Posterior Urethral Valves

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18.1 Definition/Introduction

Posterior urethral valves (PUVs) represent the most severe obstructive uropathy in children detected by prenatal ultrasonography (US) [1] with an incidence ranging from 1 per 3,000 to 8,000 male births [2]. Despite advances in medical and surgical management of PUVs in the last few decades, 13–64 % of children still have chronic renal failure (CRF) or end-stage renal disease (ESRD) at long-term follow-up [3]. Prenatal diagnosis of PUVs has not yet improved this rate [4].

Many factors have been associated with the final outcome of such children, and the search to improve their long-term renal function has steadily improved the quality of management and treatment [5]. Age at diagnosis, nadir serum creatinine during the first year of life, vesicoureteral reflux (VUR), bladder dysfunction, and urinary tract infection have been identified as predictive of future renal function [6, 7].

Several options of surgical management of infants with PUVs are available, and the mainstay of treatment is primary valve ablation [8–10]. Many studies documented that urinary diversion does not have an advantage over valve ablation in terms of renal and bladder functions [9–11].

Since the advent of fiber optic lighting and Hopkins rod lens system in pediatric endoscopes, endoscopic ablation of PUVs using various modalities under direct vision has become widely accepted and practiced all over the world [8, 10–19]. The incidence of complications after valve ablation has been reported to be between 5 and 25 % [4, 20, 21].

18.2 Prenatal Diagnosis

18.2.1 Diagnosis and Prognosis Parameters

The prenatal parameters taken in account during the last two decades are mainly: gestational age at diagnosis, renal parenchyma on US, amniotic fluid volume, and urine and fetal blood biochemical markers.

Long-term renal function remains the most important determinant of quality of life outcome in boys with PUVs [22]. In recent decades, there has been continuous improvement in the survival of these patients, while the impact of prenatal diagnosis in reducing the morbidity is still controversial. According to many published series, the postnatal outcome of these patients is variable [23–25].

Prenatal detection was initially thought to improve the outcome, but, in fact, earlier studies

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failed to demonstrate that long-term outcome of boys with prenatally detected PUVS is better than that of symptomatic boys with postnatally detected PUVs [23, 24]. Moreover, in one study the outcome of prenatally detected cases was worse than that of postnatally detected cases [25]. One possible explanation is that in the more obstructive and, thus, more severe cases, hydronephrosis is already more distinct before birth, leading to the discovery of PUVs on prenatal US. Furthermore, of the postnatally diagnosed cases, the most obstructive probably are detected early, whereas cases detected later are less obstructed and, therefore, more rarely progress to permanent CRF and ESRD.

We have reported the experience of our center in 2008 with a total of 79 cases of PUVs prenatally detected between 1987 and 2004 [7]. Of these cases 65 were managed postnatally, while pregnancy was terminated in 14. Primary valve ablation was done in all cases except two. Median follow-up was 6.8 years [range 1–14.3]. At the end of follow-up, there were 11 cases of renal failure [17 %] with 5 detected before 24 weeks of gestation, 6 cases of oligohydramnios, and 9 cases of abnormal parenchyma. Gestational age at diagnosis and oligohydramnios were statistically significant predictors of final renal outcome ($p=0.003$ and $p=0.02$, respectively). When fetal urinalysis detected good prognosis (12 cases), renal failure was developed in none, compared to two of the three cases with a bad prognosis. Continence was achieved in 42 of 55 toilet-trained children (76 %), 3 had nocturnal enuresis, and 10 (18 %) were incontinent.

Data from our team were also published in 1999, in which any significant improvement in the final outcome of these patients or a predictive value of our studied prenatal parameters was found [23]. Our more recent results have revealed significant value of some of prenatal parameters that were not significant in our first study. The discrepancy between the findings in this series and our initial report in 1999 has strengthened the need for such reevaluation with larger numbers of patients and longer follow-up.

Surgical management in our series consisted of primary valve ablation and surveillance. Urinary diversion was indicated in cases of anuria before or after valve ablation. This approach seemed reasonable when one considers that the proportion of boys with renal failure at follow-up was similar to the results achieved in those with PUVs detected postnatally [3, 26] and lower than that reported in another series of patients with prenatally diagnosed PUVs [24]. Prenatal diagnosis allowed us to treat most of the patients within the first 48 h after birth, and, thus, bladder recycling was not interrupted.

