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**Anil Deka**

Assistant Professor, Department  
of Anatomy & Histology, College  
of Veterinary Science, Assam  
Agricultural University  
Khanpara, Guwahati, Assam,  
India

**Bidyut Jyoti Das**

Veterinary officer, State  
Veterinary Dispensary, Panpur,  
Jamugurihat, Sonitpur, Assam,  
India

## Anatomical studies on the female reproductive tract of pygmy hog (*Porcula salvania*)

**Anil Deka and Bidyut Jyoti Das**

**Abstract**

The pygmy hog (*Porcula salvania*) is a critically endangered animal of wildlife species. Grossly, the surface of the ovary of both side showed uneven appearance due to presence of follicle at different developmental stages. The oviduct consists of three parts, viz. the infundibulum, ampulla and isthmus. The uterus of Pygmy hog was bicornuate type of uterus and it consists of three part-horn, body and cervix. The horn of the uterus was the longest and most coiled part of the uterus. The inner layer of the cervix contained some knob-like projection with narrow lumen. The vagina was located caudal to the cervix. Histologically, the ovary of Pygmy hog consisted of outer cortex and inner medulla. The ovarian cortex under study was occupied by numerous follicles at different stages of development viz, primordial, primary, secondary, tertiary and atretic follicles. The lamina epithelialis mucosae of oviduct were simple columnar ciliated epithelium. The mucosal fold of uterus were mainly primary and secondary types. The lamina epithelialis mucosa of vagina was stratified squamous epithelium.

**Keywords:** Anatomy, female, reproductive, follicle, Pygmy hog

**Introduction**

The pygmy hog (*Porcula salvania*) is the world's smallest suid [8]. The pygmy hog was once abundant in Himalyan foothills from Uttar Pradesh to Nepal, now confined to small isolated pocket of Manas Tiger Reserve and reintroduced population in Sonai-Rupai Wildlife Sanctuary and Orang Rajib Gandhi National Park of Sonitpur and Darrang District of Assam, India respectively [7]. Since there is very scanty literature on the Anatomy of female reproductive tract of pygmy hog. Hence, the present study was design to established a anatomical norms on female reproductive tract of pygmy hog.

**Materials and Methods**

In the present investigation, one Pygmy hog about 2 months of old was utilized. The animal was obtained from Pygmy hog Conservation Programme (Research and Breeding Centre), Indira Nagar, and Basistha, Assam. Immediately after death the female reproductive tract was taken out from the body of animals and the gross anatomical characteristics of female reproductive tract were studied. Then, the tissue samples were collected from female reproductive system for histological studies. These samples were fixed in 10% neutral buffered formalin. Then tissues were processed for Paraffin embedding method. The Paraffin sections were cut in five micron thickness and stained with Haematoxylin and Eosin for cellular details, Van Gieson's method for collagen fibre, Gomori's method for reticular fibre, Hart's method for elastic fibres as per standard methods of Luna (1968).

**Results and Discussions**

Grossly, the ovaries of Pygmy hog had an irregular ovoid shape. The surface of the ovary of both side showed uneven appearance due to presence of follicle at different developmental stages (Fig.1). Similar finding was reported by [11] in Babirusa. It had a free surface and an attached surface. The oviduct consists of three parts, viz. the infundibulum, ampulla and isthmus (Fig.2). The infundibulum consisted of two parts- wide funnel shaped membranous part and short tubular part. The wide funnel part opened immediately caudal to the ovary and had no direct connection to the ovary. The tubular part of infundibulum was connected to the ampulla by a constricted junction and attached to the broad ligament. The isthmus was short and narrow muscular segment in comparison to ampulla. These finding were in accordance with the findings of [9] in cow. It forms the caudal most part of oviduct. The uterus of Pygmy

**Corresponding Author:****Anil Deka**

Assistant Professor, Department  
of Anatomy & Histology, College  
of Veterinary Science, Assam  
Agricultural University  
Khanpara, Guwahati, Assam,  
India

hog was bicornuate type of uterus and it consists of three part-horn, body and cervix (Fig.3). The horn of the uterus was the longest and most coiled part of the uterus. These findings were corroborated with the findings of <sup>[4]</sup> in Indian Pig. The body of the uterus was very short and it located cranial to the cervix. The inner wall of the cervix contained some knob-like projection with narrow lumen (Fig.4). These findings were similar to the findings of <sup>[11]</sup> in Babirusa. The vagina was located caudal to the cervix. The wall of the vagina contained some longitudinal folds which contributed to the distensibility of the vaginal wall. Similar observations were reported by <sup>[9]</sup> in pig.

