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Lymphatic Drainage Conduit and Macro Anatomy of Lymphoid System in Large Intestine of Post Weaned Pigs

K.B. Dev Choudhury[1], M. Sarma[1]

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ABSTRACT

Background: The gut mucosa is effectively protected by a local organization of lymphoid tissue. In large intestine, isolated lymphoid follicles give rise to solitary lymphoid nodules and lympho glandular complexes, which are responsible for sampling of gut antigen and production of local immunity. Large intestine requires higher level of mucosal protection as because it is the site where food staff remains for a longer period and also for ascending rectal infection. Present study was undertaken highlighting the lymphatic drainage from large intestine and solitary lymphoid nodules of pig.

Methods: 1% solution of methylene blue up to 100 micro litters in the one place of submucosa of large intestine as per the standard technique advocated by Smedley *et al.* (2014) and then stained nearest mesenteric lymph nodes were recorded and re-injected to map the drainage to the next draining lymph node to trace the lymphatic tract.

Result: The study was designed on 12 (Twelve) apparently healthy weaned crossbred piglets of 3 to 4 months age irrespective of sex. Gross study revealed the presence of two different types of solitary lymphatic nodules (SLN) *viz*. scrotiform and faviform. The scrotiform SLN consisted of central small pore was appreciated in colon and rectum, whereas the faviform SLN although present in colon and rectum was devoid of a central pore. The average solitary lymphoid nodules in the large intestine was 427, of which 403 in colon and 24 in rectum and in terminal part of rectum patches of solitary lymphoid nodules of more than 100 numbers were observed. The different lymph nodes involved in the lymphatic drainage of large intestine of pig were colic caecal, anorectal, lumbar aortic, renal, medial lumbar and lateral lumbar lymph nodes. Again, except the right and left lumbar duct, one minor lymphatic trunk was observed parallel to the rectum, draining the lymph from anorecral lymph node to caudal mesenteric lymph node and then to renal lymph node. The celiac trunk and the jejunal trunk joined and formed a common trunk which was again joined by the colic trunk that finally opened into the caudal aspect of cysternachyli.

Key words: Large intestine, Lymphoid system, Organisation, Pig, SLN.

INTRODUCTION

The lymphatic system is a part of vascular system provides the basic information for immune surveillance and transport of nutrients and antigen from the intestine.

In India, Animal Husbandry piggery sector directly influences the socio economic status of rural poor, more particularly the tribal population. It is a promising enterprise in entire North Eastern region of India because of low rearing cost, high prolificacy, early marketable age and fast income generating potential. As the rural poor rear pigs under nomadic system, therefore, various diseases caused by different microbial agent has substantial health and economic impact.

The gut mucosa is effectively protected by a local organisation of lymphoid tissue. However, entry of antigen into the host is made possible by a special gateway comprising of “M” cells, located over organised lymphoid follicles. In large intestine, isolated lymphoid follicles give rise to solitary lymphoid nodules and lymphoglandular complexes, which are responsible for sampling of gut antigen and production of local immunity. Large intestine requires higher level of mucosal protection as the large intestine is the site where food staff remains for a longer period and of ascending rectal infection.

The gut associated lymphoid tissue is formed by Peyer’s patches in the small intestine and isolated or solitary lymphoid nodule in large intestine (Nickel *et al.,* 1996 and Frappier, 2007).

To understand the basic component of lymphatic system of large intestine, a study of solitary lymphnode and lymphoglandular complex and lymphatic drainage to nearest lymph node is necessary to study. Keeping this fact in mind, the present study was undertaken about the macroanatomy of the large intestinal lymphatic system, highlighting the lymphatic drainage from large intestine and solitary lymphoid nodules of pig.

[1]Department of Veterinary Anatomy and Histology, College of Veterinary Science, Assam Agricultural University, Khanapara-781 022, Assam, India.

Corresponding Author: K.B. Dev Choudhury, Department of Veterinary Anatomy and Histology, College of Veterinary Science, Assam Agricultural University, Khanapara-781 022, Assam, India. Email: kamal.b.devchoudhury@aau.ac.in

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MATERIALS AND METHODS

Present study was conducted for a period of three years in Department of Veterinary Anatomy and Histology, College of Veterinary Science, Assam Agricultural University, Khanapara. The study was designed on 12 (twelve) growing, apparently healthy piglets irrespective of sex and breed and after humane sacrifice with the approval of institutional animal ethics committee (Approval No. 770/ac/CPCSEA/FVSC/AAU/IAEC/17-18/488 dated 09.08.2017) the abdominal cavity was opened by laparotomy and the gross investigation on presence of solitary lymph node was done.

