

Pelvis/cortex ratio: A sonographic marker of pelvi ureteric junction obstruction in children

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ABSTRACT

Objectives: The aim of the study is to document pelvis/cortex ratio (P/C ratio) in children presenting with antenatally detected hydronephrosis and determine whether it could be used as a sonographic marker of Pelvi ureteric junction (PUJ) obstruction.

Materials and Methods: All the children presenting with unilateral fetal hydronephrosis (PUJ) between Jan 2007 and March 2008 were included. Ultrasonogram was performed by the same sonologist and P/C ratio was determined by dividing maximum anteroposterior pelvic diameter with maximum cortical thickness.

Results: Among a total of 111 children, 87 (78%) improved on conservative management while 24 (22%) required pyeloplasty. The mean (\pm SD) P/C ratio was 2.7 ± 2.18 in those improved on conservative management while 13.5 ± 1.48 in those who required surgery ($P < 0.01$). All (22/22) children with P/C ratio of 12 or above required pyeloplasty, while 2/5 with P/C ratio 8–12 and none (0/84) with P/C ratio less than 8 required pyeloplasty ($P < 0.01$).

Conclusions: P/C ratio could be used as a marker of PUJ obstruction in children with hydronephrosis.

Key words: Hydronephrosis, pelvis cortex ratio, pyeloplasty, ultrasound

INTRODUCTION

Pelvi ureteric junction (PUJ) obstruction is a common cause of hydronephrosis detected during antenatal ultrasound.^[1] Ultrasonogram (USG) and radionuclide renogram are widely used to identify those who require pyeloplasty.^[2,3] Conventionally radionuclide scans are being used as gold standard in children, with deterioration in split renal function (SRF) being used as an indication for pyeloplasty. However several authors have expressed concern regarding failure of the lost split function to recover after surgery.^[4,5]

The sonographic criteria for pyeloplasty have not been uniformly defined in the literature.^[6-8] The anteroposterior pelvic diameter (APPD) and Society of

Fetal Urology (SFU) grading have been widely used to describe the severity of hydronephrosis on ultrasound although their usefulness have been widely debated when it comes to selection of patients for surgery.^[9-12] Renal parenchymal-to-pelviccalyceal area has been used successfully to predict those who required pyeloplasty.^[13-15] We have shown that pelvis cortex ratio (P/C ratio) is superior to APPD as a marker of success following pyeloplasty in children.^[16] In this study we have analyzed the role of P/C ratio in the follow-up of children with antenatally diagnosed hydronephrosis and addressed its usefulness in selection of patients who require surgery.

MATERIALS AND METHODS

All the children presenting with unilateral fetal hydronephrosis (PUJ) between Jan 2007 and March 2008 were included. Children with bilateral hydronephrosis, hydroureter, VUR, or other associated anomalies were excluded. All the patients were followed up with USG and radionuclide scans at 3-month intervals. Indication for pyeloplasty was 10% or higher drop in split renal function on the nuclear renogram during the follow-up.

During the entire study period, USG was performed by a standardized technique by the same sonologist to avoid bias: the USG machine, probe, and settings were kept identical (Voluson 730 Expert, GE Medical Systems; wide band linear probe 4–10 Mhz) during initial and follow-up scans

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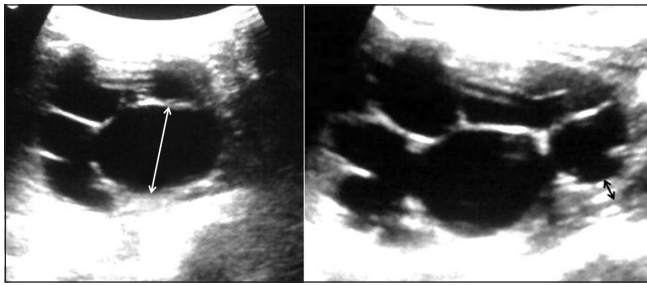


Figure 1: Preoperative USG in a patient with PUJ obstruction. White arrow represents maximum APPD in coronal section (40 mm in this patient). Black arrow represents maximum CT in longitudinal section (3 mm in this patient). P/C is calculated by dividing APPD with CT (13.3 in this patient).

to reduce error. Hydration was ensured in all children by clinical assessment to prevent dehydration causing an impact on the pelvis size. The child was kept quite so that crying and straining would not bias the measurements. The maximum APPD was measured in coronal section and maximum polar cortical thickness (CT) was measured in longitudinal section accurately. P/C ratio was calculated by dividing maximum APPD with maximum CT [Figure 1].