The length, diameter and thickness of right ovary of Pygmy hog were 8.72mm, 7.53mm and 3.77 mm, respectively as well as length, diameter and thickness of left ovary were 9.76mm, 15mm and 0.85mm, respectively. The length, diameter and thickness of right infundibulum were 13mm, 1.5mm and 0.85mm, respectively and, length, diameter and thickness of left infundibulum were 13.96mm, 1.7mm and 0.90mm, respectively. The length, diameter and thickness of right ampulla were 20mm, 1.8mm and 0.72mm as well as length, diameter and thickness of left ampulla were 20.8mm, 1.9mm and 0.76mm, respectively. The length, diameter and thickness of right isthmus were 9mm, 1.4mm and 0.65mm and, length, diameter and thickness of left isthmus were 9.6mm, 1.48mm and 0.70mm, respectively. The length, diameter and thickness of right horn of the uterus were 36.5mm, 3.32mm and 0.85mm as well as length, diameter and thickness of left horn of the uterus were 37.2mm, 3.34mm and 0.89mm, respectively. The length, diameter and thickness of body of the uterus were 7.2mm, 15mm and 1.02mm, respectively. The length, diameter and thickness of cervix were 31mm, 18mm and 3mm, respectively. The length, diameter and thickness vagina were 4.5mm, 19.5mm and 5mm, respectively (Table.1). However, these could not be contemplate due to unavailability of literature.

Histologically, the ovary of Pygmy hog was a parenchymatous organ which was covered by the surface epithelium based on tunica albuginea. The ovary consisted of outer cortex and inner medulla. These findings were supported by <sup>[3]</sup> in Asian elephant. The surface epithelium of ovary consisted of a single layer of cuboidal epithelium (Fig.5). The tunica albuginea was formed by connective tissue fibers i.e. collagens, elastic and reticular fibers. The ovarian cortex under study was occupied by numerous follicles at different stages of development *viz*, primordial, primary, secondary, tertiary and atretic follicles. Primordial follicles were beneath the tunica albugenia and the oocytes were surrounded by simple squamous epithelium (Fig.6). The oocytes in primary follicles were surrounded by cuboidal epithelium (Fig.7). Secondary follicles were larger than the primary follicles and the oocyte was covered by many layers of follicular cells (Fig.8). The tertiary follicles contained antrum, stratum granulosum, theca interna, theca externa, zona pellucida, cumulus oophorus and corona radiate (Fig.9). Numerous flattened fibroblasts lied among the connective tissues and smooth muscle fibers were observed at the theca externa. The theca externa of tertiary follicles surrounded the theca interna which consisted of compact layer of smooth muscle cells. Atretic follicles were seen at their different stages of development (Fig.11). In some follicles, the cytoplasm of oocytes was eosinophilic and shape of the follicles and oocytes became deformed which showed the presence of large oocyte surrounded by stratum granulosum.

