



## Case Report

# Pyelonephritis and Polycystic Kidneys in a Male Holstein Calf

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## ABSTRACT

**Introduction:** Pyelonephritis and cystitis in cattle are urinary tract bacterial infections that can ascend to the kidneys and cause inflammation. This article presented a rarely-seen clinical kidney complication in a male Holstein calf. This problem was accompanied by respiratory tract infections. Bacterial infection caused bovine pyelonephritis and cystitis and consequently, there was an inflammation in the kidneys. A wide range of bacteria were responsible for such infections.

**Case report:** A 5-days old male Holstein calf was initially diagnosed with high body temperature ( $> 40^{\circ}\text{C}$ ), followed by respiratory signs. Treatment with antibiotics and anti-inflammatory drugs (dexamethasone and gentamicin) began immediately after diagnosis of the high body temperature, but the clinical signs, such as appetite loss and cough did not fully disappear. The calf's growth was hindered and finally, died at the age of 90 days. Post-mortem necropsy findings included inflamed and cystic kidneys that coexisted with severe lung infections.

**Conclusion:** The present uncommon renal complication may provide further information about the physiology and pathology of such rare kidney disorders in newborn Holstein calves.

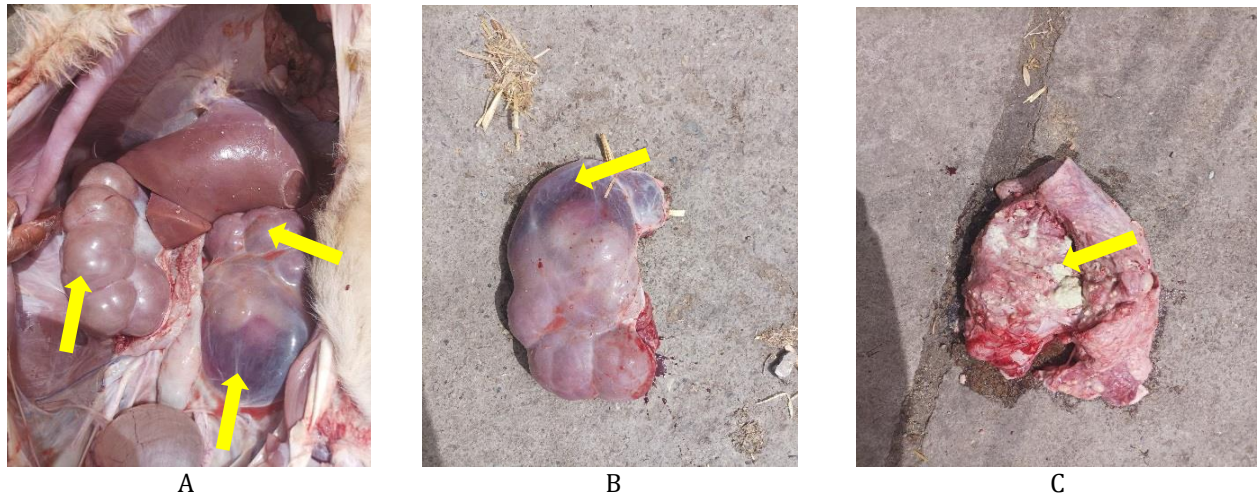
## 1. Introduction

Pyelonephritis and cystitis in cattle are bacterial infections that affect the urinary tract and can spread to the kidneys, resulting in inflammation<sup>1</sup>. Many bacteria, such as *Corynebacterium (C.) renale*, *C. pilosum*, and *C. cystitidis* as well as *Escherichia coli (E. coli)* and *Streptococcus* spp., *Proteus* spp., and *Staphylococcus* spp. are responsible for pyelonephritis and cystitis in cattle<sup>1</sup>. In addition, *Mannheimia varigena* has been reported to be a cause of pyelonephritis in Holstein calves<sup>2</sup>. Stressful conditions, such as parturition, the peak of lactation, also feeding high-protein diets could predispose cattle to bacterial attacks<sup>1</sup>. Polyuria, hematuria, anorexia, colic, and reduced milk production are common clinical signs in adult animals<sup>1</sup>. Polycystic kidneys might be a heritable disorder in human which exists in two forms<sup>3</sup>. The occurrence of congenital polycystic kidneys has been reported in an inbred herd of springbok<sup>3</sup>. In a study by Inverson et al., all animals with polycystic

kidneys had cystic dilatation of the bile duct<sup>3</sup>. Polycystic kidneys in springboks' neonates has been also reported in the literature<sup>4</sup>. It seems that mutation in genes involved in the regulation of the renal tubular epithelial cells plays an important role in the development of polycystic kidneys in both humans and animals<sup>4</sup>. With regard to the environmental and genetic origin of the kidney disorders, observing the kidney complications in a male Holstein calf in the current report may provide insight into diagnosing and preventing such fetal diseases in dairy herds.