It is difficult to compare the results of different published series because of wide variation in regard to availability of obstetrical service to account for in utero mortality, routine practice of early prenatal US in all pregnant women, postnatal indicators of renal function, duration of follow-up, type of surgical procedure, and patient age at treatment. In our series the inherent bias of in utero mortality was markedly reduced by review of all department files on PUVs during the study period, including data on prenatal diagnosis, pediatric nephrology, pediatric urology, and fetopathology. Actually, if we consider pregnancy termination as a poor outcome and we add the 14 terminations to the 11 cases of renal failure, the poor outcome changes from 17 to 32 % for the global outcome of our series.

Hutton et al. reported a series of 31 boys with prenatally detected PUVs [27]. Of the 17 cases diagnosed at or before 24 weeks of gestation, nine (53 %) had a poor outcome at follow-up, while only 1 of 14 cases (7 %) diagnosed after 24 weeks had a poor outcome ($p=0.05$). Of our 11 cases diagnosed before 24 weeks of gestation, 5 (45 %) had a poor outcome, compared to 6 of 54 cases (11 %) diagnosed after 24 weeks. Our results appear statistically significant, similar to those of Hutton et al. and allow us to be equally optimistic regarding prediction of a good outcome when the diagnosis is made after 24 weeks of gestation. Recently the same bad prognosis of early prenatal diagnosis was confirmed by our study of 709 cases of prenatally detected megacystis (PUVs included) [28].

Different studies have shown that oligohydramnios predicts poor outcome in more than 80 % of cases [3, 29, 30]. Our results, in which 6

of our 11 patients (55 %) with oligohydramnios had a poor outcome, are in accordance with these series.

Initial US may be useful for identifying patients at higher risk for deterioration of renal function. Hulbert et al. in 1992 stated that the appearance of the initial renal US can be considered as a possible predictor of renal function at follow-up [31]. In a report by Muller et al. of 40 boys with prenatally detected obstructive uropathy, 8 of 10 patients (80 %) with an abnormal appearance of the renal parenchyma on US had a poor prognosis, compared to 7 of 30 (23 %) with normal parenchyma [29]. Duel et al. in 1998 found that normal renal echogenicity and corticomedullary differentiation (CMD) are useful for predicting a good outcome, while loss of CMD and increased echogenicity are relatively insensitive and poorly specific [22]. The finding of at least one kidney with good CMD on US has been associated with a good prognosis.

In our long-term study, we have observed that initial renal US was abnormal in all patients in whom renal failure developed but was also abnormal in 77 % of those with normal renal function [7]. Thus, abnormal parenchyma on US was not specific. Furthermore, normal parenchyma could not predict a good outcome. This finding may be biased by the fact that it is a retrospective study and the absence of abnormal parenchyma on US could not strictly exclude the presence of these anomalies, since they may be missed during the US examination.

Long-term results of prenatally detected PUVs confirm that early valve ablation can be considered as the primary management in the majority of cases, without the need for preoperative drainage or diversion [7]. Gestational age at diagnosis and volume of amniotic fluid are significant predictors of long-term renal function. Nevertheless, other parameters need to be also considered [7, 23].

Our current prenatal management of PUVs includes: detailed serial US study of renal parenchyma, anteroposterior diameter of the renal pelvis and calices, amniotic fluid volume, bladder size and wall thickness, and ureteral dilatation. A detailed morphological examination of all other extra-urinary system is done with the help of fetal MRI if needed. The case is discussed in the multidisciplinary weekly meeting, and then decision is taken whether there is a need for further invasive investigations as urine or blood biochemical markers analysis (beta-2 microglobulin, calcium, sodium, phosphorus). Fetal blood analysis is feasible in cases after 22 weeks of gestation. The prognosis is based on the combined results of all the investigations and adapted to the age of gestation.

