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A. G. Karlson
Minnesota Agricultural Experiment Station

H. C.H. Kernkamp
Minnesota Agricultural Experiment Station

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Hydronephrosis in Swine

A review of literature and a report on two cases of hydronephrosis in swine*


Hydronephrosis is the distention of the renal pelvis and calyces by urine, due to some obstruction along the course of the urinary passage. The obstruction may be in the ureter, the bladder, or the urethra. The term hydronephrosis is often used to include an accompanying hydroureter which develops when the obstruction is below the uretero-pelvic junction. The enlargement of the pelvis and calyces causes atrophy of the adjacent parenchyma. The amount of kidney destruction may vary from merely a flattening of the papillae to complete replacement, leaving but a thin shell of inactive cortex. When there is a superimposed infection and the renal pelvis fills with pus, the condition is called pyonephrosis.

Normal Physiology

Normally, the urine is forced into the bladder by the peristaltic activity of the ureter. Waves of contraction start in the calyces, which contract successively downward. The pelvis then contracts and forces the urine into the ureter, which in turn pushes it down to the bladder by waves of contraction. The urine enters the bladder in jets. At each spurt of urine, the bladder relaxes slightly so that no bladder urine can be forced back up the ureter against the ureteral pressure. When the bladder contracts under normal conditions, the ureteral sphincters also contract and close the ureteral orifices, preventing the pressure of the contracting bladder from forcing urine back up the ureter. The sphincters are formed by the bladder muscle coats and relax and contract as the bladder relaxes and contracts.

Pathology

The pathogenesis of hydronephrosis can be explained from the short description of the normal physiology given above. An impediment to the passage of urine through the urethra results in incomplete emptying of the bladder or requires a more forceful contraction to evacuate the urine. In the first instance, the bladder distends more than normally and the ureters must contract more forcefully to force urine into it. The increased pressure within the ureters distends the renal pelves and causes dilatation and hypertrophy of the ureters. Since both ureters are affected, the resultant hydronephrosis is bilateral. When the bladder contractions become more forceful to overcome the urethral obstruction, there is hypertrophy of the bladder musculature. The bladder may then be capable of emptying itself, but the increased pressure produced by the hypertrophied muscle coats requires increased pressure within the ureters. This results in dilatation and hypertrophy of the ureters and distension of the renal pelves.

Bilateral hydronephrosis may also result from some obstruction to the ureteral orifices within the bladder, such as a tumor, a calculus, or cystitis. Unilateral hydronephrosis occurs when one orifice

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† Division of Veterinary Medicine, Minnesota Agricultural Experiment Station, University Farm, St. Paul, Minn.
is involved, or when one ureter has an obstruction along its course.

The Literature

According to Henschen (1) hydronephrosis is much more common in swine than in other domestic animals. Lucks (4) examined 6,425 swine carcasses in a packing plant and found that 43, or 0.67 per cent, had hydronephrosis. These included eleven males and thirty-two females. In the entire series, the two sexes were about equal in number. Twenty-nine animals had unilateral and fourteen had bilateral hydronephrosis. Thirty-one cases were examined in detail. A bilateral hydronephrosis due to occlusion of the ureteral orifices as a consequence of a catarrhal cystitis occurred in one case. A congenital occlusion of one ureteral orifice found in another case resulted in unilateral hydronephrosis of the corresponding side. In each of the other twenty-nine cases it was found that one or both ureters entered posteriorly in the neck of the bladder. The bladder in swine is very large and has a long neck, as compared with other animals. The neck of the bladder in female swine according to Lucks (4) measured 10 to 12 cm. in some cases. The lateral and median ligaments give a very loose attachment for the bladder. The result of this anatomical arrangement is that the large, freely movable bladder is displaced onto the floor of the abdominal cavity. When it is full, the long neck is pulled over the brim of the pelvis. If one or both ureters extend to a more posterior position than normal, the ureteral orifice is closed by the compressed neck of the bladder as it hangs over the pubis. This intermittent closure of the ureters might readily result in hydronephrosis.

Kukuljevic (3) also reports that hydronephrosis is common in swine, and that it is due to the malposition of the ureteral orifices plus the compression of the neck when the bladder hangs in the abdomen as described by Lucks (4).

Joest, Lauritzen, Degen and Brückl­mayer (2) suggest that the high incidence of hydronephrosis of swine seen in German packing plants, as reported by Lucks (4) and confirmed by their own studies, may be due to the difference in the breeds of swine. They record that hydronephrosis is not seen as frequently in other countries, especially Russia and Italy. These authors examined thirty hydronephrotic kidneys by injection and corrosion methods, and studied the histopathology of twenty-five others. Casts of kidneys with varying degrees of dilatation showed that there was first a widening of the calyces and pelvis, which progressed so that the individual calyces fused, or were separ-
ated only by very narrow remnants of kidney tissue. In advanced cases, there was formed a single large cavity with faint suggestions of a previous division into calyces. Casts of the arterial system showed that as the process of dilatation proceeded the number of arterioles decreased. In advanced cases, only the larger branches of the renal artery remained. This is due to the pressure. The resulting ischemia aids in the destruction of the tissue. The effect is more noticeable in the medulla, since the cortex is supplied by vessels from the capsule as well as from the minor branches of the larger arteries. Histopathologic examinations showed degeneration of the epithelial lining of the calyces with chronic proliferative changes in the muscle layers. The renal parenchyma also revealed extensive chronic proliferative changes besides the widespread atrophy and degeneration.

