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【论著】

Epidemiology and Risk Factor Analysis for Canine Echinococcosis in a Tibetan Pastoral Area of Sichuan

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【Abstact】 Objective To determine the prevalence and evaluate the risk factors of canine echinococcosis based on a field survey of dog infections with *Echinococcus granulosus* and *E. multilocularis* in Chalong, Kalong, Dade and Chazha Townships in a district of Ganzi County, Sichuan Province, China. **Method** Questionnairing associated with the acquisition of canine echinococcosis was administered to dog owners. Stray dogs were examined post-mortem and rectal faeces at necropsy were collected to validate a coproantigen ELISA. Owned dogs were screened for *Echinococcus* spp. infection in faeces using the genus specific copro-ELISA and the effectiveness of dog treatment was assessed. Chi-square and one-way ANOVA were used for statistical analysis. **Results** The prevalence of *Echinococcus* spp. infection at necropsy in stray dogs was 60.9% (14/23) in 2000; *E. multilocularis* infection accounted for 34.8% (8/23) and *E. granulosus* for 26.1% (6/23). The specificity of the copro-ELISA was 80.0% and the sensitivity was 92.3%, compared with the results at necropsy. Fifty percent of owned dogs (290/580) tested was coproantigen positive at the beginning of the project in 2000, which decreased to 17%(99/580) in the same cohort of owned dogs after praziquantel treatment (5 mg/kg) at 6-monthly period from 2003 to 2005. Analysis for risk factors associated with coproantigen positive dogs showed that the never tethered dogs had a higher rate (40.4%, 65/161) than dogs tethered during the day (32.3%, 109/337), or tethered at night [29.2%(21/72)], or those always tethered [20%(2/10)]($P<0.01$). Dogs that their owners lacked hydatid transmission knowledge [38.1% (121/318)] and did not have de-worming practice [47.7%(92/193)] had significantly higher copro-antigen positive rate than those dogs that their owners knew relevant knowledge [28.6% (75/262)] and were dewormed regularly [20.4%(79/387)]($P<0.05$ and $P<0.01$). There was no correlation between the prevalence and dog sex or age or the varieties of livestock that the owner raised. **Conclusion** Local dogs show high prevalence with both *E. granulosus* and *E. multilocularis*. The copro-ELISA can be used to detect infection of *Echinococcus* in dogs. Allowing dogs to roam, lack of the basic knowledge of hydatid disease transmission and no de-worming practice for dogs are significant factors for the transmission of canine echinococcosis.

【Key words】 *Echinococcus*; Epidemiology; Coproantigen; Risk factor; Control; Prevalence; China

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四川省藏族牧区家犬棘球绦虫病流行病学调查研究

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【摘要】 目的 对四川省甘孜县达通玛藏族牧区家犬感染细粒棘球棘球绦虫和多房棘球棘球绦虫进行流行病学调查和评价感染风险因素。 **方法** 分别对甘孜县达通玛藏族牧区查龙、卡龙、大德和查扎等 4 乡的犬主进行问卷调查, 了解家犬感染棘球绦虫的相关因素。剖检流浪犬, 检测棘球绦虫感染率, 并用此结果评价粪抗原-ELISA 方法。用该方法