18.2.2 Prenatal Treatment and Fetal Surgery

PubMed, Medline, and Embase database included 22 articles about fetal surgery for PUVs. The last review article published in 2011 by Casella et al. describes fetal surgery as case reports, small series with poor outcomes [32]. Research on vesico-amniotic shunt on fetal lamb models showed that the possibility of relieving the obstruction could improve the amniotic fluid, prevent pulmonary hypoplasia and bladder and renal damage, and recover nephrogenesis with an affordable loss of nephrons (5 % versus 20 % with persistent obstruction) [33–36]. Historically the first prenatal procedure consisted of fetal ureterostomies and cutaneous vesicotomies [37]. Because of high risk of open fetal surgery on maternal morbidity and future reproductive function, minimally invasive procedures as in utero vesico-amniotic shunt by a percutaneous approach under US guidance have been developed [38–42].

Vesicocentesis (puncturing the bladder and aspirating the urine) has to be performed several times and has disappeared nowadays [43]. A trocar was introduced into the fetal bladder in which a double-j catheter was placed to drain the fetal urine into the amniotic cavity. Fetal mortality and complication rates including preterm labor, preterm rupture of the membranes, and infections were 4.6 and 44 %, respectively, in the first 5-year review [44] and were considered too high to let vesico-amniotic shunt as a daily procedure. In 1997, Coplen et al. reported a survival rate of

47 % for 169 vesico-amniotic shunts, but 40 % of newborn infants presented an ESRD [45]. Mc Lorie et al. reduced obstetric complication rate by placing the catheter between 20 and 28 weeks of gestation [46]. Several meta-analysis showed a higher survival rate but a stable postnatal ESRD rate [47, 48].

Another procedure is fetal cystoscopy through an abdominal trocar. It has been first described in 1995 [49]. A valve ablation was performed in a few cases [50] without any difference on survival rate between vesico-amniotic shunt and cystoscopy [51]. Survival rates for shunting and cystoscopy are 40 and 75 %, respectively, whereas postnatal renal function rates are 50 and 65 %, respectively [34].

Even if fetal surgery for PUVs has been developed since 25 years, series are small without any randomized controlled trials, and outcomes need to be analyzed carefully. Morris et al. reported 20 studies in the last two decades with 261 interventions on 369 fetuses including vesico-amniotic shunt and fetal cystoscopy [48]. Prenatal surgery seems to be more effective than no intervention on survival rate but postnatal renal function is worst in the fetal surgery group. To summarize, results after vesico-amniotic shunting are poor because of poor patient selection, technical complications, US misdiagnosis (between 58 and 67 %) [43, 52, 53], and lack of good renal function predictors. Technical complications are quite high between 40 and 48 % [38, 45, 54], and fetal mortality rate is close to 50 %.

Long-term outcomes have not been improved by fetal surgery. Prenatal intervention may not change the prognosis of renal function or may not be a predictor for possible urinary diversion [55]. Despite all of these patients having favorable urinary electrolytes, this did not seem to have any implication postnatally. When counseling families about fetal intervention, efforts should be focused on that intervention may assist in delivering the fetus to term and that the sequelae of PUVs may not be preventable. Fetal surgery for obstructive uropathy should be performed only for the carefully selected patient who has severe oligohydramnios and "normal"-appearing kidneys [55]. There is clinical evidence that relief of obstruction may improve postnatal pulmonary function, but there is no evidence that it improves renal function [34].

In consequence pediatric urologists expected soon to read outcomes of PLUTO (percutaneous shunting in lower urinary tract obstruction) trial which began in 2008. This study design is to compare 150 fetuses with LUTO undergoing vesico-amniotic shunting or observation. It could lead finally to standardize fetal surgery with appropriate indications [56]. But PLUTO randomized controlled trial stopped prematurely because of poor recruitment. Conclusions are hard to be defined: the relative effectiveness of vesico-amniotic shunting is uncertain with poor prognosis at 1 year. Normal liquid volume and age at diagnosis seem to be good predictor factors. For the time being, patients who are selected for fetal surgery are fetuses with a normal karyotype and with severe LUTO (dilated bladder with key-hole sign and bilateral hydronephrosis), oligohydramnios, or any hydramnios and favorable fetal urinalysis [29, 34, 57].

