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RESEARCH ARTICLE

Pathomorphological alterations associated with gastrointestinal system of chickens in Patna district

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ABSTRACT

Genetical and managemental transformation of commercial poultry to meet the nutritional demands of increasing population can negatively affect the delicate balance among the components of the chicken gut leading to disturbances in the absorption and assimilation of nutrients, decreased feed conversion ratio and growth rate and production losses. The present study was conducted to study the occurrence of different pathomorphological affections of GIS in poultry with reference to age and season. A total of 500 dead birds in farms located at Patna district were necropsied and the lesions were critically recorded. Out of all these birds, 310 birds were found to be having affections related to GIS. Highest incidence of GIS affections was noticed in the monsoon season and least in spring season. Similarly, age-wise analysis revealed maximum incidence in the birds of 0-2 weeks age, while minimum incidence in the birds of more than 20 weeks of age. Among different components of GIS, Intestine was most affected organ while oesophagus was least affected. Histopathological lesions that range from degenerative to inflammatory changes were noticed in different organs of GIS.

Keywords: Chickens, gastro-intestinal system, gross lesions, histopathological lesions, incidence

INTRODUCTION

To meet the increasing demand with increase in population, these days birds are being genetically modified to achieve maximum growth and production in minimum times. Also, methods of poultry husbandry have changed considerably predisposing the birds to various infectious and non-infectious diseases leading to production loss and mortality. Poultry must have a healthy and functional Gastro-intestinal tract to maintain the optimal feed efficiency and productivity. The gastro-intestinal tract (GIT) also acts as a selective barrier between the tissues of the bird and its luminal environment. In addition, gut-associated lymphoid tissues (GALT) comprise of Payer'spatches, caecal tonsils, bursa of Fabricius and other lymphoid aggregates in the urodeum and proctodeum are a part of both primary and secondary lymphoid organs[1]. Thus, any abnormality in functioning of GIT leads to disturbances in the absorption and assimilation of nutrients resulting in decreased feed conversion ratio, decreased growth rate and production losses[2] along with subsequent bacterial translocation, product (meat and egg) contamination, morbidity and death. Such affections of GIT accounts for more than 30% mortality[3].

Since, the GIT has the most extensive exposed surface in the body, it is constantly exposed to a wide variety of potentially harmful substances any physical, chemical or biological disturbances can result in enteric disease[4]. Among infectious diseases, the conditions like Colibacillosis, Salmonellosis, Coccidiosis, Ranikhet disease, necrotic enteritis etc. affecting GIT are quite common. Stress is another factor that could indirectly predispose poultry to enteric diseases including leaky gut and enteritis.

Thus, the present study was undertaken to explore the role of GIT disorders in poultry mortality and to determine the age-wise and seasonal incidence of various gastrointestinal disorders in poultry.

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MATERIALS AND METHODS

Samples and Sampling

The study was conducted for a period from October 2021 to September 2022. A total of 500 dead birds from different Government and private farms located in and around Patna district were necropsied and those birds showing the lesions of digestive system were included for the current study. The birds were further categorized into five different age groups. The birds were further categorized into five different age groups *viz.* 0-2 weeks, 3-5 weeks, 6-10 weeks, 11-20 weeks and above 20 weeks to determine the effect of age on the Incidence of GIT affections.

Pathomorphological & Histo-

pathological study

The organs were critically and systematically examined during necropsy for presence of any gross lesions in the digestive system. Upon critical systemic evaluation, gross lesions were recorded based on their type and distribution. Representative tissue samples revealing gross lesions were collected in 10% Neutral Buffer Formalin for histopathological tissue processing, sectioning and staining.

RESULTS

Out of 500 dead birds examined, gross pathological lesions were noticed in the digestive system of 310 birds (60.2). Among different age groups, 0-2 weeks age group revealed highest occurrence (76.53%) of GIT affections followed by 3-5 weeks age group. However, minimum GI tract affections were seen in age group of above 20 weeks age (Fig. 1A). Among different seasons, highest occurrence of lesions was noticed in the monsoon season (74.52%) followed by winter (68.06%) season, with lowest occurrence in spring (43.18%) season (Fig. 1B).