The distribution area, numbers of SLN of large intestine was recorded grossly as per the techniques done by Gautam (2012). To establish the drainage of lymph from large intestine to regional lymph node, 1% solution of methylene blue up to 100 micro liters in the one place of submucosa of large intestine as per the standard technique advocated by Smedley *et al.* (2014) and then stained nearest mesenteric lymph nodes were recorded and re-injected to map the drainage to the next draining lymph node to trace the lymphatic tract.

RESULTS AND DISCUSSION

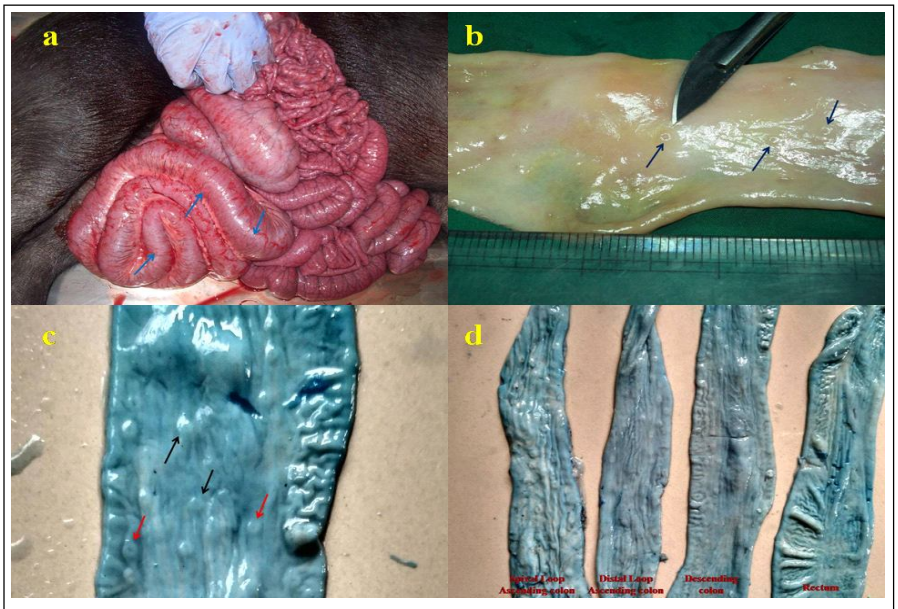
In the large intestine, the sub-mucosal solitary lymphoid nodules (SLN) was scattered throughout the colon and rectum in all the experimental animals under study. The solitary lymphoid nodules of caecum were apparently visible grossly from the outside as a round dark area (Fig 1a). However, few numbers of solitary lymphoid nodules was observed towards the proximal colon as was reported earlier reported by Dev Choudhury *et al.* (2017) in pig and Gautam *et al.* (2013) in goat.

The solitary lymphoid nodules were in the form of minute round tubercles with small depression (Fig 1b) at the centre. This is in agreement with the findings of Morfitt and Pohlenz (1989).

Grossly two different types of solitary lymphatic nodules were observed *viz*. scrotiform and faviform. The scrotiform nodule had a small pore on the dome and the faviform with no central pore (Fig 1c). However, Zhaxi *et al.* (2014) reported that there were three types of PPs in large intestine in Bactrian Camels *viz*. scrotiform, faviform and complete cup-shaped, but in present study it was recorded only scrotiform and faviform lymphatic nodule.