Richter (5) describes a case in a two-year-old sow in which the hydronephrotic sac filled three-fourths of the abdominal cavity. It measured 42 by 25 cm. and weighed 42 Kgm. The renal parenchyma had been completely destroyed. The ureter was dilated so that it resembled a portion of intestine. The other kidney was hypertrophic. In this case, no cause is given for the development of the hydronephrosis.

**Cases Observed**

We have found two cases of unilateral hydronephrosis in swine.

Case 1 was a one-day-old female pig submitted for post-mortem examination. Necropsy findings of interest were confined to the urinary tract. The left kidney contained large cavities with little parenchyma surrounding them. The corresponding ureter was distended and apparently stenosed at its entrance into the bladder.

Case 2 was a 90 pound, five-months-old female, destroyed because of suspected hog cholera. Necropsy revealed typical lesions of hog cholera. The left kidney was smaller than the right, was slightly lobulated and light brown in color with streaks of gray, and had numerous petechial hemorrhages. It consisted of a sac formed by the greatly dilated pelvis, with a thin shell of renal parenchyma surrounding it. This kidney measured 12 by 5 cm., as compared with 15 by 7 cm. for the right. The residual brown shell of parenchyma surrounding the dilated pelvis and calyces varied in thickness from 2 to 5 mm.

The left ureter was markedly dilated and tortuous throughout its entire length. It measured 7 by 2 cm. at the hilus, forming a large cavity here which was continuous with the dilated pelvis. The diameter of the rest of the ureter varied from 3 to 4.5 cm.; its wall was about 3 mm. thick. When traced to its distal end, it appeared to open into the posterior portion of the neck of the bladder about 6 cm. posterior to the opening of the right, or normal ureter (Fig. 1). The orifice was patent. The dilated kidney and ureter contained clear but tenacious urine. When pressure was applied to the kidney or ureter, the urine passed out through the urethra as well as up into the bladder.

**Microscopic Examination**

Microscopic examination of sections from the thin wall of the hydronephrotic kidney showed a very narrow zone consisting of dilated tubules and some normal glomeruli. In some areas, there were groups of atrophic, narrow tubules surrounded by proliferating connective tissue. There were large areas in which the renal parenchyma was completely replaced by connective tissue. Groups of small arteries were all that remained of the renal parenchyma. The renal capsule was increased in thickness. In most places, the epithelium of the pelvis was gone or degenerated, but some areas seemed to have retained a normal appearance.

These two cases are the only ones recorded out of approximately 6000 necropsies performed on swine in this laboratory.

**Summary**

Two cases of unilateral hydronephrosis in swine are described. One case was congenital in origin. In the other, the ureter of the affected side opened into the neck of the bladder about 6 cm. posterior to the normal one. Such a displacement of one (Concluded on page 34)
Prior to Operation

After the Operation
down over the right eye. Two similar, but smaller growths were also present, one involving the left horn and the other the right side of the neck. The animal was examined, and although no exact diagnosis as to the nature of the growth was made, it was evident that surgery would be necessary if a recovery was to be effected.

The animal was observed for a week, and the growths did not increase in size. On April 22, the bull was placed on the operating table lying on his left side. The areas surrounding the large growth on the frontal region and the growth on the side of the neck were shaved and painted with tincture of iodine. Dr. M. J. Johnson of the Department of Surgery then proceeded with the operation. The area was infiltrated with two per cent procaine solution. An incision was made around the largest growth through the skin and soft structures to the skull itself. The growth was then dissected away close to the cranial bones. The growth on the side of the neck was cut out as deeply as it was thought necessary. Hemostats were used to control hemorrhage, but the animal had lost so much blood it was decided to wait before removing the remaining growth. Sections were made of the growth by the pathology department and it was found to be a myxo-fibroma.

On May 5, the operative wounds were healing nicely so the bull was again placed on the table and prepared for a second operation. The area around the left horn was shaved and painted with tincture of iodine. Two per cent procaine was infiltrated into the tissues for anesthesia. The growth was dissected out, removing the horn with the growth. The hemorrhage was controlled with hemostats and the bull was returned to his stall.

The bull was very unruly; consequently, little after care was given after either operation. However, the operative areas healed nicely, and showed only a little swelling the first few days following the operation. The bull was discharged on May 23, 1941, almost completely healed.

The accompanying illustrations show the patient, first, before the operation; and, second, shortly before the animal was discharged.

—B. T. Hsu, ’42

HYDRONEPHROSIS

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or both ureters is said to be the most common cause of hydronephrosis in swine. The comparatively large bladder is loosely fixed and when full hangs over the brim of the pelvis into the abdominal cavity. The long neck and the aberrant ureter are compressed against the pubis so that the ureter is occluded.

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