The ovarian medulla consisted of numerous size blood vessels and it contained collagen, elastic and reticular fibers. The blood vessels in medulla were comparatively larger than those present in the ovarian cortex (Fig.10). The ovarian stromas were formed by a network of connective tissue fibers. The tunica mucosae of infundibulum of Pygmy hog were thrown into primary, secondary and tertiary fold (Fig.12) was opined by <sup>[2]</sup> in Azarbaijan buffalo. It comprised of simple columnar ciliated epithelium with some goblet cells (Fig.13). Lamina propria-submucosa contained areolar connective tissue with branched tubular glands. This layer contained scanty amount of collagen, elastic fibres and reticular fibres. The tunica muscularis consists of inner circular and outer longitudinal fibres of smooth muscles. More numbers of blood vessels were marked in longitudinal layers than the circular layers. The tunica serosa was formed by loose connective tissue along with blood vessels and lymphatic aggregation. The ampulla of Pygmy hog contained primary, secondary with occasional tertiary fold (Fig.14). These folds were lined by simple columnar ciliated epithelium (Fig.15). The lamina propria-submucosa composed of collagen fibers, reticular fibers and elastic. The tunicamascularis layers of ampulla were somewhat thicker than the muscular layer of infundibulum. The circular layer of tunica muscularis was wider than that of the longitudinal layers. Both the circular as well as longitudinal layers contained more amounts of elastic fibers, reticular fibers and less amount of collagen fibers. The tunica serosa was consists of loose connective tissue and lymphocytic aggregation. The tunica mucosae of isthmus were folded in to primary fold (Fig.16). These folds were short and wider. The lamina epithelialis mucosae of isthmus was simple ciliated columnar. Lamina propria-submucosa contained more amounts of reticular fibers as well as less amount of collagen, and elasticfibers. The tunica muscularis was consisted of inner circular and outer longitudinal fibers of smooth muscles. More numbers of blood vessels were revealed in longitudinal layers than the circular layers. The tunica serosa was formed by loose connective tissue. The mucosal fold of uterus were mainly primary and secondary types. Primary folds were long slender projecting towards the lumen. The surface epithelium of uterus was pseudostratified ciliated columnar cells (Fig.17). Lamina propria-submucosa was composed of abundant simple branched tubular gland with blood vessels. It composed of more amounts of reticular fibers and less amounts of collagen as well as elasticfibers. These findings were similar to the findings of <sup>[1]</sup> in sow. The tunica muscularis consisted of inner circular and outer longitudinal smooth muscle layers. These layers contained more amounts of reticular fibers and less amounts of elastic and collagenfibers. The tunica serosa was formed by loose connective tissue containing mainly reticular fibers and less amount of collagen fibers. The cervical mucosa of Pygmy consists of simple columnar epithelium with patches of stratified squamous epithelium (Fig.18). The demarcation was in consonance to the finding of <sup>[5]</sup> in Porcine. Contrary to the present findings of <sup>[10]</sup> in goat reported that the cervical mucosa was lined by pseudostratified ciliated columnar epithelium with patches of stratified squamous epithelium. These might be due species differences. Mucous secreting gland as well as collagen, elastic and reticular fibers were observed in lamina propria-submucosae layer. The tunica muscularis consists of inner circular and outer longitudinal layer. The tunica serosa was composed of collagen, elastic, reticular and blood vessels. The lamina epithelialis mucosa of

vagina was stratified squamous epithelium (Fig.19) in accordance with the [1] in Sow. The lamina propria-submucosae consists of abundances of collagen, elastic and reticular fibers as well as blood vessels (Fig.20, 21 and 22). Tunica muscularis was composed of inner circular and outer

longitudinal layer. Tunica serosa contained loose connective tissue with abundances of collagen fibers. Reticular fibers were also observed. However, elastic fibers were observed in the in the wall of blood vessels.

**Table 1:** Showing the measurement of different part of female reproductive tract of pygmy hog

Parameters	Ovary		Infundibulum		Ampulla		Isthmus		Horn of the uterus		Body of the uterus	cervix	vagina
	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left			
Length (mm)	8.72	9.76	13	13.96	20	20.8	9	9.6	36.5	37.2	7.2	31	4.5
Diameter (mm)	7.53	7.74	1.5	1.7	1.8	1.9	1.4	1.48	3.32	3.34	15	18	19.5
Thickness (mm)	3.77	3.94	0.85	0.90	0.72	0.76	0.65	0.70	0.85	0.89	1.02	3	5



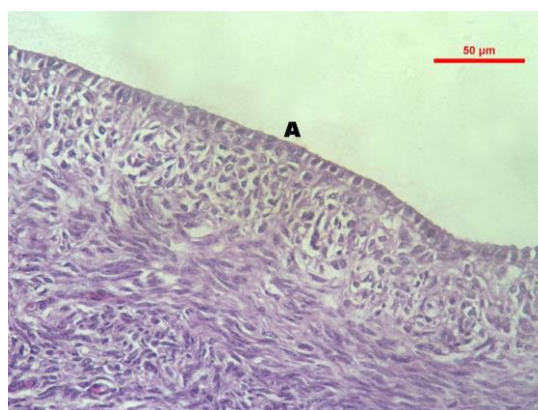
**Fig 1:** Photograph showing the ex-situ position of ovary (A) of Pygmy hog.



