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Computed Tomographic Features of the Camel Nasal Myiasis

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ABSTRACT

The purpose of this work was to describe the computed tomographic (CT) features of nasal myiasis in camel (*Camelus dromedarius*), which caused by the larvae of camel nasal botfly *Cephalopina titillator*. Twenty infested heads of emergency slaughtered camels and five normal heads were obtained for the study. The normal anatomical features of the nasal cavity in CT images were identical to their cross sections without any pathological changes. The most commonly encountered CT findings in the infested group were (1) unilateral-rounded foci of soft tissue or fluid opacity in the ventral nasal concha in 100 % of cases, the foci also found bilaterally in the ethmoidal labyrinth 20% and frontal sinuses 5%. (2) Kidney-shaped hypolucent foci were found unilaterally in the ventral bulla 20% (3) Specific pattern of lesions distribution, which tend to be localized in three levels, the caudal two thirds of the ventral nasal concha, the ethmoidal labyrinth and the frontal sinus. It was concluded that, CT may be useful in detecting intranasal pathological changes associated with Cephalopina larval infestation in camel.

Introduction

Computed tomography is a reliable, non-invasive technique, and is superior to routine radiography for identification of nasal cavity diseases, defining the extent and severity of disease processes (Conder *et al*., 1993).

Camels (*Camelus dromedarius*) have great economic importance because it's a source of high-quality meat, diary and leather products, they also have been involved in many racing sports. Naopharyngeal myiasis caused health hazards and severe economic losses for the camel industry in many camel-producing areas of the world (Oryan *et al*., 2008). It caused by the larvae of camel nasal botfly *Cephalopina titillator* (Higgins, 1985). The larvae deposited into the nasal cavity and from there they crawl up to the nasopharynx, and remain attached to the mucous membrane for up to 11 months (Hussein *et al*., 1982). High mortality incidence among the infested camels may be related to the damages and penetrations of the turbinates caused by the migrating larvae, which facilitate secondary bacterial and viral infections causing meningitis and finally the camels die (Musa *et al*., 1989; Zayed, 1998).

The larval infestation is detected only during postmortem examination of the camel heads after slaughtering (AL-Nasr *et al*., 2013). Clinical signs are not enough for diagnosis as it depends on the amounts of damage caused by the migrating larvae. Using of computed tomography in early diagnosis of such a serious problem in camel may facilitate treatment and decrease losses. Computed tomography may provide vital information to assist in treatment planning and to provide prognostic infor-

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mation. However, to date there is no available study about the specific CT features of camel nasal myiasis. In this respect, the present study aimed to determine whether computed tomography is useful in detecting intranasal changes associated with Cephalopina larval infestation in camel.

Materials and methods

One hundred and twenty cases of adult male camels were suffered from difficulty in breathing, snort, sneeze and expel the larvae from their nostrils, finally they became restless and stopped feeding. They treated with ivermectin 200 µgm/kg sub-cut in the loose skin behind the shoulder. 30% of these cases were slightly responded to treatment, 40% did not respond and emergency slaughtered and 30% died. For this study, twenty heads of the emergency slaughtered camels and Five heads of apparently healthy camels were obtained from Shebien-Elkanater abattoir (Qalyubia Governorate, Egypt) during autumn season (in October and November). The non-infested heads were used for determining the normal anatomical structures in the series of CT images. The use of camel heads for this research complied with protocols approved by the institutional animal care committee and adhered to the legal requirements of our country.

Computed tomography performed at 130 Kv and 80 mAs by using Hitachi-CXR 4Multi-Slice CT scanner (Hitachi Medical Corp., Tokyo, Japan). Soft tissue-window (WL: 40, WW: 300), Bone window (WL: 2000, WW: 400) were used, continuous transverse series of CT scan obtained every 0.5 cm thickness from the level of the first mandibular incisors (nostrils) to the caudal border of the last check teeth (Ethmoidal labyrinth). The images printed by using Hitachi-digital printer and photographed. CT images of the infested heads studied in comparison to the non-infested group, then the heads were frozen at -15 ^{o}C and cross sectioned into slices of 0.5 cm thickness with a high-speed electric band saw. These sections were used to validate the accuracy of CT images.