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检测家犬感染棘球绦虫的阳性率，评价犬驱虫效果。用χ^2 检验和方差分析对结果进行统计。 **结果** 2000 年流浪犬棘球绦虫感染率为 60.9%（14/23），其中细粒棘球绦虫感染率为 26.1%（6/23），多房棘球绦虫感染率为 34.8%（8/23）。粪抗原-ELISA 特异性为 80.0%，敏感性为 92.3%。家犬粪抗原-ELISA 阳性率平均为 50%（290/580）。从 2003 年起，经每半年 1 次吡喹酮犬驱虫（5 mg/kg），2005 年同一犬群粪抗原阳性率降为 17.0%（99/580）。犬感染风险因素调查发现敞放犬粪抗原阳性率 [40.4%（65/161）] 明显高于半栓养犬 [白天拴养夜晚放养的犬 32.3%（109/337）；夜晚拴养白天放养的犬 29.2%（21/72)]及一直栓养的犬[20%(2/10)]（P<0.01）；主人缺乏防治相关知识的犬 [38.1%（121/318)] 和不进行驱虫的犬 [47.7%（92/193)]，阳性率明显高于主人具有相关知识 [28.6%（75/262)] 和驱虫犬 [20.4%（79/387)]（P<0.05 和 P<0.01）。粪抗原-ELISA 阳性率与犬的年龄、性别和饲养家畜的种类无关。 **结论** 四川省甘孜县达通玛藏族牧区是家犬两种棘球绦虫病流行区。粪抗原-ELISA 法可用于检测犬棘球蚴病。犬敞放和不对犬驱虫，以及牧民缺乏相关知识是造成家犬棘球蚴病传播、流行的重要原因。

【关键词】 棘球绦虫；流行病学；粪抗原；风险因子；控制；流行；中国

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The Tibetan plateau of western China has been considered to have a high prevalence of cystic echinococcosis (CE) caused by larval stage of *Echinococcus granulosus* and alveolar echinococcosis (AE) caused by larval stage of *E. multilocularis* in humans [1-3]. Humans become infected by ingesting the eggs derived from faeces of the definitive host. Contaminated food or water supply, or contact with the definitive hosts have been suspected as infectious source of human cases. Canine animals are the major definitive hosts harbouring the adult worms (canine echinococcosis) . The worm burden in domestic dogs tends to be over dispersed and very high intensity (over 10 000 worms) may occur; however, the mean worm burden is usually 200–300 worms per dog[4]. Surveillance of *Echinococcus* spp. infection in dogs is useful for establishing a baseline of infection at the beginning of a control program, and for monitoring progress in control. It can also indicate the potential risk to humans of being infected with hydatid disease[5].

Datangma District of Ganzi County (Figure 1) covers an elevated area (average altitude 4 000 m) of 3 476 km^2, situated about 100 km north of Ganzi County in the northwest corner of the Ganzi Tibetan Autonomous Prefecture in Sichuan Province. There are four townships in this district comprising 29 villages: Chalong, Kalong, Dade and Chazha. The annual average temperature is 1.8 ℃ , total annual sunshine is 2 389 hours[6]. Winter (November to April) is a dry season, with most precipitation occurring in the summer(May to October). Ethnic Tibetans comprise 99% of the total population(about 9 000) with over 100 000 yaks and over 30 000 Tibetan sheep and goats[7]. A large number of owned dogs (>5 000) and stray dogs (> 2 000) exist in the area. In the winter, livestock are taken to lower altitude winter pastureland and to higher altitude summer pastureland during the spring. Local herdsmen live closely with their livestock and dogs due to their traditional productive style and religious belief. Since there are no abattoir facilities in the area, most slaughtering and carcass disposal are performed at home. Strong Buddhist beliefs do not allow for the elimination of stray dogs which are usually fed by the monasteries, so there are always more stray dogs roaming in the vicinity.

A previous survey showed that both human AE and CE were prevalent in Datangma District [8] and a further study revealed that the local dogs could har-

Fig.1 The map of Sichuan Province and project implemented area in Ganzi County

bour these two species of taeniid tapeworm[9]. It is considered that domestic dogs are the primary definitive host for both *E. granulosus* and *E. multilocularis* transmission to human in this region[10]. However, no studies of epidemiology and risk factors for canine echinococcosis have been carried out previously. It has become increasingly important to evaluate the epidemiological situation of the parasite especially in owned dogs in order to determine trends in infection frequency, and to determine the relative risk factors for canine echinococcosis in endemic communities.