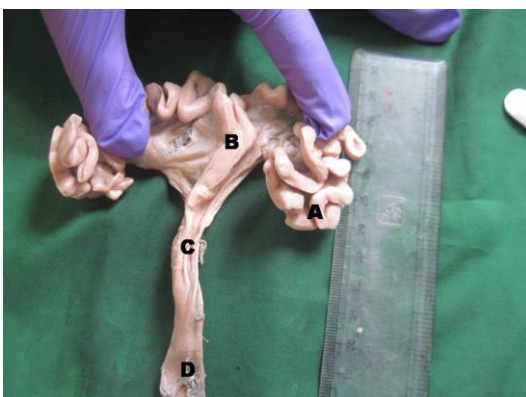
**Fig 4:** Photograph showing the knobe like projection with narrow lumen of cervix of Pygmy hog.



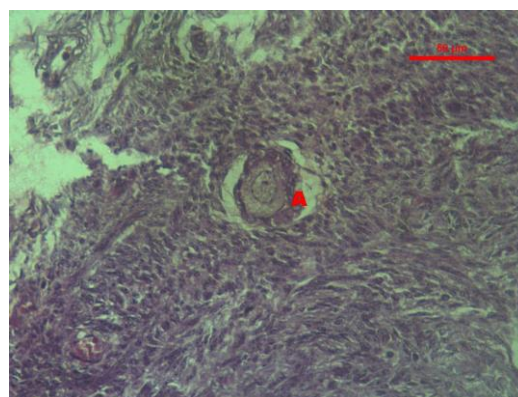
**Fig 2:** Photograph showing the ex-situ position of infundibulum (A), ampulla (B) and isthmus (C) of Pygmy hog.



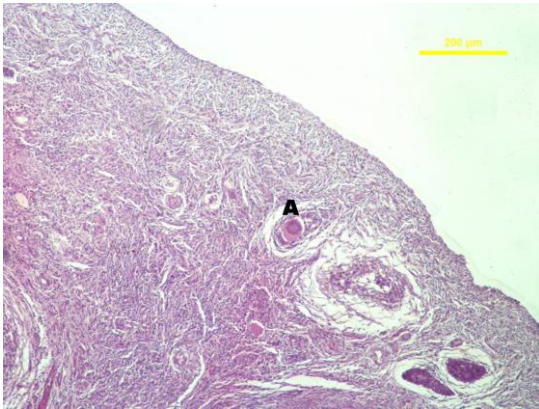
**Fig 5:** Photomicrograph showing the ovary of Pygmy hog along with Simple cuboidal epithelium. H&E, 100X



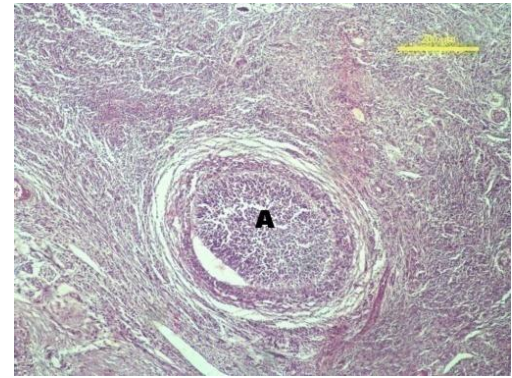
**Fig 3:** Photograph showing the ex-situ position of horn of uterus (A), body of uterus (B), cervix (C) and Vagina (D) of Pygmy hog.



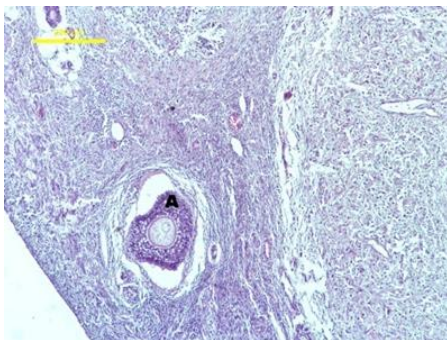
**Fig 6:** Photomicrograph showing the ovary of Pygmy hog along with primordial follicle (A).H&E, 40



