BACTERIURIA AND ITS EFFECT ON URETER

(A radiological study)

by

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Introduction

Pyelonephritis is one of the frequent medical indications requiring hospitalization during pregnancy. The urinary stasis and the constipation so commonly met with during pregnancy are aetiological factors of importance. The critical need for early and accurate diagnosis has been growing steadily with the increasing awareness of the part that this disease plays in hypertension, toxaemias of pregnancy and diabetes mellitus.

It is well known that bacteriuria during pregnancy may not produce symptoms and yet may be responsible for complications during labour and puerperium.

The high incidence of bacteriuria during pregnancy as compared to non-pregnant state naturally needs investigation regarding changed renal factors, which might ultimately help us to understand urinary tract infection in general.

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Review of literature

Pronounced physiological changes take place in the urinary tract during pregnancy which are peculiarly well suited to careful study by intravenous pyelography.

These changes are those of (i) atony, (ii) stasis, (iii) dilatation and (iv) dilatability (on retrograde pyelography) and they affect the calyces, renal pelves and the ureters. The changes are transitory and a steady return to the normal non-pregnant state occurs after parturition.

"The altered physiology which takes place in pregnancy is a balanced even though extensively modified one, and is entirely adequate for continued good health". This apt quotation from Crabtree's monograph may well be remembered when it is seen radiologically how extensively the appearances may alter during pregnancy, even though no urinary infection may be present.

These changes have also been well described by Baird (1936) from his observations in 102 autopsy cases. These are usually asymmetrical dilatation of the calyces, pelves and ureters, the increase in calibre usually being much more pronounced on

the right side. The ureters show elongation and kinking and the dilatation is continued from the renal pelvis down to the pelvic brim but seldom below this level. Histologically, the most striking change is a considerable hyperplasia of the muscular periureteric sheath (Waldeyer's sheath) in the pelvic part of the lower ureter.

Radiological appearances

The calyces lose the normal cupping and their margins become rounded and blunted. The pelvis is "full" and has a greater capacity than in the non-pregnant state. The usual narrowing of the pelvi-ureteric junctional area is lost and the calibre of the ureter is greatly increased down to the level of the pelvic brim; the calibre of the pelvic spindle is usually unaltered. The ureter is usually displaced outwards, is elongated and often shows marked kinking (Shanks and Kerley 1950).

There is general agreement amongst most workers who have made a particular study of the urinary tract in pregnancy, notably Schumacher (1930) Kretschmer, Heany and Ockuly (1933) and Duncan and Seng that, (i) the dilatation and stasis occurs in almost every pregnant woman in some part of the pelvi-calycine system or in the ureter, (ii) these physiological changes are more commonly found on the right side than on the left and when they are present bilaterally the changes are almost invariably greater on the right, (iii) dilatation of the lower one-third of the ureter is rarely observed. Crabtree considers that if such dilatation occurs it is frankly pathological; quite marked dilatation may occur very early in pregnancy and is nearly always established by the 32nd weak.

There is little doubt that these physiological alterations in the urinary tract of pregnant women result from hormonal influences. The hormones at various times have been regarded as oestrogen (Hundley 1935), progesterone (Mclane 1937) or placental hormones. The pressure of the enlarged uterus may be a contributory factor to the dilatation and stasis in some cases, but it is certain that this is never the sole factor responsible.

The phenomenon of ureteral kinking is also important. Stander (1941) thought them to be illusory due to the ex-rays taken in the plane of the curves rather than at right angles to them. It is possible that mechanical factors of kinking are important in genesis of various lesions of pregnancy.

Puerperal changes

The atony of the upper urinary tract in pregnancy does not recover immediately after parturition; indeed Baird (1936) considers that the puerperal atony is maximal about 10 days after delivery. There is subsequently a gradual return to the normal non-pregnant state over a period of several weeks.

Material and Method

The anatomical changes in the urinary tract were studied by intravenous pyelography. The solution used was Uropac which contains iodine. The average dose was 20 ml. The patient was prepared by giving

mild vegetable aperient the previous evening; fluid was withheld for 8 hours before pyelography. Charcoal tablets, 2 tablets every 2 hours, were administered, such 16 tablets were given. Enema was given in the morning. The patient was asked to empty the bladder just before the injection.

Twenty c.cs. of warm solution of Uropac were injected in the antecubital vein very slowly. Special care was taken so as to avoid extravasation of the solution in the surrounding tissues. The first film was exposed 7½ minutes after the injection. Instructions for subsequent radiography based on inspection of the first film were then given. If the appearance was quite normal a second film at 25 minutes was taken (Shanks and Kerley 1950).

Observations

Intravenous pyelography was done in 50 cases. Of these, 25 cases were of bacteriuria with pregnancy, 15 pregnant women without bacteriuria (out of the 200 cases screened for bacteriuria) and 10 non-pregnant women.