18.3 Postnatal Management

A multidisciplinary approach is necessary to improve short- and long-term outcomes for patients born with PUVs. Metabolic disorders have to be managed by pediatric nephrologists to avoid any added damage to the renal function. Micturating cystourethrogram (MCUG) remains today the most reliable tool to confirm the diagnosis of PUVs and to study the morphology of the bladder and the bladder neck (Fig. 18.1). MCUG can be done either retrograde through urethral catheter or by suprapubic puncture (Fig. 18.2). Our preference goes to suprapubic puncture. We believe that the urethra should be kept intact without any trauma till valve ablation. In fact there is no evidence to advocate for one or another method. As most of the patients with PUVs are managed in our center after prenatal referral, it is feasible for us to manage the newborn in the first 24 h without the need for urinary drainage. Suprapubic insertion of intravenous catheter is done under US guidance. If the diagnosis is con-

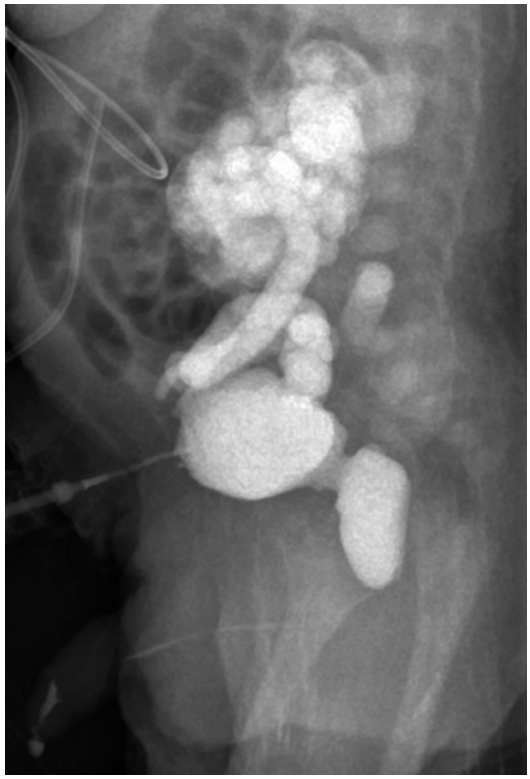

Fig. 18.1 Micturating cystourethrogram: posterior urethral valves with posterior urethral dilatation, bladder neck hypertrophy, and bilateral high-grade vesicoureteral reflux

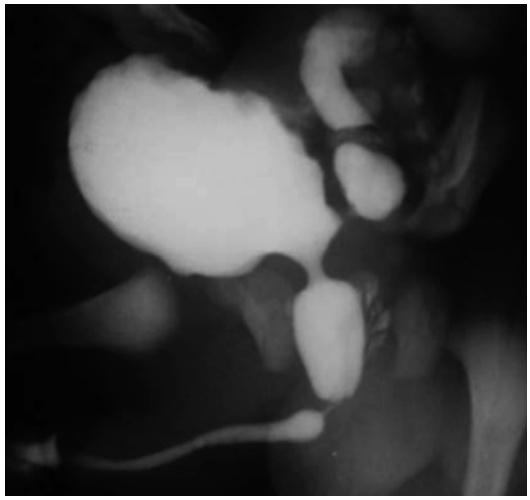

Fig. 18.2 Micturating cystourethrogram by suprapubic puncture. Note the reflux in the ejaculatory ducts associated with typical aspect of posterior urethral valves, urethra, and bladder neck

firmed, the newborn is managed in few hours at the operating room for valve ablation.

Surgical treatment aims at relieving obstruction. It could be done by urinary diversion or valve ablation (Fig. 18.3) under general anesthesia. Low diversion includes vesicostomy or bladder catheterization [58–60]. Complications of catheter drainage are more frequent with infection, bladder contraction, and ureterovesical obstruction. Vesicostomy reproduces bladder filling and contraction and eases bladder reconstruction in comparison to supravesical diversion. In our current practice, it is used for children less than 2 kg. High drainage as pyelostomy or ureterostomy did not improve renal function outcomes and decreased bladder cycling function [61, 62]. In some instance, a refluxing unilateral lateral ureterostomy can be an option to relieve the obstruction in severely sick children.