## 2. Case report

This case was observed in February 2023 in a large commercial dairy farm (Behroozi CO., Tehran, Iran) with approximately 1000 milking cows. A 5-day-old male Holstein calf was first diagnosed with anorexia, lethargy,



**Figures 1.** The internal organs of a Holstein calf aged 90 days old in Iran, 2023. A. Pyelonephritis and polycystic kidneys, B. Lesion on kidney and cystitis, and C. *Pus* in the lung

and fever (41°C). In addition, the calf had respiratory disease signs (pneumonia) identified by hyperpnea and cough. After diagnosing the calf with fever and pneumonia, 2 mL of dexamethasone, an anti-inflammatory drug, and 5 mL of gentamicin, an antibiotic, were administered immediately<sup>1</sup>. The treatment of the calf lasted for 5 days. The calf's appetite, body temperature, and general appearance became better after treatment, but the calf did not become fully healthy. The calf was still lethargic with signs of pneumonia. The growth rate was slower, compared to other calves at the same age. The calf's weakness was significant. The calf's eyes were severely protruded at 60 days of age. The calf finally died at the age of 90 days. Necropsy was performed on the farm to investigate the cause of death. Enlarged, inflamed, and pale kidneys were the main postmortem findings. Both kidneys were inflamed and one of them was polycystic (Figure 1A). In the other kidney, lesions and inflammation were present (Figure 1B). Further investigation of the other vital organs revealed severe infection and pus in both lungs (Figure 1C). Organs, such as the liver and heart were in healthy shape. Inflammations and lesions on the kidneys were apparent (Figure 1A).

### 3. Discussion

Polycystic kidney disease (PKD) might be a congenital disease and characterized by multiple cysts in one or both kidneys. The causes of PKD is mutations in genes regulating the development and function of renal tubular epithelial cells in various species. Polycystic kidney disease is caused by various gene defects that lead to protein dysfunction. This dysfunction results in the dedifferentiation of cells, the proliferation of tubular epithelia, and the excessive secretion of fluid, ultimately causing the formation of renal cysts. It has been reported that PKD is associated with an autosomal dominant and autosomal recessive mode of inheritance due to

mutations in different genes<sup>6</sup>. The mutations in the PKD1 and PKD2 genes in autosomal dominant PKD may occur that affecting proteins, which play an important role in the physiology of renal tubular cells, primary cilia, and basal bodies in human<sup>6</sup>. Human autosomal recessive PKD causes cysts in kidneys and the liver and is associated with defects in the PKHD1 gene. Other animals, such as dogs and cats, could develop PKD<sup>7</sup>.

Ascending urinary tract infection mostly causes pyelonephritis in ruminants with *Corynebacterium renale* or *E. coli* but hematogenous route is much less common and may result from bacteremia with such agents as *Salmonella* species or *Actinomyces pyogenes*<sup>8</sup>.

With respect to the sign of fever in the calf, it seems that bacterial infections may occur in the early stages of life. The existence of cystic areas on both kidneys might be attributed to genetics. It is important to note that the incidence of brucellosis might be the other cause for such a complicated phenomenon. As *Brucella* spp. attacks trophoblast cells of the placenta<sup>5</sup>, it can affect fetus organ development. Generally, it is suggested that hygiene of the maternity pen and proper disinfection of the umbilical cord alongside optimal transition period's feeding and welfare may be useful in minimizing the congenital disorders in the offspring.

### 4. Conclusion

Pyelonephritis and polycystic kidneys can be fatal diseases in neonatal calves. Environment and genetics are the two major factors mediating the occurrence of kidney problems. Routine treatment with antibiotics may not be effective against kidney infections. As a result, prevention is preferred. Nutrition and welfare of cows in late pregnancy have critical effects on the fetus's development. Thus, feeding a balanced diet along with reducing stress in the pregnant cow's environment may decrease the risk of congenital problems in the offspring.

## Declarations

### Competing interest

None.

### Authors' contribution

Akbar Nikkhah led the project, created, and expanded the idea, generated the topic development, and conducted the final writing and editing. Masoud Alimirzaei made the clinical observations and contributed to writing the initial draft. The final manuscript was checked by all authors.

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### Availability of data and materials

Data from the study are available according to a reasonable request.

### Ethical considerations

The authors have made necessary ethical considerations (plagiarism, consent to publish, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy).

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