Gross lesions

Among different components of GIT, intestine revealed highest occurrence of lesions (38.38%) followed by liver with intestines (19.03%), while the least occurrence was noticed in oesophagus (0.32%). The details of occurrence of lesions in various components of GIT were showed in Table 1.

Lesions in the oral cavity included extensive erosions on the epithelial surface of tongue (Fig. 2A) with yellowish sticky substance covering the entire oral cavity. Oesophageal lesions were characterised by the congestion of mucosal surface with homogeneous, translucent material (Fig. 2B). Crop revealed inflammatory changes in the mucosa characterized by thickening, congestion, hemorrhages with minute ulcers. Dilatation of crop was also noticed with the blockage of feed passage (Fig. 2C). Proventricular lesions were characterized by profuse dilatation (Fig. 2D), serosal haemorrhages, haemorrhage in between the proventricular glands along with necrosis and erosions in the mucosa. Haemorrhages at the junction of proventriculus and gizzard were also noticed in few birds.

Gizzard revealed lesions in both keratinized layer

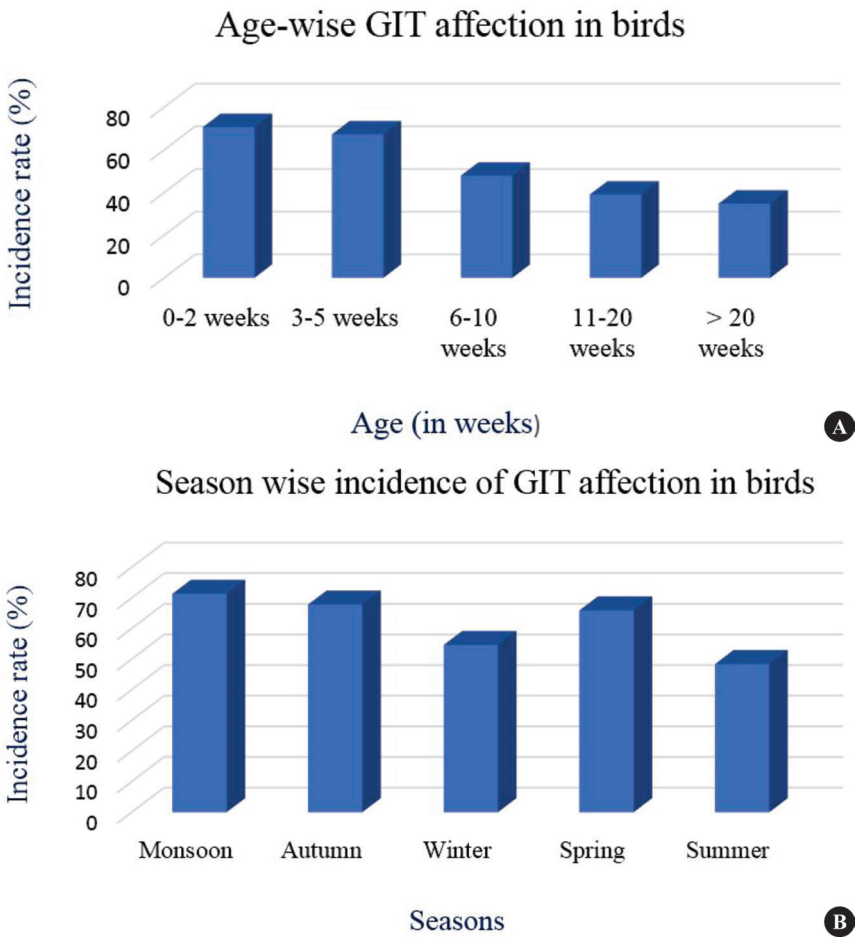

Fig. 1. Occurrence of gastro-intestinal affections in Chickens. **A.** Age-wise occurrence of GIT affections in Chickens. **B.** Seasonal incidence of GIT affections in Chickens.

and mucosal surface, which included erosive changes, ulceration and whitish discoloration of mucosa. Intestine was the mostly affected organ with the significant gross lesions of variable degree of hemorrhages, enteritis (necrotic and catarrhal) (Fig. 3A), thickening of intestine with corrugations (Fig. 3B). Caecal lesions included ballooning with bloody contents with necrosis and ulceration of caecal tonsils. Presence of Ascaris round worm was also evident in some birds. The findings have been depicted in Table 2. Gross lesion of liver

Table 1. Occurrence of gross GIT lesions in different organs.