Materials and methods

1 Design

The first part of the study was to determine the prevalence of canine echinococcosis infection in stray dogs by necropsy. Secondly, a coproantigen-ELISA was validated against the post mortem findings and this genus specific assay was used to estimate *Echinocucus* coproantigen prevalence in owned dogs. Multistage sampling took place before and after 6-monthly interval of praziquantel treatment (5 mg/kg) for a same cohort of owned dogs and samples were tested using this method sequentically. Thirdly, 20 herdsmen or householders who were willing to participate voluntarily in this study from each village were randomly selected to carry out the questionnaire survey for risk factor identification of canine infections.

2 Necropsy of stray dog

In October 2000, 23 of unwanted dogs were necropsied [11] after euthanasia by food-ball with para-aminopropiophenone (PAPP)[12] at the beginning of the project. The small intestine was removed out, slit open from the stomach end downwards, the inner surface was inspected. Rectal faecal samples were collected in 50 ml of lid-screwed plastic tubes. The parts of intestine containing worms were placed in a bucket of warm 0.85% saline for 10 minutes. The intestine was then agitated gently, and left for another 5 minutes. When mucus started to come off, the intestine was removed. After the worms were settled, the liquid was carefully poured off. The residue was tipped into a small container and the worms were washed by sedimentation with 1 or 2 more changes of saline until they were clean. Then the worms were kept in leak-proof bags with 0.85% normal saline. All materials were taken to laboratory later. Faeces in tubes was frozen at −80 ℃ for at least 3 days or heated at 70 ℃ overnight to kill the eggs before faecal extracts were made using sample buffer [PBS containing 0.02% thiomersal and 0.3% Tween-20 (BDH) and 1% formalin]. Worms were counted, and placed in 5% formalin in saline or 75% ethanol. Morphological identification was made by microscopy.

3 Dog treatment, faecal sample collection, and questionnairing

Praziquantel tablet for owned dogs at 6-monthly (Spring and Autumn respectively) interval was one of the control tools in this project. Each dog was dosed orally with one praziquantel tablet (Nanjing Pharmaceutics, China, 200 mg/tablet). Dog weights ranged from 5 kg to 40 kg, so the biggest dogs received 5 mg/kg praziquantel, which is an appropriate dosage for removing *Echinococcus* cestodes. From the Spring of 2003 on, all dog-owners in the study area were requested to carry out the de-worming practice at 6-monthly interval.

The village veterinarians and cadres were asked to select 20 houses that were representative of the village, and to collect a deposited faecal sample from a tied dog at each household and were expected to collect subsequent samples from the same household and same dog if the dog was still alive. A total of 580 owned dogs were registered for faecal sampling and coproantigen detection. Each sample of 10 g (approx.) faeces was collected into a 50 ml screw-capped tube labeled with the dog reference number (1–580). During the Autumn of 2000, and 6-monthly from the Spring of 2003 to the Spring of 2005, 6 occasions of faecal collection for coproantigen analysis preceded treatment were done in the study area.

A questionnaire survey written in both Mandarin Chinese and Tibetan was conducted orally to dog owners. The first part of the questionnaire was designed for general information about the dog owner including name, village name, education level, occupation, the variety and the number of livestock owned. The second part included dog information focusing on age, gender, breed and when tied. Dog owners were also asked for whether or not they practiced home slaughter and how they disposed of slaughter offal, whether or not they knew the basic knowledge of the transmission for echinococcosis.

4 Coproantigen detection for dog faeces

A safe diagnostic assay detecting coproantigen in heat-sterilized faecal samples had been developed for adult *Echinococcus* infections [13]. In this study, the double sandwich enzyme-linked immunosorbent assay (ELISA) was modified [14]. Faecal samples were mixed (1∶2) with sample buffer and then heated at 70℃ overnight to kill the eggs. The following day, sample extracts were centrifuged, the supernatants were tested for the presence of *Echinococcus* coproantigen using ELISA standardized against 23 necropsied dogs that utilized a capture antibody against EgES (Excretory/Secretion of *E. granulosus*, treated with proteinase K) or EgFT (fragment/tegument of *E. granulosus*, treated with proteinase K) in rabbits and a detection antibody against EgES or EgFT in sheep. The cut-off value for positive-negative threshold was determined as $>3s$ (standard deviation) above the mean absorbance (A_{450}) for 21 control dogs from a nonendemic area in the province.