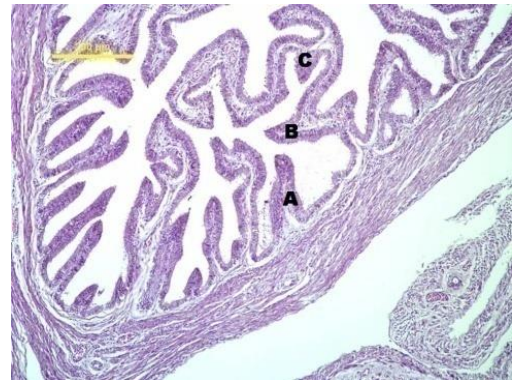
**Fig 7:** Photomicrograph showing the ovary of Pygmy hog along with primary follicle (A).H&E, 400X



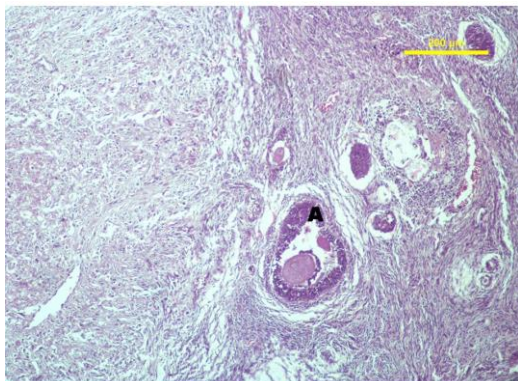
**Fig 11:** Photomicrograph showing the ovary of Pygmy hog along with Atretic follicle. H&E, 400X



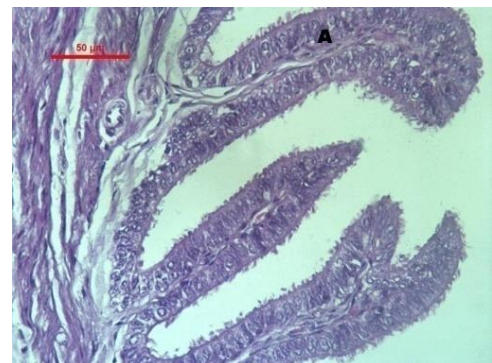
**Fig 8:** Photomicrograph showing the ovary of Pygmy hog along with secondary follicle (A).H&E, 400X



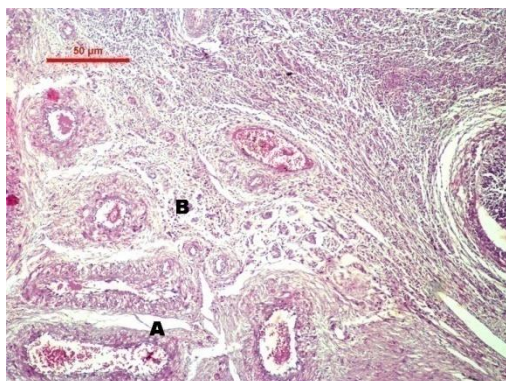
**Fig 12:** Photomicrograph showing the infundibulum of Pygmy hog along with primary fold (A), secondary fold (B) and tertiary fold (C). H&E, 100X



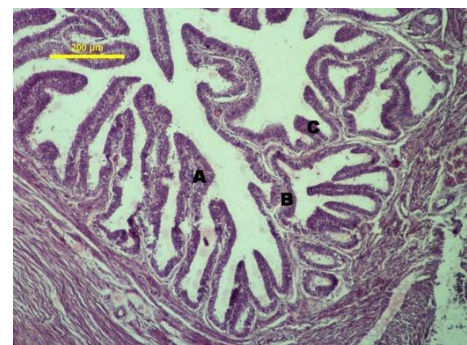
**Fig 9:** Photomicrograph showing the ovary of Pygmy hog along with tertiary follicle (A).H&E, 400X



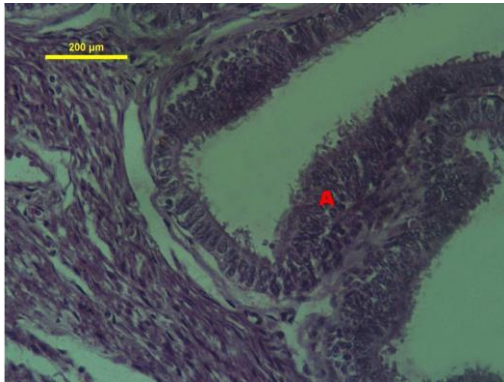
**Fig 13:** Photomicrograph showing the infundibulum of Pygmy hog along with simple columnar ciliated epithelium. H&E, 400X