Mean P/C ratio was compared between those who improved on conservative management and those who required surgery. Further analysis of P/C ratio versus outcome was performed. The outcome between groups was expressed as percentage. Statistical analysis was done using students *t* test and Fishers exact test and the difference in outcome was considered significant when the *P* value was less than 0.05.

RESULTS

Among a total of 111 children (age range 1 month to 5 years; M: F = 2:1; median follow-up = 25 months), 87 (78%) improved on conservative management while 24 (22%) required pyeloplasty. The mean (\pm SD) P/C ratio was 2.7 ± 2.18 in those managed conservatively, and 13.5 ± 1.48 in those who required pyeloplasty [Figure 2]. The difference between the groups was statistically significant ($P < 0.01$ student's *t* test).

Table 1 shows the outcomes based on P/C ratio. All (22/22) children with P/C ratio of 12 or above required pyeloplasty; while 2/5 in the group with P/C ratio 8–12 and none (0/84) with P/C ratio less than 8 required pyeloplasty ($P < 0.01$ Fisher's Exact test). P/C ratio of 12 or above as a marker of PUJ obstruction has a sensitivity of 92%; specificity 100%; positive predictive value 100%; and negative predictive value 98%.

DISCUSSION

The incidence of antenatally diagnosed hydronephrosis is as high as 1–5%. PUJ obstruction and transient physiological

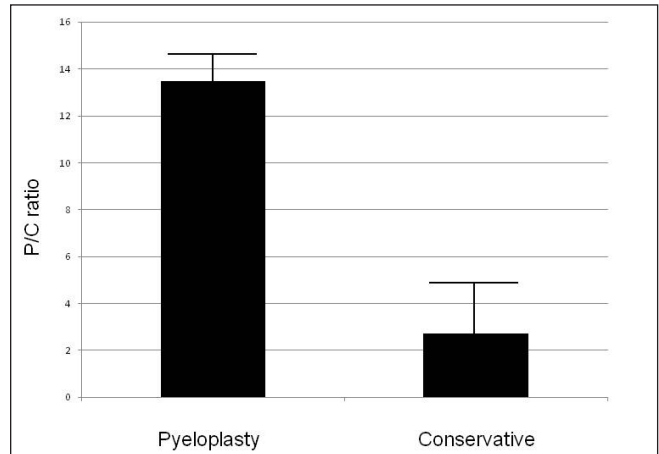


Figure 2: Bars represent mean (+SD) P/C ratio in patients who required pyeloplasty ($13.5 + 1.48$) and those managed conservatively ($2.7 + 2.18$). The difference was statistically significant ($P < 0.01$).

Table 1: Table showing the outcome based on P/C ratio. All children with P/C ratio of 12 or above required pyeloplasty while only 2/5 with P/C ratio 8- 12, and none of those with P/C ratio < 8 required pyeloplasty ($P < 0.01$ Fisher's Exact test)

P/C ratio	Pyeloplasty	Conservative	Total
> 12	22	0	22
8-12	2	3	5
< 8	0	84	84
Total	24	87	111

renal pelvic dilatation are important causes of unilateral hydronephrosis.^[1] Diuretic renography remains a gold standard in the evaluation of these patients with loss of SRF in progressive renal scans being the criterion to determine the presence of significant PUJ obstruction. However the lost SRF does not always recover following pyeloplasty^[2-5] underscoring the need to select such patients earlier by alternative methods.

Hafez *et al.*^[6] felt patterns on serial USG were superior to invasive renography. Dhillon^[7] recommended simple follow-up for pelvic dilatations less than 12 mm, while surgery for those more than 50 mm. For the 20–50 mm group surgery was recommended in those with reduced function, symptoms, and increasing dilatation. Although SFU grading made sonographic assessment more descriptive, it helped more in comparing data between centers, rather than selection of patients for surgery.^[8-11] Onen^[10] reported that neither SFU nor APPD could act the gold standard in determining the severity of hydronephrosis. Cost *et al.*^[13] felt that renal parenchymal area provided a more accurate estimate of renal size and function in the hydronephrotic kidney.

Imaji and Dewan^[15] introduced calyx parenchyma ratio as a marker of success following pyeloplasty. We felt that CT was also counted to assess success following pyeloplasty in children.^[16]

In the present study, we have analyzed the role of P/C ratio in the evaluation of children who presented with antenatally detected hydronephrosis. All patients with P/C ratio above 12 required pyeloplasty. All the children with P/C ratio less than 8 were successfully managed conservatively. In the group with P/C ratio 8–12, 2/5 (40%) required pyeloplasty.

Standardization of USG is an essential step in making it a useful tool. P/C ratio could be a useful, noninvasive, and simple criterion in addition to renographic parameters to select patients with significant obstruction for pyeloplasty. Further larger studies are required to strengthen or negate the evidence.

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