5 Statistics

Information obtained from the questionnaire was inputted into an EpiInfo Version 3 database and was analyzed for the infection factors associated with echinococcosis in owned dogs.

Results of coproantigen test were put into an Excel spreadsheet (Microsoft, 2003). The first set of household data collected in September 2003 was examined for the association between the test results (coproantigen positive or negative) and the questionnaire. A Chi-square and one-way ANOVA were utilized to do the analysis.

Results

1 Dog necropsy

Fourteen out of 23 stray dogs were found infected by necropsy (60.9%), of which 8 dogs (34.8%) infected with *E. multilocularis* and 6 (26.1%) harbouring *E. granulosus*. Nine of these dogs did not have *Echinococcus* worms although 4 infected with *Taenia serialis* or *T. pisiformis*. There was no significant difference between dog sex and the prevalence or intensity of infection. Light infection with a low worm number (< 300 adult worms/dog) was seen in 2 dogs (14%), 7 (50%) of the infected dogs harboured 300–2000 worms each and 5 (36%) with heavy infection(> 2 000 worms). Dogs infected with *Echinococcus* spp. could harbor other *Taenia* worms at the same time. Three out of 23 dogs (13.0%) were infected with both *E. multilocularis* and *Taenia* worms. Two dogs (8.7%) were also found infected with *Dipylidium caninum*.

2 Coproantigen detection

The copro-ELISA was assessed against findings of the 23 necropsied dogs, with a sensitivity of 92.3% (12/13) and a specificity of 80.0% (8/10) (Table 1).

The overall coproantigen positive figures in owned dogs were shown in Table 2. In the absence of any hydatid control at the beginning in 2000, 50% of dogs had faeces that were positive to *Echinococcus* in coproantigen test, Chazha Township had the highest copro-prevalence at 58.0%, the rest 3 townships had a copro-positive around 46.0%. After de-worming implementation since 2003, the overall coproantigen positive rate gradually decreased to 17% in October of 2005.

Table 1 Coproantigen-ELISA results against post-mortem finding in dogs (n=23)

Coproantigen ELISA	Necropsy finding		
	Positive	Negative	Total
Positive	12(a)	2(b)	14
Negative	1(c)	8(d)	9
Total	13	10	23

Note: Sensitivity = a /(a+c)× 100% = 12/13 × 100% = 92.3%,
Specificity = d /(b+d) × 100% = 8/10 × 100% = 80.0%.

Table 2 Number of coproantigen positive owned dogs from each survey (n=580)

Township	Sep.2000	May.2003	Sep.2003	Apr.2004	Oct.2004	Apr.2005
Chazha	58	6	23	21	30	20
Chalong	44	35	23	26	27	22
Kalong	46	21	40	55	22	11
Dade	49	41	30	7	23	15
Total	50	35	30	30	26	17

3 Correlation associated with a positive coproantigen test and risk factors

In 2003, there were 2 villages (Duoyong and Yinduo) with higher coproantigen positive rate ($P<0.01$) in dog coproantigen tests within Chazha Township. There was no significance ($P>0.05$) of coproantigen-positive dogs among villages in Chalong Township. In the townships of Kalong, Duobu and Haxi 2 had higher rate ($P<0.05$) of coproantigen-positive dogs. Jiarong and especially Tuhua had higher rates ($P<0.01$) of coproantigen-positive dogs in Dade Township (Table 3).