Different options of ablation have been described. Blind methods have disappeared and must be kept as historic, because of poor results and severe complications [63, 64]. The development of pediatric endoscopes since 1970 and Hopkins and Storz has been the best technical progress. Valve ablation could be done by a Bugbee, a cold knife (Fig. 18.4), or a laser [13]. These techniques need experienced pediatric urologists to minimize urethral trauma, operative time, and irrigation. Cold knife is preferred than resectoscope with diathermy loop to reduce postoperative retention and strictures. No routine preoperative and postoperative drainage is needed in our experience.

Several studies have investigated the best timing and approach in treatment of patients with PUVs [4, 9, 11]. Smith et al. stated that PUVs should be treated with primary valve ablation, and vesicostomy should be reserved for patients in whom valve ablation is not technically possible [10]. Regardless of whether a vesicostomy or a high urinary diversion is performed, eventually the valves have to be resected or incised.

Currently, with the advance in endoscopes and fiber optics, better instruments have allowed surgeons to treat valves endoscopically using different modalities under direct vision with minimal incidence of complications [4].

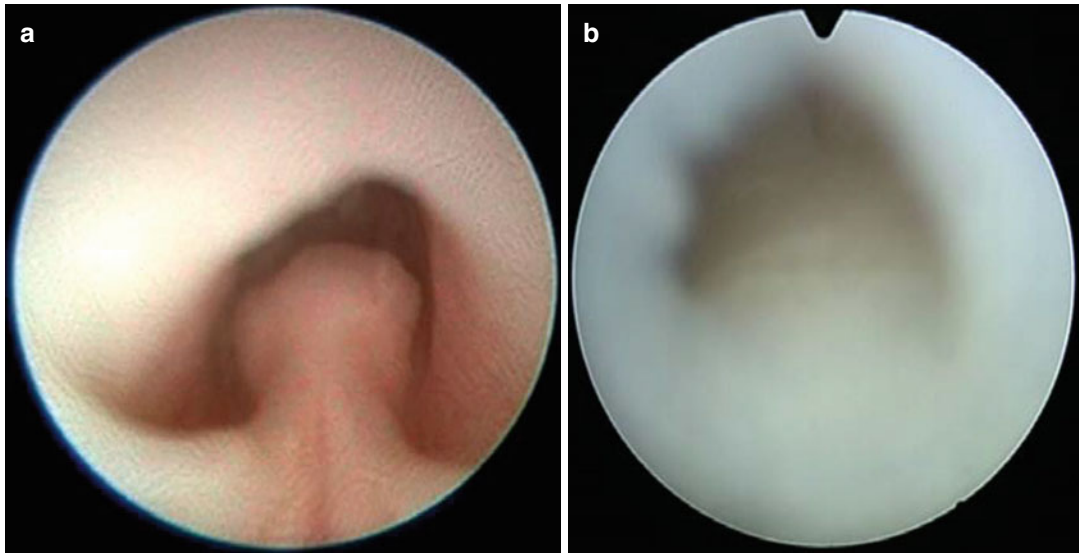

Fig. 18.3 (**a**) Endoscopy view of posterior urethral valves. (**b**) Endoscopic view of neonatal aspect of PUV, before any endoscopic or catheter introduction, notice the verumontanum visible in the background