S.No.	Organs Affected	Number & Percent of Birds Showing Lesions
1.	Oral cavity	3 (0.96%)
2.	Oesophagus	1 (0.32%)
3.	Crop	7 (2.25%)
4.	Proventriculus	25 (8.06%)
5.	Gizzard	7 (2.25%)
6.	Intestine	119 (38.38%)
7.	Liver	55 (17.74%)
8.	Liver and Intestine	59 (19.03%)
9.	Liver, Proventriculus & Intestine	34 (10.96%)

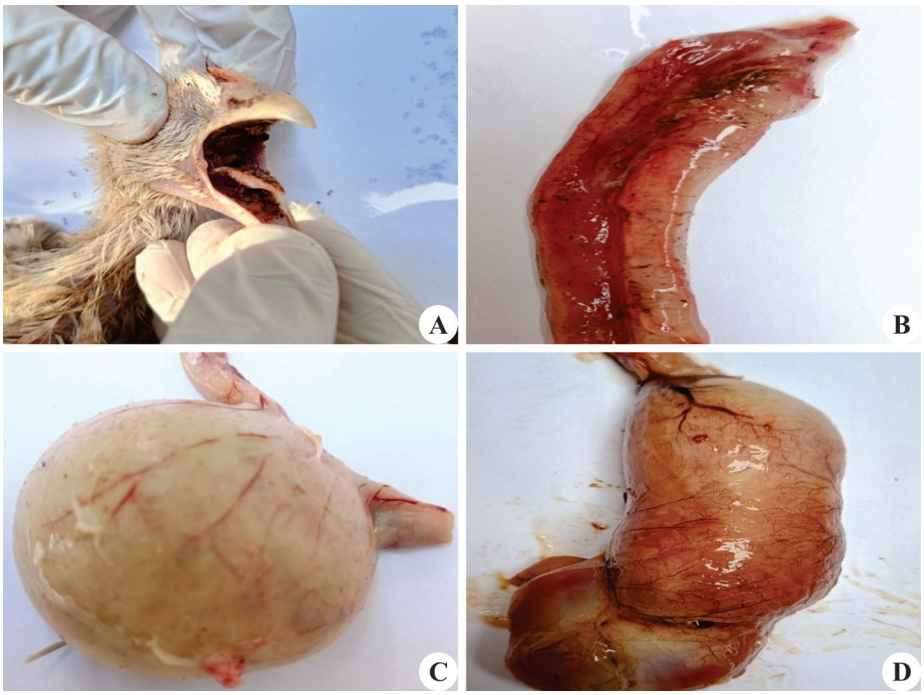

Fig. 2. Gross lesions in GIT of affected Chickens. **A.** Ulcerated oral lesions with extensive epithelial erosions. **B.** Congestion of oesophageal mucosa with homogeneous translucent material. **C.** Crop impaction with complete blockage of feed passage. **D.** Proventricular dilatation.

Table 2. Gross lesions observed in the Intestine.

S.No.	Lesions in intestine	No. of birds affected
1.	Haemorrhagic enteritis	84
2.	Catarrhal enteritis	38
3.	Necrotic enteritis	29
4.	Enlarged Caeca with blood	32
5.	Ascaris affection	14
6.	Corrugation with thickening	06
7.	Ulcerative Caecal tonsil	09
	Total No. of Birds affected	212

noticed in the current study are depicted in Table 3 and they were characterized by swelling and enlargement, fatty change, hemorrhages (Fig. 3C), multiple necrotic foci (Fig. 3D), fibrin deposition over the surface and mottling with deposition of urate crystals.