Computed Tomographic features that were evaluated were: Presence or absence of abnormal soft-tissue and/or mucosal thickening, Presence of a focal rounded soft tissue accumulation, Destruction of the cribriform plate and/or the turbinates, and the extension of the lesions (rostral, middle, caudal nasal cavity, paranasal sinuses, uni- or bilateral). Abnormal shape or displacement of the anatomical structures, and any evidence of lucent foci (abnormal soft tissue or fluid opacity) was considered a positive pathologic change.

Results

Grossly, the larvae of *C. titillator* were white colored and measured 33-36 mm in length. They found in various locations in the infested heads (Fig.1). During examination most of the larvae were still alive and attached to the nasopharynx 18 of 20 (90%), ethmoid labyrinth 10 of 20 (50%), ventral nasal concha 8 of 20 (40%) and ventral nasal meatus 1 of 20 (5%). The mucous membrane of the affected parts was thick, congested and ulcerated. The dorsal nasal concha appeared normal, while the ventral one was the most affected structure. In prepared cross sections different sites of the ventral nasal conchae were either penetrated or enclosed dead or degenerated larvae (Fig. 3b). Amourphus masses of granulated tissue (Fig. 3a) were also found in the ethmoidal labyrinth, the ventral nasal concha, and the frontal sinus.

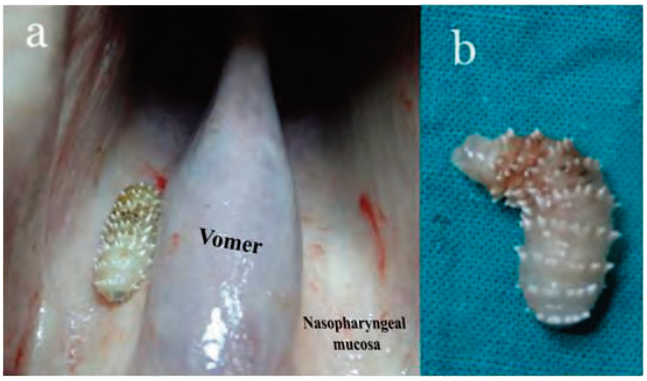

Fig. 1. A photograph of *C. titillator* infested camel: a) Note the larva still alive and loosely attached to the nasopharyngeal mucosa; b) 3rd instar of *C. titillator*.

The normal anatomical features of the nasal cavity in CT images were identical to their cross sections without any pathological changes. The nasal conchae (dorsal, ventral, and ethmoidal) were restricted to the caudal two-thirds of the nasal cavity, leaving the rostral third for the mucosal folds. The dorsal nasal turbinate was simple and formed of basal lamella rostrally, while its caudal third formed a sinus. The ventral nasal turbinate was complex and larger than the dorsal one, it formed of T shaped lamellae at the level of the last lower (mandibular) incisors (Fig. 2a). Dorsal and ventral spiral lamellae which enclosed recesses were

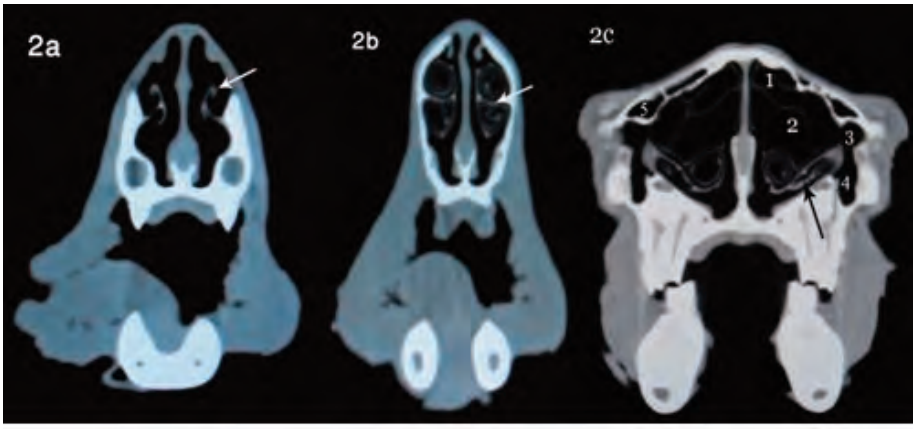

Fig. 2. Series of CT images of control group showing: a) T-shaped ventral nasal concha (arrow); b) Dorsal and ventral spiral lamellae of ventral nasal concha (arrow); c) Twisting of ventral nasal concha (arrow) and sinuses of dorsal (1) and middle (2) Nasal concha, 3-Lacrimal sinus, 4- Maxillary sinus, 5- Frontal sinus.