The uretric diameter was measured at the level of 2nd lumbar vertebra. The statistical evaluation of these is given in Table 1. In all the cases the diameter of the left ureter was smaller than that of the right (photographs 1 to 4), the average diameter of right ureter in non-pregnant women being 3.500 mm., of pregnant without bacteriuria 4.114 mm., and of pregnant with bacteriuria 5.740 mm. The diameter of the left ureter in the corresponding groups was 3.340 mm., 3.880 mm. and 5.580 mm. The mean value of the right ureteric diameter in the pregnant cases with bacteriuria is greater than in the pregnant without bacteriuria and was greater as compared to non-pregnant cases. The same is observed as to the diameter of the left ureter. The ureters, specially the right, appeared to have a tortuous course.

The renal pelves were carefully studied in these cases for the maintenance of the concavity at the upper border of the pelves. This border was

TABLE I

Showing the statistical evaluation of ureteric diameter in non-pregnant, pregnant without bacteriuria and pregnancy with bacteriuria

	Non-pregnant		Pregnant without bacteriuria		Pregnancy with bacteriuria	
	Right ureter	Left ureter	Right ureter	Left ureter	Right ureter	Left ureter
Variation *	3.1-4.5 mm	2.8-4.2 mm	3.5-6 mm	3.3-5.6 mm	5-8 mm	4.8-7.6 mm
Mean	3.550 mm	3.340 mm	4.114 mm	3.880 mm	5.740 mm	5.580 mm
S.D.	0.142	0.392	0.262	0.938	0.283	0.823
Range: **	3.402 to 3.692 mm	2.848 to 3.732 mm	3.852 to 4.376 mm	2.848 to 4.812 mm	4.457 to 6.023 mm	4.757 to 6.403 mm

concave in all pyelograms of all ten non-pregnant females. (Fig. 1). Loss of definite concavity or slight convexity was observed on the right side in 8 out of 15 cases of pregnancy without bacteriuria and 20 of the 25 cases of pregnancy with bacteriuria (Fig. 2). Definite convexity of the upper border of pelvis was seen in 15 out of the 25 cases of pregnancy with bacteriuria studied (Fig. 3). On the left side changes were similar but less marked except in one case where the right pelvis showed convexity but the left pelvis showed maintained concavity (Fig. 4).

The calyces showed normal cupping in all the non-pregnant women (Fig.), slight rounding of the calyx shadow was observed in one right, and left side in 8 out of 15 pregnant cases (Fig. 2), while this was observed in all 25 cases of pregnancy with bacteriuria on right side (Fig. 3). The changes on left side were less marked, definite clubbing of the calyces was observed in 15 cases on right side and 12 cases on left side, out of 25 cases of pregnancy with bacteriuria. None of the pregnant cases without bacteriuria showed definite clubbing.

Comments

The intravenous pyelography revealed interesting findings. The diameter of the ureter was measured at the level of 2nd lumbar vertebra. The average diameter of the right ureter in the non-pregnant, pregnant without bacteriuria and pregnant women with bacteriuria was 3.55 mm., 4.114 mm. and 5.74 mm. respectively.

The diameter of the left ureter was found to be smaller than the right ureter in all cases. This is confirmatory with the findings of Duncan *et al* (1928) and Schumacher (1930) Kretschmer *et al* (1933).

There was dilatation of the ureter, renal pelvis and calyces as evidenced by increased diameter, loss of S shaped curve of superior border of pelvis and loss of cupping of calyces in the pregnant women as compared to non-pregnant women and the dilatation was more marked in pregnant women with bacteriuria Figure 1 to 4).

The cause of this dilatation has been subject of controversy for a long time. Shanks and Kerley (1950) have reported that during infection it is probable that the dilatation, atony and stasis of urinary tract increases further, but in mild cases there is no impairment of urinary excretion. Extreme dilatation of the calyces and pelvis is usually indicative of presence of infection, but on radiographic evidence alone, if there is no functional impairment, it is extremely difficult to give any clear guidance as to the upper limit of "physiological dilatation".

The importance of finding this physiological dilatation is recently enhanced because of a concept developing that such dilatation and bacteriuria result in later life pyelonephritis and subsequent hypertension. The present study emphasizes the increased presence of dilatation in cases of asymptomatic bacteriuria. Obviously the natural conclusion would be to investigate all multigravidas from this angle and cases who show dilatation and asymptomatic bacteriuria are treated properly. Such a treat-

ment may be helpful in reducing the ultimate development of hypertension in such cases.

Summary and Conclusion

1. The literature is briefly reviewed.

2. Intravenous pyelography was done in 50 cases comprising 25 cases of bacteriuria with pregnancy, 15 pregnant women with sterile urine and ten non-pregnant women.

3. The diameter of the right ureter was found to be greater than the left ureter in all cases. The ureters and pelves were dilated in pregnant women as compared to the non-pregnant women. The calyces showed loss of cupping in these cases.

An exaggeration of these anatomical changes in the urinary tract was found in pregnant women with bacteriuria. The average diameter of the right ureter in non-pregnant women, pregnant women and pregnant women with bacteriuria was 3.5 mm., 4.114 mm and 5.74 mm respectively and that of left ureter 3.34 mm, 3.88 mm and 5.58 mm respectively.

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Figs. on Art Paper VIII