The age, sex of dogs, number of yaks and/or sheep/goats owned by the dog-owners were not found to be associated with coproantigen-positive rate ($P>0.05$). But the proportion of coproantigen-positive dogs was associated with the period of the day or night when the dog was let loose ($P<0.01$). There was a significant difference in coproantigen level among never tethered dogs (40.4%) and other dog restraint groups [tethered during the day (32.3%), tethered at night (29.2%), or always tethered (20.0%)]. The coproantigen-positive rate in the group of no de-worming practice for dogs was 47.7% ($P<0.01$) and the group of lack of owner knowledge about hydatid disease was 38.1% ($P<0.05$) (Table 4).

Table 3 Univariate analysis for possible variables associated with the number of coproantigen-positive dogs (n=580) **in 29 villages of the 4 townships**

Township	Village	Number of tested samples		
		Total	Positive	%
Chazha				
	Duoyong	20	12	60.0*
	DeXi	20	6	30.0
	Mutong 1	20	5	25.0
	Yarong	20	6	30.0
	Mutong 2	20	5	25.0
	Mutong 3	20	3	15.0
	Yinduo	20	13	65.0*
	Subtotal	140	50	35.7
Chalong				
	Chalong 1	20	9	45.0
	Chalong 2	20	4	20.0
	Jiqing 1	20	6	30.0
	Jiqing 2	20	10	50.0
	Nanka	20	6	30.0
	Subtotal	100	35	35.0
Kalong				
	Kalong	20	4	20.0
	Asha 1	20	4	20.0
	Liuzu 1	20	2	10.0
	Haxi 1	20	2	10.0
	Haxi 2	20	9	45.0**
	Asha 2	20	1	5.0
	Liuzu 2	20	3	15.0
	DuoBu	20	8	40.0**
	Subtotal	160	33	20.6
Dade				
	Ajia 1	20	7	35.0
	DaLong	20	2	10.0
	Ajia	20	6	30.0
	Narong	20	8	40.0
	Qilong	20	7	35.0
	Zhonglong	20	9	45.0
	Gongma	20	4	20.0
	Tuhua	20	17	85.0*
	Jiarong	20	13	65.0*
	Subtotal	180	73	40.6
Total		580	191	32.9

Note: * $P<0.01$, ** $P<0.05$.

Table 4 Univariate analysis for possible variables associated with the acquisition of coproantigen-positive dogs (n=580)

Variables	Number of tested samples		
	Total	Positive	%
Sex			
Female	178	52	29.21
Male	402	130	32.34
Tied-time			
Day	337	109	32.34
Day & night	10	2	20.00
Free	161	65	40.37*
Night	72	21	29.17
Age			
≤1 year	162	50	30.86
>1 and ≤5	255	77	30.20
>5 years	163	46	28.22
De-worming practice			
Yes	387	79	20.41
No	193	92	47.67*
Hydatid knowledge			
Yes	262	75	28.63
No	318	121	38.05**
Livestock owned by household			
Yaks	414	122	29.47
Sheep/goats	61	19	31.15
Both	105	30	28.57
Total	3 480	1 090	31.32

Note: Day: Tethered during the day, Day & night: Always tethered, Free: Never tethered, Night: Tethered at night, Yes: Having de-worming practice and dog owner with hydatid knowledge, No: No de-worming practice and dog owner without hydatid knowledge; * $P<0.01$, ** $P<0.05$.

Discussion

Human echinococcosis (hydatidosis) is an important parasitic disease with wide distribution particularly where pastoralism is common[15] and /or have a high density of small mammals[16]. In China, hydatidosis mainly prevails in northwest regions/provinces, namely, Xinjiang, Qinghai, Gansu, Ningxia, Inner

Mongolia and Sichuan[17]. Several reports have shown that human echinococcosis is prevalent in the eastern Tibetan Plateau of western Sichuan Province[1-3,10,18]. Ganzi County in Ganzi Prefecture of western Sichuan has shown the highest prevalence of human hydatid disease yet recorded[1,2]. The prevalence and mean abundance of *Echinococcus* infection in dogs is probable the best index of the extent of transmission potential for this zoonotic parasite in a local area[26,27], so it is necessary to carry out an investigation on dog infection with *Echinococcus* spp.

