



# Radiation-free monitoring in the long-term follow-up of pyeloplasty: Are ultrasound new parameters good enough to evaluate a successful procedure?

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## Keywords

Pyeloplasty; Anteroposterior diameter; Pelvis/cortex ratio; Ultrasound monitoring; Residual hydronephrosis

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## Summary

### Introduction

Long-term evolution of residual hydronephrosis after successful pyeloplasty is not common. In this report, we have studied new ultrasound parameters, and have investigated the frequency of residual hydronephrosis. We highlight alternative radiation-free monitoring of pediatric pyeloplasties with ultrasound alone.

### Patients and methods

Children who had undergone successful open Anderson–Hynes pyeloplasties in the period 2001–2010 were followed up. Exclusion criteria included non-clearly obstructed renography scans (tracer clearance half-time < 20 min), crossing vessels, failed pyeloplasty, bilateral disease, other renal concomitant anomaly, absence of ultrasound measurements, and loss to follow up (<1 year). Postoperative (postoperative) ultrasound parameters were anteroposterior (AP) diameter, pelvis–cortex (P/C) ratio, a proportion that takes in account these two values, enhancing sensitivity to evaluate minimal evolutive changes), and percentage of improvement (PI) in AP diameter (which reflects in relative means the evolution of each AP diameter, being 0% no change, and 100% absence of hydronephrosis) (Figure). Echographic checks were made at 3 and 6 months postoperatively and then yearly afterwards. SPSS software (v. 17.0 IBM, College Station, TX, USA) was used.

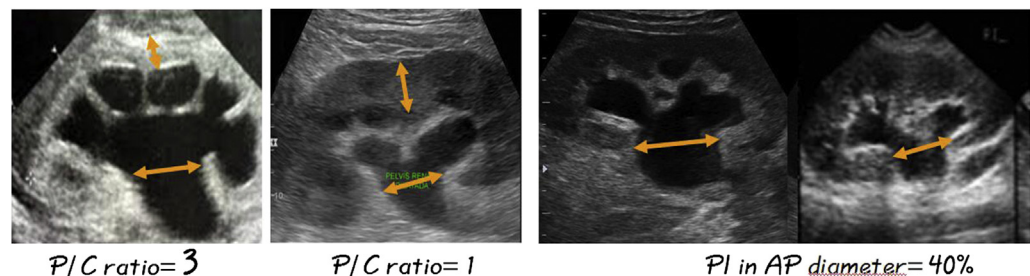
### Results

Out of 80 pyeloplasties performed in the above-mentioned period, 44 patients (i.e., 44 renal units)

fulfilled the inclusion criteria for the main study. The median age at time of operation was 15 months (range 2 months–10.3 years). The median follow-up was 4.5 years (range 1–12 years). The mean preoperative anteroposterior diameter was 26 mm (range 16–54 mm). At the third postoperative check, the mean the PI was 29%, and rose to 53% at 6 months ( $p = 0.027$ ). Posterior controls showed a stable yearly PI during follow-up, without statistically significant variations (40–59% in subsequent years,  $p > 0.5$ ). The P/C ratio had already downgraded significantly at the third postoperative check (4.6 preoperative vs. 1.8 postoperative;  $p = 0.03$ ). A subgroup analysis of failed pyeloplasty (4 renal units) showed all PI < 15% at the third postoperative month (sensitivity 100%, specificity 86%). Complete resolution of hydronephrosis occurred in nine patients (20%).

### Discussion

The P/C ratio and PI are new feasible ultrasound parameters in pyeloplasty follow-up. Early improvement in the P/C ratio can be expected and might avoid repeated ionizing scans. A PI > 15% in subsequent postoperative checks might be enough for safe monitoring with ultrasound alone. Thus, renograms may be solicited only in these cases where ultrasound parameters do not improve in the first 6 postoperative months. Afterwards, ultrasound parameters often remain stable in the long term. Absence of hydronephrosis could only be documented in the long term in one out of every five patients.



**Figure** Graphic illustration of pelvis–cortex (P/C) ratio and percentage of improvement (PI) in anteroposterior (AP) diameter. Evolution in ultrasound parameters following a successful pyeloplasty is shown: the P/C ratio decreases and the PI in AP diameter shows values over 15%.