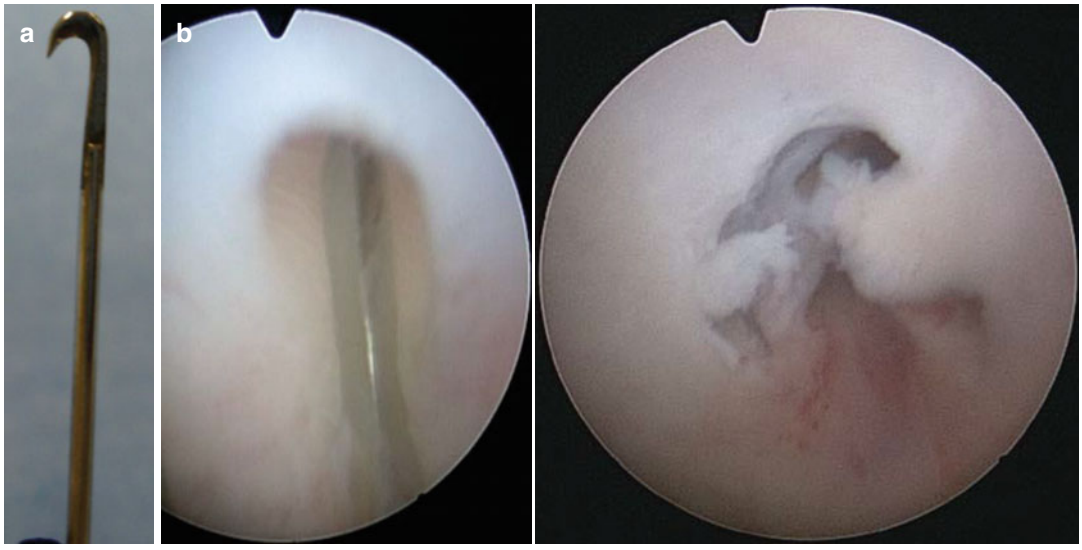

Fig. 18.4 (**a**) Cold knife hook used to perform valves ablation under cystoscopy. (**b**) The hook localizes the first point of section at 12 o'clock, followed by 5 and 7 o'clock

Complications after valve ablation have been reported to be between 5 and 25 % [18, 65]. Sarhan et al. published an incidence of complications of 7.5 % which is nearly similar to that reported by Nijman et al. in 1991 who reported an incidence of only 5 % complication rate in a group of 85 boys undergoing electroincision of urethral valves [19, 20].

Stricture formation after valve ablation occurs infrequently ranging from 0 to 25 % [4, 18, 19, 21, 65, 66]. Urethral strictures were reported after fulguration in 7 of 28 patients (25 %) by Myers et al. in 1981 [18], 3 of 36 patients (8 %) by Crooks et al. in 1981 [21], 4 of 30 patients (13 %) by Bruce et al. in 1987 [66], and 3 of 82 (3.6 %) by Lal et al. in 1999 [65]. On the other

hand, Nijman et al. in his series of 85 patients including newborn and infants reported no incidence of urethral stricture [19].

Prevention of urethral stricture after valve ablation depends on many factors. These are gentleness in surgical technique, avoidance of oversized instrumentation in a small caliber urethra especially since patients with PUVs are usually small for age, minimizing fulguration time, avoiding excessive and deep fulguration, fulguration under direct vision, and shortening the duration of preoperative catheterization and use of nonreactive small-sized catheters [20, 65].

Sarhan et al. retrospectively reviewed database of 291 patients with PUVs treated by primary valve ablation from two separate centers between 1987 and 2006 [20]. Primary valve ablation was performed in all patients regardless of serum creatinine level or upper tract configuration. A hot loop resectoscope was used in 122 patients, cold knife urethrotome in 108, a hook diathermy electrode in 18, and a diathermy coagulation Bugbee in 20, while stripping using Fogarty catheter was performed in 23. The follow-up duration ranged from 1.5 to 20 years (median = 6.5). Early postoperative complications occurred in 22 patients (7.5 %). The most common complication was urine retention in 16 patients (5.5 %). Urinary extravasations occurred in three cases, significant hematuria from urethral bleeding occurred in two, and obstructive anuria developed in one patient. The majority of cases were treated conservatively. Urethral strictures developed in six patients (2 %) mainly after endoscopic loop resection (four of six). All were treated by visual internal urethrotomy and urethral dilatation with successful results without the need of open urethroplasty.