Fig. 3. Cross section caudal to the level of 2nd check tooth showing: a) Granulated tissue mass partly replaced the bulla of ventral nasal concha; b) Dead larva inside the bulla of ventral nasal concha.

formed at the level of the caudal third of the interdental space (Fig. 2b), while dorsal and ventral bulla formed at the level of second check teeth. Caudal to the third check teeth remarkable twisting of the ventral concha occurred (Fig. 2c). The previous level also showed the sinuses of the middle and dorsal nasal conchae, which extended caudally to the rostral border of the last check teeth (Fig. 2c).

The last series of CT images showed the ethmoidal labyrinth. The camel paranasal sinuses were appeared small and consisted of the maxillary, lacrimal and sphenoid sinuses. The frontal sinus was the largest and divided into lateral and medial parts, while the others were single (Fig. 2c,5).

The CT images of the infested heads showed positive pathological changes which found mainly in the caudal two thirds of the nasal cavity (bony part). The lesions were appeared at the level of the rostral border of the second check teeth and extended serially toward the nasal fundus. No pathological changes were observed between the level of the first lower incisors (nostrils) and the second check teeth. Lesions were mainly distributed in three regions, the caudal two thirds of the ventral nasal conchae, the ethmoidal labyrinth and the frontal sinus.

Rounded to crescent shaped foci of soft tissue or fluid opacity were found in the ventral parts of the ventral nasal conchae in 100 % of cases, when the CT images examined jointly with their corresponding cross sections, the rounded foci were related either to granulated tissue masses 60% or parts of the larvae 40% (Fig. 3a,4b). The rounded foci were appeared unilaterally in 100 % of cases (Fig. 3a), where it replaced the ventral bulla 20 of 20 (100%), parts of the twisted lamella of ventral nasal concha 12 of 20 (60%) (Fig. 4c). Hypolucent kidney-shaped foci were found unilaterally in the ventral bulla of the ventral nasal concha in 20% of cases, (Fig. 4a) these foci were related to complete larvae which found lying inside the bullae (Fig. 3b). Rounded foci of soft tissue or fluid opacity were also found bilaterally in the ethmoidal labyrinth in 4 of 20 (20%) of cases. The ethmoidal and ventral conchae have several abnormal fenestrae (penetration sites) and the mucous membranes were slightly thicker when compared to the normal group. No evidence of mucosal thickening or conchal penetration were observed in the CT images (Fig. 5). Hypolucent rounded foci of different sizes appeared unilaterally in 1 of 20 (5%) of frontal sinuses. The maxillary, the lacrimal sinuses and the dorsal nasal conchae did not show any abnormalities neither in CT or cross sections.