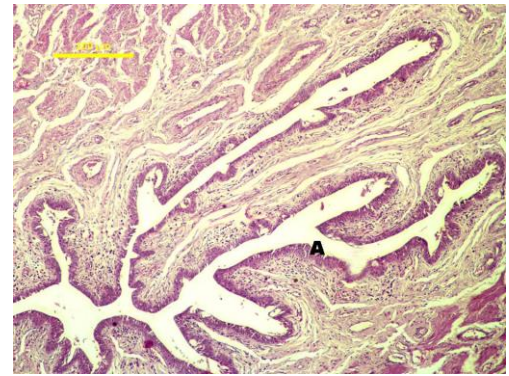
**Fig 10:** Photomicrograph showing the ovary of Pygmy hog along with medulla (A) and blood vessels (B).H&E, 400X



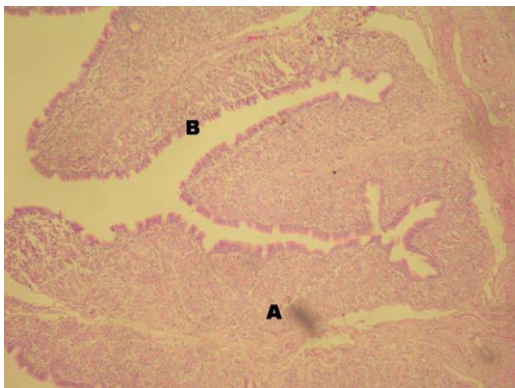
**Fig 14:** Photomicrograph showing the ampulla of Pygmy hog along with primary fold (A), secondary fold (B) and tertiary fold(C). H&E.100X



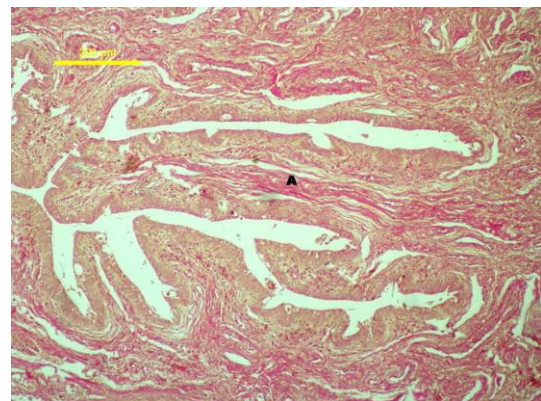
**Fig 15:** Photomicrograph showing the ampulla of Pygmy hog along with simple columnar ciliated epithelium (A). H&E.100X



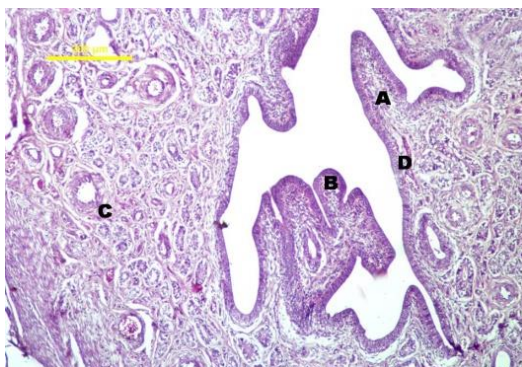
**Fig 19:** Photomicrograph showing the vagina of Pygmy hog along with stratified squamous epithelium (A).H&E, 100X.



