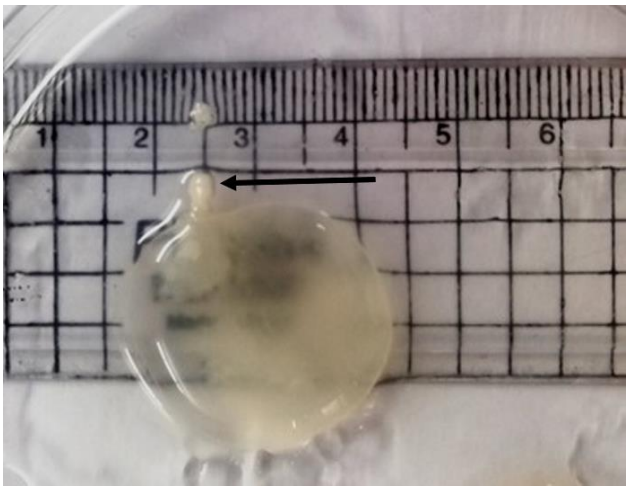

Fig. (3): Photograph of cyst showing scolex appear as white dot, (arrow).

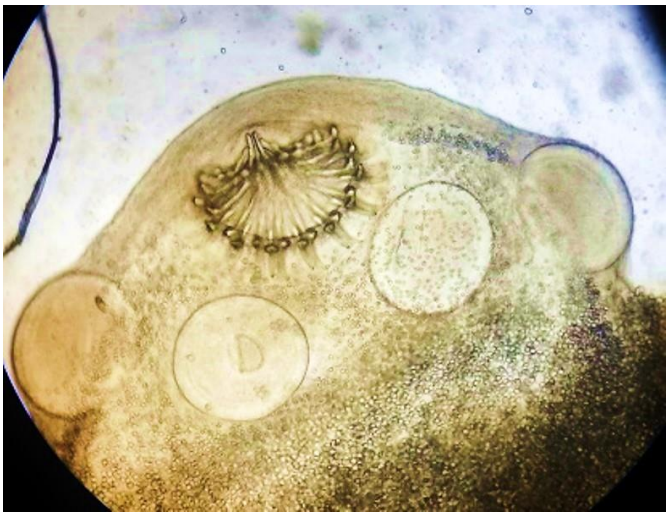

Fig. (4): Protoscolex of *Cysticercus tenuicollis*

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الملخص العربى

تسجيل الانتشار الموسي للطور اليرقي *Cysticercus tenuicollis* في صغار المجترات لاول مرة في مجزر علم الروم محافظة مطروح بمصر

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تضمنت الدراسة عزل وتشخيص الطور اليرقي *Cysticercus tenuicollis* (الكيسة المذنبة) لدودة الكلاب الشريطية رقيقة العنق *Taenia hydatigena* بين صغار المجترات (الماعز والاغنام) المذبوحة في مجزر علم الروم-محافظة مطروح – مصر. تم فحص ١٤٠٠ ذبيحة من الاغنام و ٢٨١٦ ذبيحة من الماعز باجمالي ٤٢١٦ ذبيحة وذلك بعد ان تم تثبيت جنس كل حيوان مفحوص خلال فترة الدراسة الممتدة من ٢٨ نوفمبر ٢٠١٩ الي ٢٧ نوفمبر ٢٠٢٠.كانت نسبة الاصابة الكلية بالطور اليرقي ١٧% وقد تم تسجيل نسبة الاصابة لكل نوع علي حدة حيث كانت نسبة الاصابة في الاغنام ١١% والماعز ٢١%.بالنسبة الي الانتشار الموسمي علي مدار فصول السنة الاربعة فكانت اعلي نسبة اصابة في فصل الشتاء ٢٠,٧% يليها فصل الخريف بواقع ١٩,١% ثم تقل نسبة الاصابة تدريجا في فصل الربيع لتكون ١٧,١% في حين سجل فصل الصيف اقل نسبة اصابة بالطور اليرقي بواقع ١٥%
وقد تم تحديد اكثر اعضاء الجسم اصابة بهذا الطور اليرقي حيث وجد ان منديل الكرش الاكثر اصابة يلية الكبد ثم الرئة في حين كان الحجاب الحاجز اقل الاماكن اصابة بالطور اليرقي .
واشتملت هذة الدراسة ايضا علي اجراء الفحص الميكروسكوبي للطور اليرقي لتحديد صفاتة المورفولوجية وتصنيفة طبقا لمعايير التصنيف العالمية وبناء علي ماتقدم يمكن القول ان شريطة الكلاب *Taenia hydatigena* تشكل خطرا في مدي واسع علي المجترات والحيوانات البرية بسبب ان زيادة انتشارها والقدرة الامراضية التي تحدثها ممكن ان تؤثر علي الصحة العامة .وبناء علي ما تقدم يمكن القول ان انتشار شريطة الكلاب يزيد من تاثير هذا الطفيل المرضي علي الاغنام والماعز في مدينة مطروح.

الكلمات الدالة: الطور اليرقي- الاغنام والماعز- شريطة الكلاب- مجزر علم الروم- مطروح