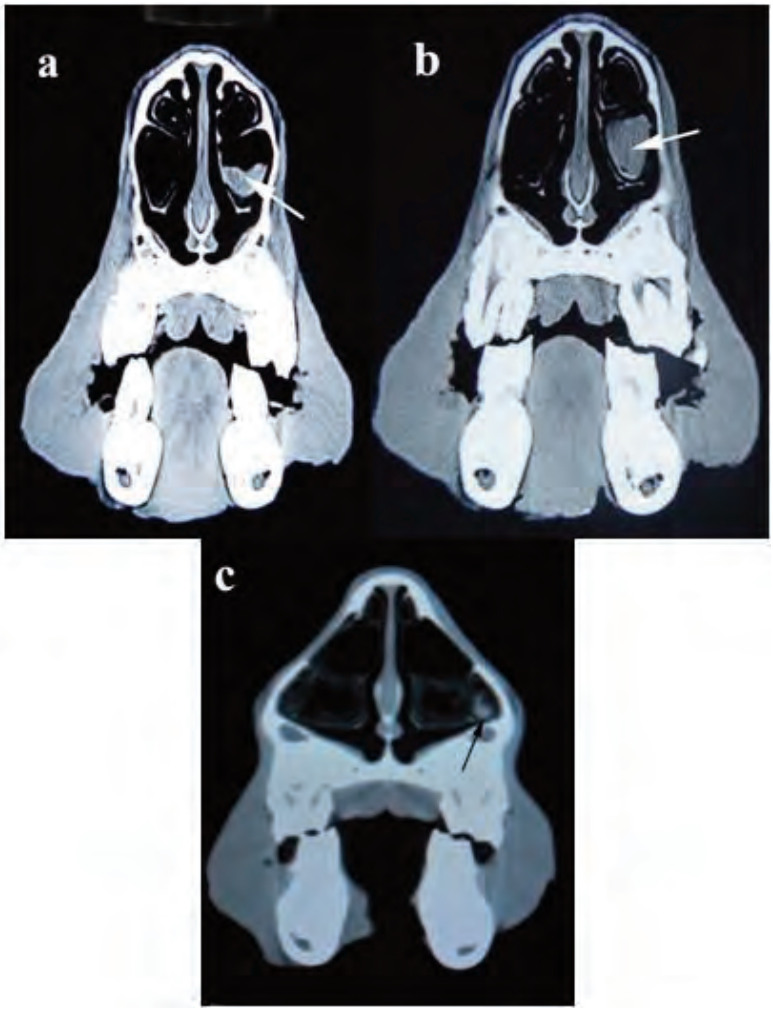

Fig. 4. CT image of infested camel showing: a) Kidney-shaped hypolucent area in the ventral nasal bulla (arrow); b) Rounded focus of soft tissue or fluid opacity in the ventral nasal bulla (arrow); c) Crescent-shaped area of soft tissue or fluid opacity in the twisted part of the ventral nasal concha (arrow).

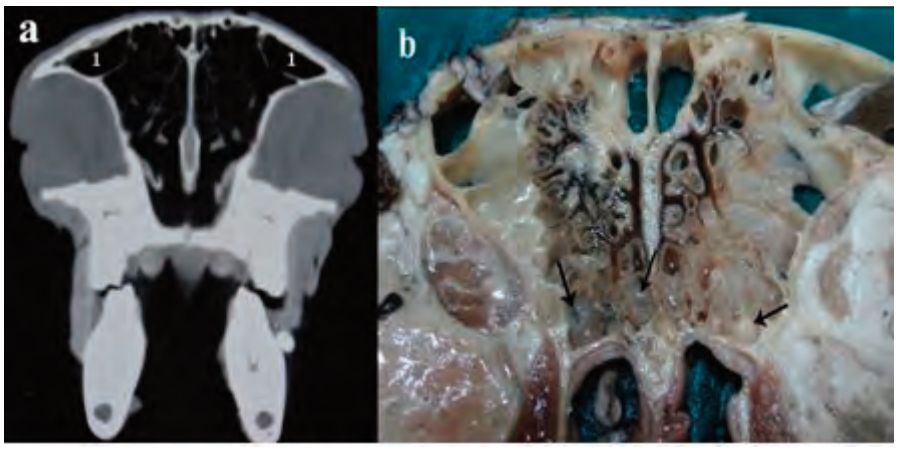

Fig. 5. CT image of infested ethmoidal labyrinth, and its corresponding cross section showing: a)1, The frontal sinus; b) Note the perforation and thickening of mucosa appear in the cross section but not distinguishable in its corresponding CT image.

Discussion

The radiological studies regarding the camel nasal cavity are very few. Therefore, this study attempted to provide the data which may help interpretations of CT images in both normal and infested animals. CT images provided excellent depiction and details of anatomical structures when compared to their identical cross sections. The result concerned the normal camels were in-agree-

ment with the current few literatures (Badawy *et al*., 1974; Eshrah, 2011). These results also revealed some pecularities of the camel nasal cavity which could be summarized as follows, the conchae restricted to the caudal two-thirds of the nasal cavity, the caudal third of the ventral nasal concha was twisted, and the paranasal sinuses were very small sized. The previously mentioned features were also found in Bactrain camels and proboscis-bearing mammals which known for their ability to adapt with hard climatic conditions (Clifford and Witmer, 2004; Zhong *et al*., 2011).

Nasal myiasis is a serious problem for the camel-industry because of its high incidence in camels 70-100% and its high fatality rate (Hussein *et al*., 1982; Higgins, 1985; Oryan *et al*., 2008). In this study all the infested heads were of adult males, it was reported that males were more susceptible to *C. titllator* infestation than females (Abd El-Rhman, 2010). All heads were obtained from emergency slaughtered camels and Late diagnosis may be the cause of losses.