The most accurate detection for *Echinococcus* spp. infection in dogs is parasitological examination of the small intestine by necropsy. But this technique is biohazardous, labor intensive[19], especially difficult in Tibetan community where strong Buddhist belief does not allow dog-killing. Therefore, necropsy for surveillance of infection in dogs is not a practical way. Detection of *Echinococcus* eggs in faeces from infected definitive host is an alternative, but eggs are morphologically indistinguishable among taeniid families and the eggs do not occur in definitive host faeces during prepatency [20]. Arecoline purgation is the most widely used method of ante-mortem diagnosis for infection of taeniid worms in dogs. But this procedure is time-consuming and lacks sensitivity[21]. Recently a coproantigen technology for detecting specific *Echinococcus* antigens in faeces of infected dogs has been developed and several papers have been published to describe the methodology[22-24]. An improved coproantigen ELISA test was utilized in this study to follow-up the change of dog infection before and after treatments with praziquantel during the control period from 2000 to 2005[14]. The assessment of the coproantigen-ELISA against a total of 23 necropsied dogs indicated a sensitivity of 92% (12/13) and a genus specificity of 80% (8/10). The advent of this technique has increased the effectiveness and acceptability of dog survey.

At the beginning of this project in 2000, a necropsy survey of stray dogs, together with a much large coproantigen survey of owned dogs from 580 homesteads later, was undertaken to obtain the baseline of dog infection with *Taenia* worms and to assess more recent transmission and to identify risk factors for canine echinococcosis in the study area. Dog faeces at necropsy were collected to validate the reliability of this coproantigen-ELISA assay. The necropsy survey of stray dogs revealed an overall prevalence of 60.9% (14/23), with a prevalence of *E. multilocularis* of 34.8% (8/23) and *E. granulosus* of 26.1% (6/23). Furthermore, high prevalence (26%) of other *Taenia* infection was observed at post-mortem in dogs from these localities which also indicated access of dogs to offal. The coproantigen-ELISA survey of owned dogs gave a positive rate of 50% in 2000. Those results seemed consistent with human echinococcosis infection of 7.7% (AE was 4.6%, CE was 3.1%) diagnosed by abdomenal ultrasound scanning in this area in 1998[8].

It seems that there is a slow improvement over the 5 years in the number of dogs found infected at 6-monthly period as shown by coproantigen analysis, probably due to more dogs being treated with praziquantel. But we found that the coproantigen findings much more relied on the correction of dog faecal collection each period. During the coproantigen-ELISA analysis sometimes one village might have 7 or more dogs all with the same result, but with sequential dog numbers. This was probably due to the faecal samples all being collected from one or fewer dogs. Because of the distances involved (up to 26 kilometers from the township government building) and the need to use horses or motorbikes for travel, faecal collection was not easy. The wrong collection of dog faeces induced unusual coproantigen-ELISA results for Chazha (6%) in May 2003, Kalong (55%) and Dade (7%) in April 2004, in comparison to other data obtained from the same time. Usually, the township veterinarian delivered the equipment and note book to each village veterinarian, with appropriate training, and returned to pick up the collected samples and note book for delivery to the Datangma district government base. So it was difficult to supervise the process of faecal collection.

The risk factor analysis showed that the infection was not correlated with dog sex or age or the number of livestock raised by dog owners. But coproantigen-positive rate was associated with allowing dogs to roam all the time ($P<0.01$ in never tethered dogs). This indicates that never tethered dogs have more opportunities to hunt small mammal intermediate hosts or the discarded livestock offal, and therefore have more access to the infection than dogs that tethered or partially tethered. The opportunity for infection comes from ubiquitous rodents (especially *Ochotona curzoniae* and *Lepus oiostolus*) which were often found infected with *E. multilocularis*, and from old sheep, goats and yaks infected with *E. granulosus*, which died in the field or home-slaughtered [25]. So if the traditional Tibetan herding lifestyle is to be maintained, and there are no changes in animal husbandry or dog control, echinococcosis will still remain a human problem. Lack of basic knowledge about hydatid disease among dog owners is also a significant risk factor ($P<0.05$) correlated to a coproantigen-positive dog. This might be explained by the frequent practice of feeding livestock offal to dogs. Absence of routine deworming practice is highly associated with ($P<0.01$) the proportion of coproantigen-positive dogs.