Histopathological Lesions

Histopathological lesions in different components of GIT were depicted in Fig. 4. Oesophagal lesions were characterized by hyalinization of tissues (Fig. 4A) with increased numbers of spindle cells, focal edema, necrosis and fibrosis without significant inflammatory cell infiltration. Proventricular lesions included congestion, haemorrhages, degeneration and necrosis of glandular epithelium accompanied by marked lymphocytic infiltration. Cellular debris of desquamated cells (Fig. 4B), hyperplasia of ductualar epithelial cells, degeneration and necrosis of proventricular glands and inter-glandular connective tissue proliferation were the other lesions of proventriculus. Histopathological lesions of gizzard included variable degrees of keratinized layer depletion and necrosis of the lining epithelium with infiltration of lymphocytes and few heterophils.

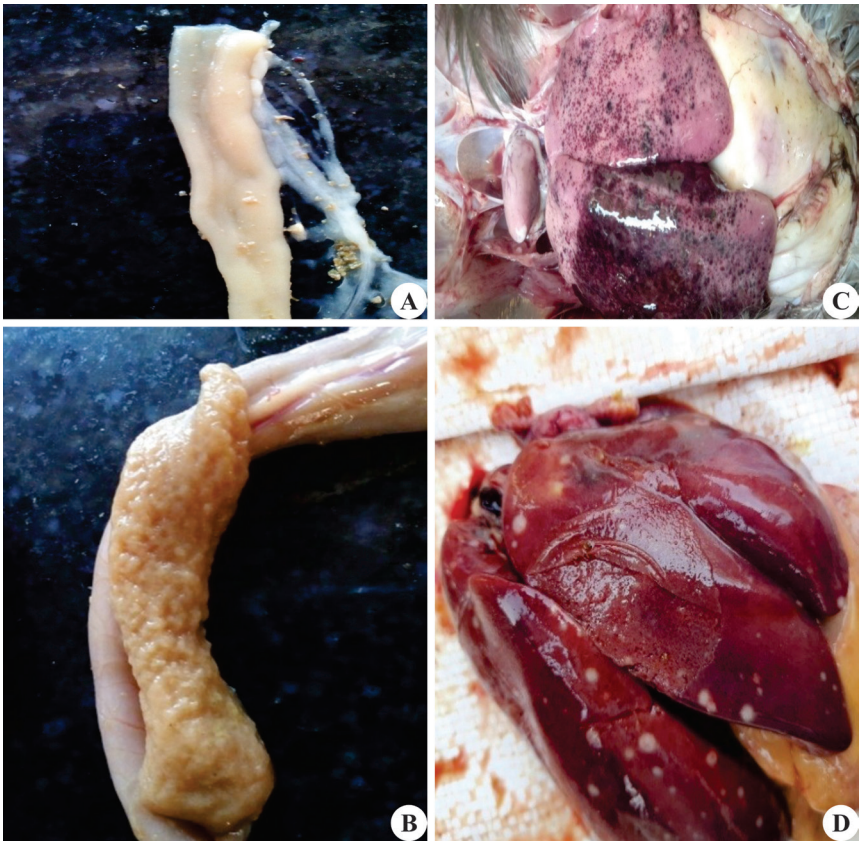

Fig. 3. Gross lesions in different organs of affected chickens. **A.** Catarrhal enteritis with thick layer of mucous. **B.** Thickened and corrugated intestines. **C.** Multiple hemorrhages on the liver surface. **D.** Multiple necrotic foci over the liver surface.