Currently, Diagnosis of nasal myiasis in camels depends mostly on the clinical signs which usually accompanied the migration of 3rd instar during autumn season (Morsy *et al*.,1998; Zayed, 1998). The reason of high mortality rate may be due to the large-sized 3rd instar larvae (33-35 mm) which caused serious damages to the nasal passages during migration (Zayed, 1998; Otranto, 2001), in addition the camels poorly responded to ivermectin during this stage as it may immobilize the larvae, but could not overcome the intensity of damage. Early detection of myiasis may facilitate treatment, especially in the summer season when the larvae still small in size (0.7 mm) (Zayed, 1998; Otranto, 2001). Neither clinical signs or post-mortem examination are suitable for early diagnosis of camel nasal myiasis, hence the need of new diagnostic tools. This study tried to validate CT as a diagnostic tool for nasal myiasis through demonstration of its ability to detect the pathological changes caused by larval infestations in the camel nasal myiasis.

Computed tomography is excellent imaging modality however, its usage in the large animal medicine is limited due to its expense, availability and the animal should be anaesthetized before scanning (Garland *et al*., 2002). Nevertheless, it has some potential advantages over the conventional radiography; it provides a cross-sectional image with superior soft tissue differentiation and no superimposition of the overlying structure. CT is also superior to radiography in demonstrating the extent of lesions and differentiating chronic infectious rhinitis in both dogs, cats and human (Conder *et al*., 1993). Magnetic resonance imaging (MRI) is another excellent imaging modality for the nasal cavity, but CT is currently the most popular imaging technique because it lacks ionizing radiation used in MRI and its lower cost compared with MRI (Garland *et al*., 2002). Computed tomographic findings of dog and cat chronic rhinitis has been widely studied, On the contrary and to our knowledge, there is no specific study for the CT features of camel chronic rhinitis or nasal myiasis.

Computed tomography used in diagnosis of nasal myiasis in man successfully, where radiological findings presented as rounded hypolucent images in CT scans (Carlos *et al*., 2005). Results revealed similar findings in CT scans of the infested camels, whereas rounded to crescent shaped foci of soft tissue or fluid opacity were found in the ventral parts of the ventral nasal conchae in 100 % of cases, the ethmoidal conchae 20% and the frontal sinuses 5%. Except at the level of ethmoidal labyrinth and the frontal sinuses the lesions were mostly unilateral. No pathological changes were found in the dorsal nasal concha, the lacrmial or the maxillary sinuses. No camel had an ethmoidal or frontal sinus lesion without a concurrent abnormality in the ventral nasal concha. These findings suggest that nasal myiasis in these camels presented as a destructive, slowly progressive process, affecting the ventral nasal concha, then extending into the contralateral nasal cavity and/or ipsilateral ethmoidal conchae and frontal sinus. Finally, the damages and penetrations of the turbinates caused by the migrating larvae may facilitate secondary bacterial and viral infections causing meningitis which has been reported as the main cause of death in camel nasal myiasis (Musa *et al*., 1989; Zayed, 1998).

It may be difficult to differentiate nasal myiasis from chronic rhinitis cases as both diseases cause soft-tissue opacification (Windsor and Johnson, 2006). However, nasal myiasis seems to have a specific pattern of lesions distribution, which tend to be localized in three levels, the caudal two thirds of the ventral nasal concha, the ethmoidal labyrinth and the frontal sinus. The pattern nearly illustrate the route of the larval migration, which did not include the dorsal nasal concha or the dorsal parts of

the ventral nasal conchae. Abnormalities were found in 100% of ventral parts of ventral nasal conchae, as these parts perform the main route of larval migration for 11 months (Zayed, 1998; Otranto, 2001). The maxillary and the lacrimal sinuses were not affected that may be referred to the very small size of these sinuses in camel. The pattern of chronic rhinitis is different, as abnormalities noted on CT are often diffusely distributed throughout the nasal cavity, but rostral or caudal localization may be observed (Windsor and Johnson, 2006). Rostral localization not found in these camels, and No pathological changes were observed between the level of the first lower incisors (nostrils) and the second check teeth.

Conclusion

Computed tomography may be useful in detecting intranasal changes associated with Cephalopina larval infestation in camel. The abnormalities noted on CT were located mainly in the caudal two thirds of the nasal cavity, caudal to the level of the rostral border of the second check teeth. The characteristic CT features of camel nasal myiasis were rounded to crescent shaped foci of soft tissue or fluid opacity were found in the ventral parts of the ventral nasal conchae in 100 % of cases, the ethmoidal conchae 20% and the frontal sinuses 5%. The pattern of lesions distribution may be useful in differentiation between nasal myiasis and other cases of chronic rhinitis.

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