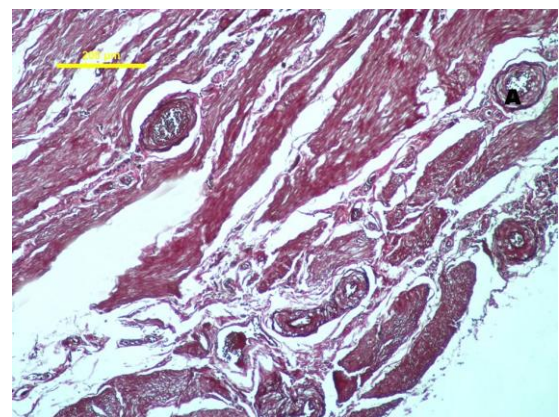
**Fig 16:** Photomicrograph showing the isthmus of Pygmy hog along with simple columnar ciliated epithelium (B) and Primary fold (A).H&E.100X



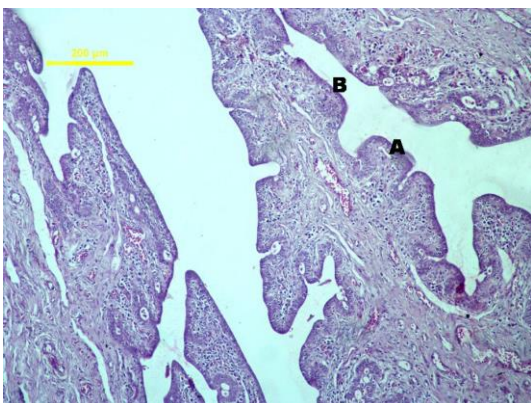
**Fig 20:** Photomicrograph showing the collagen fibers (A) of vagina of Pygmy hog. VAN GIESON'S stain, 400X.



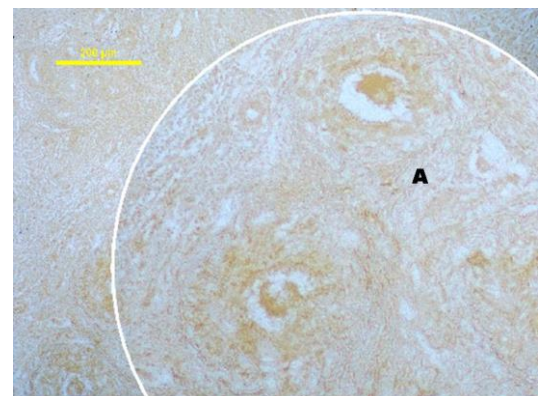
**Fig 17:** Photomicrograph showing the uterus of Pygmy hog along with primary folds (A), secondary folds (B), uterine gland (C) and pseudostratified ciliated columnar epithelium (D). H&E, 100X.



**Fig 21:** Photomicrograph showing the elastic fibers (A) of vagina of Pygmy hog. Hart's Method, 400X.



**Fig 18:** Photomicrograph showing the cervix of Pygmy hog along with simple columnar epithelium (A) and stratified squamous epithelium (B).H&E, 100X.



**Fig 22:** Photomicrograph showing the reticular fibers (A) of vagina of Pygmy hog. Gomori's Method, 400X.

### Summary and Conclusion

The present investigation was undertaken to elaborate certain gross anatomical, histomorphological parameters of Pygmy hog (*Porcula salvania*). Since there is very scanty literature on the detailed anatomy of female reproductive tract of Pygmy hog being a critically endangered animal of wildlife hence the present study was designed to establish anatomical norms on the female reproductive tract of Pygmy hog. These will help physiologist, pathologist and wildlife veterinarian for effective disease control regime. Grossly, the ovaries of Pygmy hog had an irregular ovoid surface. The infundibulum consisted of wide funnel shaped membranous part and short tubular part. The ampulla had a thin wall and attached to the broad ligament. The isthmus was short and narrow muscular segment in comparison to ampulla. The uterus of Pygmy hog was bicornuate type of uterus. The inner wall of the vagina contained some longitudinal folds which contributed to the distensibility of the vaginal wall. Histologically, the ovary of Pygmy hog was a parenchymatous organ which was covered by the surface epithelium based on tunica albuginea. The tunica mucosae of infundibulum of Pygmy hog were thrown into primary, secondary and tertiary fold. The ampulla of Pygmy hog contained primary, secondary with occasional tertiary fold. The tunica mucosae of isthmus were folded in to primary fold. The mucosal fold of uterus were mainly primary and secondary types. Primary folds were long slender projecting towards the lumen. The surface epithelium of uterus was pseudostratified ciliated columnar cells. The cervical mucosa of Pygmy consists of simple columnar epithelium with patches of stratified squamous epithelium. The lamina epithelialis mucosa of vagina was stratified squamous epithelium.

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