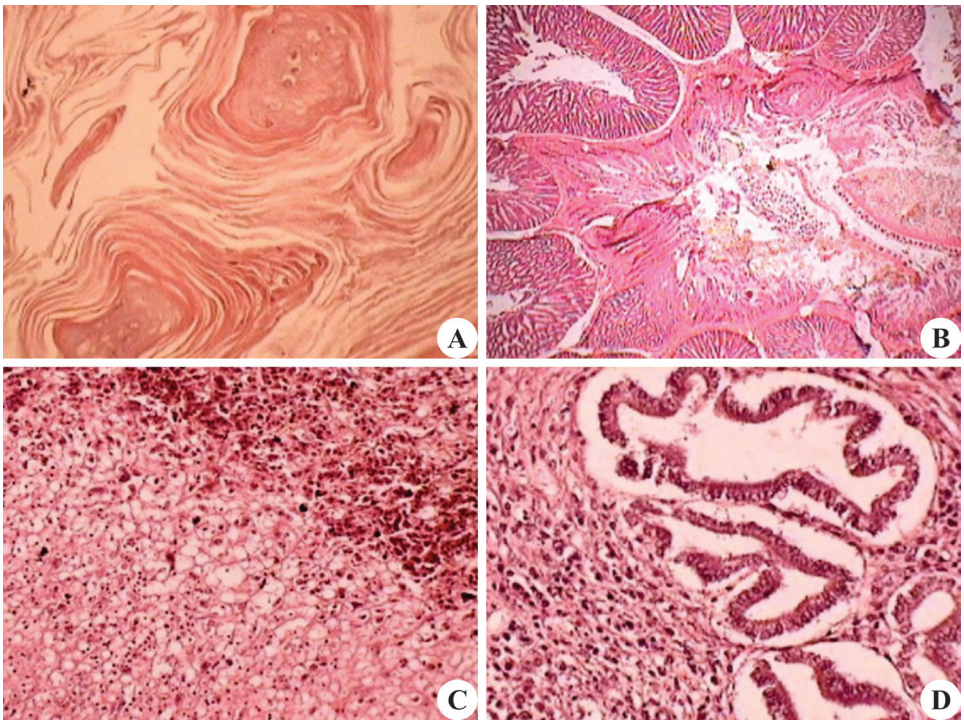

Fig. 4. Histopathological lesions in different organs of affected chickens. **A.** Marked hyalinization of oesophageal mucosa (H&E x100). **B.** Proventriculus with degeneration and desquamation of lining epithelium forming cellular debris in the lumen (H&E x40). **C.** Hepatocytes with cytoplasmic vacuolization and inflammatory changes (H&E x100). **D.** Liver with hyperplasia of bile ducts along with infiltration of heterophils, macrophages and few lymphocytes in the portal area (H&E x100).

Microscopic examination of affected intestines revealed predominant lesions of enteritis. Catarrhal enteritis was characterised by congestion, necrosis of epithelium, hyperplasia of goblet cells and cellular infiltration mainly with heterophils. Necrotic enteritis revealed severe denudation and necrosis of intestinal epithelium extending upto the crypts along severe inflammatory exudates comprising of an admixture of necrotic epithelial cells, fibrin and inflammatory cells mainly heterophils. In some cases, epithelium was found to be sloughed into the lumen along with congestion and edema of the lamina propria with vacuolation and subsequent lifting up of epithelial cells. Clubbing of intestinal villi, Gram positive bacilli lining necrosed villi were other intestinal findings.

Few cases revealed infection of coccidiosis with lesions of congestion, haemorrhages, necrosis of villi along with the presence of developing meronts, schizonts and oocysts in epithelium of villi and crypts. Mucosal scrapings from the affected intestines revealed Eimeria oocysts characterised by four sporocysts with two sporozoites in each sporocyst.

Histopathological lesions in the liver tissues revealed hydropic degeneration (Fig. 4C), fatty change and necrotic changes in centrilobular and periportal areas. Nuclear changes varied from pyknosis to karyorrhexis and karyolysis. Few cases revealed periportal fibrosis, congestion of portal vein, hyperplasia of bile duct epithelium (Fig. 4D) along with deposition of urate crystals within the liver parenchyma.

DISCUSSION

Over the past few decades, poultry husbandry practices have undergone significant transformations, largely driven by the emphasis on intensive rearing systems. While these practices have enhanced productivity, they have also increased the birds' susceptibility to a range of infectious diseases, leading to substantial economic losses for the poultry industry. Among these disorders affecting the GIT are particularly prevalent. In light of this, the present study was designed to investigate the patho-morphological lesions of the gastrointestinal system in poultry from different regions in and around Patna.

