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## PRIMARY PNEUMATURIA

WITH A REPORT OF A CASE DIAGNOSED RADIOLOGICALLY

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Pneumaturia, namely the passage of gas from the bladder on voluntary micturition or during catheterization, is a rare phenomenon. The first mention of the condition was in 1671 in a publication entitled 'Curiosities of Nature', quoted by Taussig<sup>1</sup> as follows: 'A leading citizen of Gotha was afflicted by anal colic, with rumbling tension in the abdomen, pain about the navel, and, what is strange, wind was passed by the penis, as if through the usual and accustomed channel, sometimes with, and sometimes without urine.'

The aetiology may be secondary to introduction of air during instrumentation, or to a fistulous connection between the bladder and a gas-containing viscus such as bowel or vagina. Primary pneumaturia results from the formation of gas within the bladder as a result of urinary infection by a gas-forming organism. Rarely, pneumaturia may follow cystitis emphysematosa (see below), in which gas vesicles form within the bladder wall and subsequently rupture to liberate gas into the bladder cavity.

Fineman, Ferber and Roginsky<sup>2</sup> divide primary pneumaturia into 2 groups, viz. a group with glycosuria and a non-diabetic group.

Up to 1950, 18 cases of each group had been described according to these authors, who add reports of 4 additional diabetic cases with pneumaturia. Spring and Hymes<sup>3</sup> report a further diabetic case, contributing in addition an excellent review of the literature, and Foord and Nabarro<sup>4</sup> 2 additional cases associated with glycosuria, bringing the total of the reported instances of diabetic pneumaturia to 25.

### *Aetiology*

Residual urine is almost invariably present owing either to the 'neurogenic bladder' of diabetic neuropathy or to bladder-neck obstruction in the non-glycosuric group. In Spring and Hymes' diabetic case<sup>3</sup>, however, there was no evidence of incomplete bladder emptying.

Infection is superimposed on the vesical urinary stasis, and a gas is produced which is not readily soluble in urine. The infecting organism is usually *B. coli*, but *B. lactis aerogenes*, *B. aerobacter aerogenes*, *B. aerogenes capsulatus* and yeasts may be present. The urine is acid but becomes neutral or ammoniacal as fermentation proceeds.

Gas production may take place in the kidney and ureter as well as the bladder, but unless there is obstruction with urinary stasis in the kidneys no gas accumulation can occur since the urine passes rapidly into the bladder. Mueller<sup>5</sup> analysed the gas present in a diabetic patient with pneumaturia, and found it to contain carbon dioxide 9.1%, hydrogen 57.3%, nitrogen 33.5% and methane 0.79%. As the urine stands, more carbon dioxide is formed, and the proportion of this gas may reach 19%, while the hydrogen decreases with prolongation of fermentation. Hydrogen forms the bulk of the gas formed in diabetics, and carbon dioxide in the non-diabetic group. The gas is produced by fermentation in the glucose-rich urine with production of butyric and lactic acids. An appreciable quantity of alcohol may be produced on distillation of the urine.

There are several theories to explain the production of gas in non-diabetic urine. The gas may result from proteolytic break-down of a special type of albumen, or of ordinary albumen by a special strain of *B. coli*. Taussig<sup>1</sup> believed that the gas-producing ability of the coliform bacillus might be associated with a developmental phase of the organism. Mulsow and Gillies<sup>6</sup> suggest that acid urine from the kidneys may interact with bicarbonates present in the retained bladder urine with production of gas.

Diabetic cases may mistakenly be grouped as non-diabetic when the glucose is present in very small quantity or intermittently. Furthermore, glucose may be absent at the time of urine testing owing to its having been used up in the

fermentation process. A blood-sugar determination is therefore essential in patients exhibiting primary pneumaturia.

Ammoniacal fermentation or urine putrefaction does not produce pneumaturia because the gases are too readily soluble in urine.

The possible relationship of primary pneumaturia to cystitis emphysematosa deserves mention. This is an inflammatory condition, occurring more frequently in diabetics than non-diabetics, in which gas-filled vesicles appear in the walls of the urinary bladder as the result of *B. coli* infection. Pneumaturia is cited in case reports as a frequent symptom and, though Fineman, Ferber and Roginsky<sup>2</sup> are sceptical of a relationship, Boijssen and Lewis-Jonsson<sup>7</sup> believe that free gas in the bladder follows rupture of the vesicles in the late stages of emphysematous cystitis.

#### Diagnosis

The clinical diagnosis is suggested by the finding of a mid-line supra-pubic tympanitic 'mass' which may reach the level of the umbilicus. The patient complains of the passage of gas during micturition, or the condition may be found on catheterization or abdominal radiography without the patient's being aware of it.

Reference in the literature to the radiological diagnosis has been made only 7 times so far. The radiological features to be noted are:

1. A round or pyriform translucency in the supra-pubic mid-line area, distinguishable from the sigmoid and rectal gas-shadows or not resembling bowel gas-shadows (Fig. 1).

2. A pelvic fluid level with gas cap above it when a horizontal X-ray beam is used with the patient in the erect position.