## Introduction

Ureteropelvic junction obstruction (UPJO) is demonstrated when the Tc99-MAG3 diuretic renography tracer clearance half-time under the standardized procedure is longer than 20 min. The Anderson–Hynes dismembered pyeloplasty (whether performed by an open approach or laparoscopically) is universally regarded as the operation of choice, an effective way to correct UPJO [1–3]. The goal of pediatric pyeloplasty is to preserve renal function. According to this definition, the success rate of pyeloplasty (stentless or not) is as high as 88–98% [1–13]. Postoperatively, the success of the procedure is evaluated by a variety of renal ultrasounds and ionizing studies. There is no consensus on the follow-up protocol. Some surgeons perform an early ultrasound at the third postoperative month [14] (although some authors underline that only 38% of these will show any clear improvement [15]) and a diuretic renography during the third to sixth month postoperative [14–17]. Other investigators claim that, ideally, follow-up should be extended to 2 years, which would include the period when the initial symptoms of recurrence (infection and pain) are most likely to take place [16,17]. No formal recommendation is given for impaired renal units and the need of further scintigrams. Since most of the recommended protocols advocate stopping follow-up 2 years after surgery, there are few data on the long-term definitive resolution of hydronephrosis, and even some adult urologists point out the possibility of asymptomatic obstruction recurrence beyond puberty [18].

Renal ultrasounds define successful pyeloplasty as improvement in the Society of Fetal Urology (SFU)-graded hydronephrosis [19]. More recently, the measurement that has proved to be of most value is the widely used AP diameter of the renal pelvis, measured at the renal hilum preoperatively. Significant obstruction that represents a threat to renal function is most unlikely to be present when the AP diameter is more than 15 mm [20]. The sensitivity of ultrasound in the diagnosis of obstruction, when compared with scintigraphy as the gold standard, can be enhanced by including an assessment of the renal cortex, demonstrating an objective increase in the parenchyma width. Recently, two new parameters have been identified: the pelvis/cortex ratio (P/C ratio) [21], and the percentage of improvement (PI) in AP diameter [22]. The renal cortex grows rapidly as draining capacity improves, and the P/C ratio takes in account two values (the pelvis and cortex sizes) and that enhances the sensitivity to evaluate the minimal evolutive changes. It decreases after a successful pyeloplasty. On the other hand, the PI in AP diameter reflects in relative terms the evolution of each AP diameter: with 0% no change, 50% half of the initial AP diameter, and 100% the absence of hydronephrosis. Both new parameters have shown high sensitivity to predict a successful pyeloplasty without the need to perform further scans.

In the present study, we aimed to define the long-term ultrasound evolution of a series of pyeloplasties, showing the usefulness of these new ultrasound parameters. We highlight an alternative radiation-free monitoring of pediatric pyeloplasties with ultrasound alone. New parameters such as the P/C ratio and the PI in AP diameter are analyzed and evaluated in the long term, to show whether they can

be useful and feasible to demonstrate a successful procedure, demonstrating a non-obstructed renal pelvis and avoiding ionizing studies in the growing child. Thus, the primary study aims were to describe ultrasound parameters changes in the short and long term in a cohort of successful ordinary UPJO pyeloplasty and describe the real frequency of hydronephrosis resolution in the long term in this group. Secondly, a subset of failed pyeloplasties (not included in the main study group), was analyzed to determine how ultrasound parameters can distinguish early those renal units in risk of recurrent obstruction.

## Patients and methods

All consecutive patients in our department at the pediatric referral center operated on using the Anderson–Hynes pyeloplasty in the period 2001–2010 (10 years) were retrospectively analyzed. Inclusion criteria for the present study are summarized in Table 1. Strict inclusion criteria were followed to maintain homogeneity in ultrasound measures, such as duplicated systems, as extrinsic obstruction might not behave the same echographically in the short and long term. Nevertheless, we performed a subgroup analysis on failed pyeloplasties that fulfilled the inclusion criteria (except for item 9: “no reintervention”) but were not included in the main study group, to show if ultrasound studied parameters behaved uniformly worse.

Surgical management criteria during the study period were worsening hydronephrosis (SFU grade III or higher), an obstructed renogram (regardless of differential renal function disruption and symptoms), and recurrent infection. A diuretic renogram was performed under standardized circumstances, which included supine position, hydration, and a transurethral catheter. An obstructive

**Table 1** Inclusion criteria list for the present study.

1	Society for Fetal Urology grade III or higher hydronephrosis
2	AP diameter > 15 mm <sup>a</sup>
3	Diuretic renography performed under standardized circumstances (hydration, transurethral catheter)
4	Obstructive diuretic renography (tracer clearance half-time > 20 min)
5	No bilateral disease
6	Intrinsic stenosis (no crossing vessels)
7	No other renal anomaly (vesico-ureteral reflux, obstructed megaureter, duplicity, etc.)
8	Normal creatinine clearance
9	A minimum of 1-year follow-up including ultrasound anteroposterior and cortex measurements
	No reintervention (successful pyeloplasty)

<sup>a</sup> A preoperative anteroposterior diameter > 15 mm was the cut-off value according to previous studies demonstrating the highest sensitivity for this value to determine the need for surgery.

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