In general, better and effective education about echinococcosis transmission for herdsmen and more frequent praziquantel treatments for all dogs are needed to control echinococcosis in this Tibetan community.

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【读者 & 作者】

对天津报道的耻阴虱形态结构的更正

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中图分类号：R384.31　　文献标识码：D

耻阴虱（*Pthirus pubis* Linnaeus，1758）是一种古老的人体吸虱。赵广明等报道的“阴虱显微合成图片形态观察及测量”一文（中国寄生虫学与寄生虫病杂志，2006，24（1）：Ⅰ-Ⅱ）中血管网、血管窦和雌性泄殖孔等结构与前人记述[1,2]的大相径庭，笔者认为是错误的，特提出讨论并作更正。

“血管网”：昆虫的主要循环器官是背血管，位于背中线体壁下方，是纵贯于背血窦(dorsal sinus)中央的一根纵向的细长管道，从尾端一直延伸到头内。其管壁由肌纤维和结缔组织组成。背血管分成直管型、球茎型和分支型[3]。在常规脱水，透明处理的标本中难以看到血管。赵广明等报道的图 A，B-8 所指的“血管网”，其形态和所处部位，显然与昆虫的背血管不相符。

昆虫的气管系统是管状系统，气管内膜(壁)形成环状或螺旋状突起的几丁质构造——螺旋丝[3]，螺旋丝易见[4]。因此，赵广明等所谓的“血管网”，应是 Keilin 等[2](1930)所描述的主纵气管干（main longitudinal tracheal trunk）、气门气管支(spiracular tracheal branch)、后横(气管)连索(posterior transverse commissure)和三根横前(气管)连索（transverse anterior commissures）。

“血管窦”：昆虫整个体腔或血腔被两片纤维肌隔膜分隔成围心窦或背血窦（pericardial sinus）、围脏窦（visceral sinus）、围神经窦或腹血窦（perineural sinus）、前窦（anterior sinus）和后窦（posterior sinus）[3,4]，此外，尚有神经上窦（epineural sinus）[3]。这些血窦均呈空隙，其形态与赵广明等报道的图 1 所指的“血管窦”完全不同。文献报道的腹部第 4 节至第 9 节，呈 3-1-1-1 对称性有序排列，具有陷口和骨化的围气门板等结构的是耻阴虱的 6 对腹气门[2,4]。

“雌性泄殖孔”：昆虫的排泄功能是由马氏管和直肠共同完成的，食物残渣和排泄物经肛门排出体外[3,4]。赵广明等图 1 所指的“泄殖孔”，应是 George 等[1](1917)描述的肛门。

侧突(疣状突起)，笔者等 1993[5,6]首次报道耻阴虱Ⅲ龄若虫区分为雌若虫和雄若虫，Ⅱ~Ⅲ龄若虫和成虫各具侧突 5 对[5,6]。而赵广明等记述的侧突数（图 1），雌虫 4 对（少 1 对），雄虫 2 对（少 3 对），若虫 0 对（少 5 对）。

综上所述，耻阴虱的形态结构前人早已有描述。赵广明等提出的“血管网”、“血管窦”、“雌性泄殖孔”和雌虫、雄虫、若虫侧突数 4、2、0 是错误的。应分别更正为主纵气管干、气门气管支、后横连索、三根横前连索，腹气门（6 对），肛门和侧突数 5、5、5 对。

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