3. On excretory urography, the opaque medium pools in the dependent portion of the bladder in the supine position, giving the appearance of a poorly defined blob of opacity, surrounded by a broad halo of translucent gas. In the erect posture there is a fluid level at the upper limit of urographic medium, with gas cap completing the bladder outline.

4. Any translucencies in the region of the urinary bladder in the plain abdominal film should raise suspicion of gas in the bladder, particularly if bowel shadows can be separately distinguished. Often it is impossible to distinguish between bowel and bladder gas, and catheterization must be resorted to as the final arbiter.

#### CASE REPORT

Mr. C.J.M., a deaf-mute aged 53, suffering from primary testicular atrophy and eunuchoid gigantism for many years, had diabetes mellitus, present for the past 10 years. The diabetes was always difficult to control with insulin, and he had been admitted to hospital on numerous occasions either in hypoglycaemic or hyperglycaemic coma.

The patient was in hospital convalescing from an episode of hypoglycaemic coma, when he developed burning micturition, and profuse haematuria which lasted one week. When the haematuria ceased, the urine contained traces of albumen and varying amounts of glucose. Cultivation of mid-stream specimens of urine and subsequent catheter specimens yielded abundant growths of coliform bacilli sensitive only to neomycin. Straight X-ray of the abdomen revealed the gas shadow in the bladder seen in Fig. 1. In view of the X-ray picture, the bladder was catheterized under water, when first urine and then gas were obtained. Insufficient gas was obtained for laboratory analysis. On rectal examination, the prostate was found to be small. There was no evidence of a fistulous connection between the bowel and the bladder.

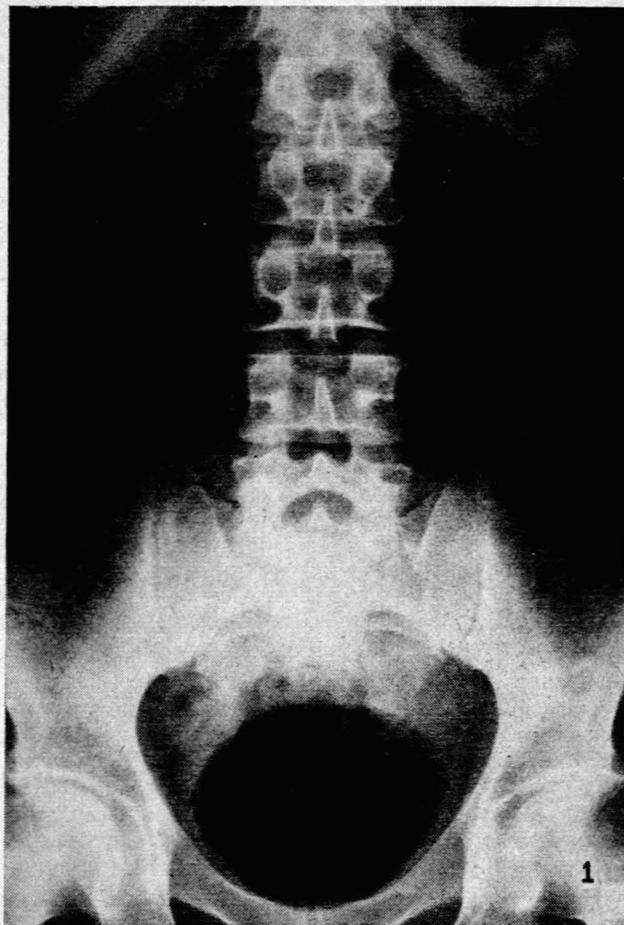


Fig. 1.

Cystoscopy and retrograde pyelography (Mr. E. Abro) revealed a normal posterior urethra. The bladder mucosa showed gross increased vascularity with abundant loose floating muco-purulent debris. No intramural cystic formation was noted. Retrograde pyelography revealed normal calyceal systems with some pyelectasis but no renal papillary necrosis. There appeared to be narrowing of the pelvi-ureteric junction, but the emptying was normal. Ureteric dilatation was present, consistent with bladder infection.

Neomycin was instilled daily into the bladder. The pneumaturia disappeared, but the coliform infection persisted. The daily lente insulin requirement as calculated by urinary sugars was 40 units before the onset of the haematuria and pneumaturia and 15 units during the episode, and gradually increased to 50 units when the pneumaturia disappeared. This is contrary to what is expected in a diabetic who develops secondary infection, at least insofar as control by urine testing is concerned. The blood sugars before, during and after the pneumaturia episode in this case were not studied in enough detail to permit of correlating the blood-sugar levels, the presence or absence of gas in the urine, and the insulin requirements and dosage.

#### SUMMARY

Primary pneumaturia is a rare phenomenon. It occurs slightly more commonly in diabetics than in non-diabetics, and is usually due to coliform bacillus infection. The clinical and radiological features of a case are described. It is important to recognize the condition because, apart from the obvious

implication of infection of the urinary tract, urine testing may give fallacious results because of the using up of the glucose by the infecting organisms. Clinical control of the diabetes can only be adequately effected by frequent blood-sugar estimations.

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