A total of 500 birds were examined, and the findings revealed that the highest incidence of gastrointestinal lesions occurred in the 0-2 week age group, while birds older than 20 weeks exhibited the lowest incidence. This observation contrasts with earlier studies, where the highest incidence was reported in birds over 24 weeks of age and the lowest in the 18-24 week age group[6]. Seasonally, the prevalence of lesions was highest during the monsoon and lowest in the spring, although spring recorded the highest mortality rate, with winter showing the least[5].

Among the gastrointestinal organs examined, the intestine was found to be the most frequently affected, followed by the liver. The esophagus was the least affected. Histological examination of the esophagus revealed four distinct layers: mucosa, submucosa, musculosa and adventitia or serosa. Affected birds exhibited glassy appearance and hyalinization of tissues, an abnormal finding in the avian esophagus[7]. Such hyalinization is typically associated with aging or chronic irritation, as also reported earlier, who described similar histopathological changes in multiple organs in broilers naturally infected with colibacillosis.

The proventriculus, continuous with the esophagus at the base of the heart and containing digestive enzymes and goblet cells, showed variable pathological changes. While proventriculitis is commonly linked with infectious bursal disease virus, other etiologies may also be involved[9]. Although multiple factors can cause such lesions, fungal infections are considered a common cause[10]. The ventriculus (gizzard), characterized by its thick muscular walls and protective koilin membrane, demonstrated lesions primarily in the keratinized and mucosal layers[11].

Histologically, the small intestine, composed of the tunica mucosa, submucosa, muscularis and serosa, exhibited a wide range of lesions[12]. These lesions are often associated with various pathogens, including viruses (e.g., astrovirus, avian nephritis virus, rotavirus, reovirus), bacteria (e.g., Clostridium spp.) and protozoa such as *Eimeria acervulina* and *E. tenella*[13,14].

The liver, the largest accessory digestive gland in poultry and encapsulated by Glisson's capsule, also exhibited considerable pathological changes. These may be attributed to infections with hepatitis virus, adenovirus or parasitic migration, such as by *Ascaris*[15,16]. Consistent with the findings of earlier worker[17], this study observed a range of gross liver lesions including congestion (71.27%), hemorrhage (18.05%), necrosis (9.26%), fatty changes (0.78%) and hematomas (0.62%). Histologically, the most common non-inflammatory lesions were congestion (64.52%), hemorrhage (10.20%), fatty liver (0.47%) and hepatosis (3.29%).

These findings were in agreement with those of earlier worker[18], who documented hepatic necrosis (29.41%), congestion (25.88%) and hepatitis (20%) in White broiler breeds. Gross lesions such as multifocal to diffuse necrosis, discoloration, mottling and hepatomegaly as well as histopathological features including sinusoidal and portal vein dilation and infiltration of hepatocytes with heterophils and mononuclear cells were similarly observed in the current study.

In conclusion, the study highlights the significant burden of gastrointestinal lesions in poultry, particularly in younger birds and during the monsoon season. The findings underscore the need for timely diagnosis and effective control measures to mitigate losses in commercial poultry production.

CONCLUSION

Poultry production incurs significant losses due to various conditions affecting the GIT. The findings of the present study highlight that the GIT, being the most directly exposed interface with potential pathogens requires focused attention from poultry farm owners to ensure optimal health, productivity and economic sustainability. The pathology of enteric diseases in poultry is diverse, reflecting the continuous exposure of the GIT to a wide range of harmful agents, including viruses, bacteria and parasites.

Our study revealed that gastrointestinal affections were most prevalent during the monsoon season, with the lowest incidence observed in the spring. Age-wise, young chicks particularly those in the 0-2 week age group were most commonly affected, whereas birds older than 20 weeks exhibited the least susceptibility. Among the various segments of the gastrointestinal system, the intestine emerged as the most frequently affected organ, while the esophagus was comparatively the least involved.

These findings underscore the importance of preventive strategies aimed at protecting the gastrointestinal system to reduce morbidity, enhance productivity and promote economic viability in poultry farming. A comprehensive understanding of GIT lesions can also serve as a valuable foundation for future research and the development of improved management and disease prevention practices in commercial poultry operations.

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