Introduction
Primary megaureter (PM) represents 6-10% of all displaced urinary malformations in utero (1). Because of the low ultrasonographic sensitivity in individualizing the fetal ureter, PM had been valued as a specific diagnosis (2) and the majority of PM is diagnosed just in an advanced stage of gestation (3). A larger extent of ureteral dilatations results, at birth, to be of a non-obstructed type, and kidneys keep a normal size (4).

Spontaneous resolution of PM is a well-known event, presumably owing to maturation of the vesico-ureteral junction (2-6). Retrospective correlations between spontaneous resolution and definite morphologic and functional parameters after long-term follow-up have been attempted (7, 8). In this study, we reviewed a group of patients, including some patients from our initial neonatal PM cohort (2), to assess long-term follow-up results, and the incidence and the rate of resolution of congenital upper urinary tract dilatation. We also revised some predictor factors, based on classic morphologic classification and scintigraphic pattern on diuretic renogram.

Materials and methods
Between 1992 and 2001, 60 neonates with PM were followed in our institution: 48 (80%) had a prenatal ultrasonographic diagnosis of uretero-pelvic dilatation, while 12 (20%) had a suspected diagnosis of PM during a neonatal ultrasound screening. In patients with prenatal suspected diagnosis, the diagnosis of uretero-pelvic dilatation was made according to the guidelines of the American Academy of Pediatrics (2). Approximately within the first 48 hours of life, Diagnosis of megaureter was based on the presence of a dilated ureter down to the ureterovesical junction, with detectable hydrourephrosis. The degree of hydrourephrosis was graded from 1 to 5 based on the appearance of the renal parenchyma: 1 = normal renal pelvis, 2 = mild hydronephrosis, 3 = moderate hydronephrosis, 4 = severe hydronephrosis, 5 = renal dysplasia.

Assessment was done using Student’s 2-tailed t test after the F test for equal variance. Kaplan-Meier survival analysis methods were used to determine the effect of clinical and radiographic parameters, including initial PM diameter, initial hydronephrosis grade, and the presence of vesicoureteral reflux, on the rate of likelihood of resolution (p<0.01). The percentage of PM that resolved, persisted or required surgery in relation to initial hydronephrosis grade is reported in figure 1. Median age at resolution for grades 1 to 5 hydronephrosis was 10.5 ± 8.8 (4-36 months), 15.0 ± 7.9 (6.0-30 months), 20.0 ± 4.7 (12-30 months), 34.8 ± 29.7 (6-84 months) and 36 ± 0.0 months respectively. Two cases only with grade 5 hydronephrosis (10%) resolved on at 36 months (dei pazienti con grado 5 di idronefronia alla nascita solo 2 (10%) sono guari all’età di 36 mesi).

At the end of our follow-up period, 38 PM (62.8%) (33 patients = 28 monolateral + 5 bilateral) had resolved. The number of patients for these PM to normalize ranged from 6 months to 8 years (mean 1.9 ± 1.5 years). On contrary, in 18 PM (25%) (15 patients = 12 monolateral + 3 bilateral), ureteral dilatation persisted until to the end of follow-up period: for a total of 18 patients, an initial PM diameter remained unvariable, while in 8 (11.1%) there was a significant improvement of ureteral dilatation, but ureteral diameter was more than 6 mm at the last follow-up period. PM (22.2%) required a surgical procedure. Ureteral reimplantation was performed on the left side in 6 cases, on the right side in 2 bilaterally in 4 cases. Patient age at the time of surgery ranged 6 to 48 months, with a mean age of 17.1 ± 13.5 months. Median follow-up (age) in the resolved group was 5.8 ± 3.1 years (range 2 to 14 yr). Median follow-up (age) in the unresolved group was 9.7 ± 3.8 years (range 4 yr to 15 yr). We were not able to follow-up all PM affected-patients until puberty because some parents were not compliant with a long-term follow-up. Median preoperative follow-up age in the surgical group was 1.4 ± 1.3 years (range 0.5 to 4 yr). After surgical procedure, we considered patients followed from PM and the last postoperative Tc99m DMSA diuretic renogram that demonstrated the complete resolution of hydrourephrosis.

Discussion
Retrospective studies, showing a spontaneous resolution of PM without a impairment in renal function (2, 3, 4, 11), have recently led to a change about the therapeutic approach to neonatal PM. The question is if we have to perform a routine surgical treatment in all cases of PM or to wait for a spontaneous resolution of the process. The long-term follow-up of conservatively-treated PM cohorts in previous studies ranged from 24 months to 7.3 years, with the longest reported follow-up at 13.4 years (8, 3, 4, 7, 12, 13). In our study, all patients were previously studied with a spontaneous resolution rate of 75% at 10 years and 97% at 20 years after PM. The need for renal function follow-up in patients with persistent urinary tract dilatation remained undetermined. In our series only 22.2% of all PM who were allocated for conservative management required surgical correction, even if, in our series, the 25% of patients with renal dysplasia required surgical correction 8-12 months after PM. The percentage of PM that resolved, persisted or required surgery in relation to initial hydronephrosis grade is reported in figure 1. No decrease in function was observed in resolved and unresolved cases, even after long-term observation.