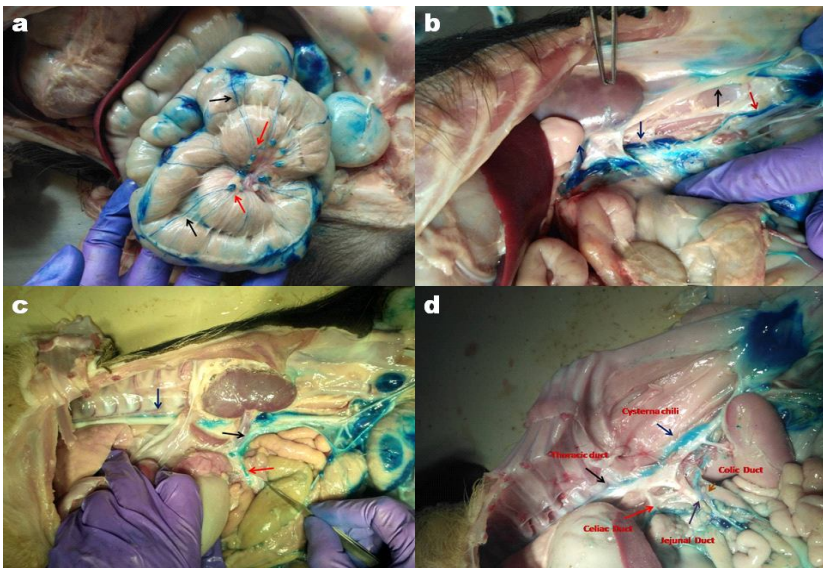
Morfit and Pohlenz (1989) reported that an average of 1,231 number of LGC was present in colon of aged pigs and Gautam *et al.* (2013) reported that an average of 68.17±3.15 and 17.33±4.11 number of SNL was recorded in colon and rectum respectively in goat with a total number of SLNs was 85.50±4.47. However, in the present findings it was observed that the concentration of the solitary lymphoid nodule was maximum in the spiral loop of ascending colon, the number decreased towards the distal loop of the ascending colon, descending colon and rectum respectively (Fig 1d). The average solitary lymphoid nodules counted in the large intestine were 427, out of which 403 was in colon and 24 in rectum of weaned piglets. Again, in the terminal part of rectum patches of solitary lymphatic nodules of more than 100 numbers were observed.

In the large intestinal lymphatic circulation, different lymph nodes were involved in the abdominal viscera, abdominal wall and pelvic wall *viz*. the anorectal, caudal mesenteric, sacral lumber lumbar aortic, renal and colic lymph nodes (Fig 2a and 2c).



a) SLN (arrow), b) SLN with depression, c) scrotiform SLN (red arrow) and faviform SLN (black arrow). d) spiral loop of ascending colon, distal loop of ascending colon, descending colon and rectum.

Fig 1: Gross observation of colon and 0.5% methylene blue stained large intestine of post weaned pigs were done.



Then the stained lymph nodes were reinjected with methylene blueto map out the lymphatic drainage conduit. a) lymphatic vessel of colon and colic lymph nodes (arrow), b) aorta (black arrow), left lumbar trunk (red arrow) and cysternachyli (blue arrow), c) colic trunk (red arrow), continued visceral trunk (black arrow) and thoracic duct (blue arrow), d) celiac trunk joined to jejunal trunk and then colic trunk joined to common trunk which drained caudal to cysternachyli and thoracic duct.

Fig 2: Lymphatic drainage conduit after injecting 1% solution of methylene blue dye in the submucosa of large intestine up to 100 micro litters in one place of submucosa and tracked the stained lymph node and lymphatic pathway.

The lymphatic draining tract to the colic lymph nodes was recorded (Fig 2a) by injecting 100 µl of 1% methylene blue in different site of colon and then stained colic lymph nodes were re-injected to map the drainage to the next draining lymph node to trace the lymphatic tract to record the colic trunk. The colic trunk continued as visceral trunk and finally emptied in the cisterna chyli (Fig 2c). Again, it was found that the celiac trunk carried lymph from the cranial part of abdominal viscera and joined the jejunal trunk. The colic trunk then joined the common trunk to form visceral trunk (Fig 2d). However, Saar and Getty (2012) reported that the colic trunk and jejunal trunk joined to form intestinal trunk in pig and then only the celiac trunk joined to the common intestinal trunk to form visceral trunk in pig.

It was observed that the injected dye from the site of injection reached the anorectal lymph node, from which it reached the caudal mesenteric lymph nodes and then it reached the renal and middle colic lymph node. The left and right lumber trunks joined to form the cysternachyli which appeared as a dilated sac adjacent to renal artery and vein (Fig 2b) and dorsal to aorta from where the lymph was drained out to the caudal vena cava through thoracic duct (Fig 2c). This was in contrary to the findings of Gomercic *et al.* (2010) who reported that the cisterna chyli was present at the level of third lumbar vertebra under crura of diaphragm at the origin of renal artery and cranially covered the dorsal surface of aorta in Yorkshire pig.

CONCLUSION

The knowledge of lymphatic drainage of large intestine of pig is essential to elucidate how the uptake antigen flows to the circulation through mesenteric lymph node and gut immunity in pig. One minor lymphatic trunk was observed parallel to the rectum, draining the lymph from anorectal lymph node to caudal mesenteric lymph node and then to renal lymph node. The celiac trunk and the jejunal trunk joined and formed a common trunk which was again joined by the colic trunk that finally opened into the caudal aspect of cysternachyli. This study will help the pig researchers in the field of gut immunity and antigen uptake research.

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Conflict of interest

All authors declared that they have no conflict of interest.

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