All conservative-treated children were followed for 6 months to 15 years with median follow-up of 5.2 ± 4.1 years. Analysis of resolution patterns was performed using standard survival analysis methods to determine the effect of clinical and radiographic features on the rate of spontaneous resolution. The incidence of PM was calculated using the log-rank test. Correlation was evaluated using the Spearman ratio. Group comparisons were assessed using Student's 2-tailed t test after the F test for equal variance.

Percentage of PM resolved, persisted, or required surgery in relation to initial hydronephrosis grade is reported in figure 1. Median age at resolution for grades 1 to 5 hydronephrosis was 10.5 ± 8.8 (4-36 months), 15.0 ± 7.9 (6.0-30 months), 20.0 ± 4.7 (12-30 months), 34.8 ± 29.7 (6-84 months) and 36 ± 0.0 months respectively. Two cases only with grade 5 hydronephrosis (10%) resolved on at 36 months (dei pazienti con grado 5 di idronefronia alla nascita solo 2 (10%) sono guari all’età di 36 mesi).
who were allocated for a conservative treatment following perinatal finding of hydronephrosis, showed that postnatal grades 1 to 3 hydronephrosis were likely to resolve in 70.6% within 4 to 28 months, PM grade 4 may resolve spontaneously (55% in our cases) without an impairment in renal function, although the time to resolution was on the average of 3 years (in our series two cases had resolved spontaneously when they were 7 years old). On contrary, only two PM (10%) with postnatal grade 5 hydronephrosis resolved spontaneously, both when children were 3 years old. Although it seems evident that high grade pelvi-ureteral dilatation can spontaneously resolve, without any adverse effect on renal function, the decision regarding conservative management must be discussed with parents, in regard to the duration of observational follow-up and the reasonable expectation of the potential for a spontaneous resolution. Ureteral diameter more than 1 cm may be considered as an indicator of persistent megaloureter or of need for surgical management because it is usually associated with impairment of drainage pattern on renal scan (2). More recently Chertin (12) showed that ureteral diameter more than 1.33 cm is a significant independent risk factor leading to surgical correction. Our data showed also a definite correlation between the degree of initial ureteral dilatation and clinical outcome. In fact, the average of ureteral diameter in the resolved group was 0.9 cm while in the surgical managed group was 1.2 cm. Moreover, hydronephrosis resolved spontaneously in 60.7% when the retrovesical ureteral diameter was lesser than 1 cm, this percentage dropped at 55.6% when the diameter was between 11 and 15 mm and there was not any spontaneous resolution when retrovesical ureteral diam was more than 15 mm. Our data are partially agree with McElhanan (7). In fact, their data suggested that retrovesical ureteral diameter seems to be predictive of resolution, but not of rapidity at which the condition resolves (7). Differently, in our experience, the retrovesical ureteral diameter appears to be predictive not only of resolution but also of rapidity like this condition spontaneously resolves. In fact, in patients with ureteral diameter up to 1 cm, the recovery average age was significantly lower (1.2 years), as compared to one of patients with diameter between 11-15 mm (3.6 years). Although the radiotope renogram is a convenient and relatively non invasive method to obtain information regarding renal function and drainage, its use in the diagnosis of vesicoureteral junction obstruction in asymptomatic megaloureters is not without pitfalls. The main problem is that to date there are not standardized criteria for obstruction.

As regards, even if the aim of this study is not to establish strict criteria for ureteral obstruction but to determine if there is any correlation between drainage on duretic 99mTc-DTPA renogram and prognosis, our data has shown that there is a significant correlation between obstruction and prognosis. In fact, 80% of PM with obstructive pattern and 30% with borderline pattern have required a surgical treatment; conversely, just a PM (4.7%) with non-obstructive pattern but with grade 5 hydronephrosis has needed of a surgical procedure because the child has a solitary kidney.

Conclusions
Our data show that only 22% of children with neonatal diagnosis of PM required a surgical treatment. Poor drainage on 99mTc-DTPA scan, grade IV-V hydronephrosis and ureteric diameter more than 1.50 cm are statistically significant and independent predictive factors for surgery.

The time of spontaneous resolution in neonatal diagnosed PM may exceed 3.6 years, although recovery is a rare event after this period. Therefore, after informed the parents in regard to the duration of observational management and the potential of a non-spontaneous resolution of ureteral dilatation, themselves might decide if to continue a long term follow-up or to opt for a surgical procedure.

References
Legende to figures

Figure 1 - Percentage of PM that resolved, persisted or required surgery in relation to initial hydronephrosis grade.

Figure 2 - The Spearman correlation test shows a significant effect of presenting hydronephrosis grade on the median age at resolution ($r = 0.913; P = 0.042$).

Figure 3 - Comparison of ureteral diameter at diagnosis in resolved, surgical treated and persistent megaureter cases.

Figure 4 - Percentage of PM that resolved, persisted or required surgery in relation to degree of dilatation in newborn period.

Figure 5 - Correlation between cross-sectional diameter at diagnosis and time to spontaneous resolution (il gruppo 3 è stato raggruppato al gruppo 2 in quanto solo due casi (10%) sono guariti spontaneamente).

Figure 6 - Percentage of dilated ureters that resolved, persisted or required surgery in relation to $99mTc$-DTPA diuretic renogram results.