Risk factors for the development of postoperative complications were studied by a univariate analysis by Sarhan et al. in 2010 [20]. The incidence of complications was significantly related to preoperative catheter drainage. Postoperative complications developed in 16 out of 130 patients (12.3 %) in whom preoperative draining catheter was fixed, while it occurred in only 6 out of the 161 patients (3.7 %) with no preoperative drainage ($p < 0.05$). This may be due to the fact that patients who needed preoperative drainage were actually of poor general condition with uremia that make them at risk of development of postoperative complications. None of the 41 patients who did not have postoperative catheter developed any complications, while all the 22 patients who developed complications had postoperative drainage ($p < 0.05$). Patient age at valve ablation had no significant relation with the occurrence of postoperative complications. Also, technique of valve ablation had no statistically significant impact on complications although the incidence was more with resection group (12.3 %) than other groups, but the difference was not statistically significant ($p = 0.08$). Multivariate analysis showed that preoperative catheter drainage was the independent risk factor for the development of postoperative complications. On the univariate analysis, stricture formation does not have statistically significant relation with either age at ablation, technique of valve ablation, or presence or absence of pre- or postoperative drainage. Although four out of the six cases with stricture urethra developed after electroresection, the difference from other techniques was not statistically significant. The same finding was noted with preoperative catheter drainage which was associated with more incidence of stricture formation (four out of six) especially when the suprapubic catheter drainage was maintained after endoscopic incision.

18.4 Outcomes

18.4.1 Bladder Function

It has been documented that there is a window for bladder healing that is limited to the first few months of life [23]. Primary valve ablation allows bladder cycling without obstruction, thus setting up the milieu for resumption of bladder function. Urinary incontinence has been a common problem in boys after valve ablation [65, 67]. Although numerous related causes exist, post-obstructive bladder dysfunction has gained recognition as the principal factor in the etiol-

ogy of incontinence after valve surgery [67]. The reported incidence of significant voiding dysfunction in boys after valve surgery varies from 13 to 38 % [65, 67]. Sarhan et al. evaluated the incidence of voiding dysfunction at 41 % in toilet-trained children [7]. Using their criteria, bladder dysfunction could be overestimated because all children who had symptoms of voiding dysfunction were included. The most severe cases requiring clean intermittent catheterization (CIC) or bladder augmentation comprised only 4.6 % of the study population.

Others advocate for routine drainage of the bladder before valve ablation [5], which may add morbidity to the treatment of these children [prolonged hospital stay, risk of nosocomial infection]. Sarhan et al. rarely had to divert the urine before or after valve ablation, and initial serum creatinine level was not a parameter to drain or to start valve ablation [7]. These results are overall comparable to others and may indicate that routine urine drainage should be reconsidered.

Early management of children born with PUVs is to reduce the rate of "valve bladder syndrome" first described by Hoover et al. in 1982 [68]. The most frequent urodynamic patterns found in these dysfunctional bladders are bladder overactivity, poor compliance, and myogenic failure. The incidence of these three types of bladder dysfunction varies markedly among authors and may be related to the patient's age at time of urodynamic study. It has become apparent that bladder function is a dynamic process and puberty has specific effects on these bladders [69]. High pressure in a noncompliant bladder alters upper urinary tract, increases hydronephrosis, reduces glomerular filtration rate, and leads to polyuria and tubulopathy. To avoid bladder dysfunction, bladder surgery and indwelling catheters should be avoided. Bladder has to be evaluated by MCUG, US, and post-voiding residual and video-urodynamics studies (Fig. 18.5a–c). For children with not toilet-trained bladder, 4-h observation will give an idea about post-void residual (PVR) and the average bladder capacity. For toilet-trained children, urodynamics and voiding diary are mandatory. Voiding diary includes amount of liquid intake, frequency of voiding, amount of voiding, and quantification of urinary leaks. Urodynamics is composed of flowmetry associated with electromyogram and PVR and video-urodynamics. Video-imaging is interesting in valves bladder specially if there is VUR. This exam will define if the reflux is either a low-pressure or a high-pressure reflux. Bladder capacity at the onset of the VUR will be also evaluated. Urodynamics is mandatory to distinguish the two categories of valves bladder: the poor compliant overactive bladder with high risk for the upper urinary tract and the compliant large capacity bladder with detrusor myogenic insufficiency (Figs. 18.5a–c). The last group is synonym of urinary incontinence and urinary tract infections, treated usually by either regular voluntary voiding and if insufficient CIC either by the urethra or through a Mitrofanoff channel.

The first-line treatment is anticholinergic medications with progressive increasing dose. This treatment is monitored by evaluation of PVR and upper tract dilatation then urodynamics studies. This can be associated with alpha-blocker treatment to decrease the outlet pressure. If these treatments are insufficient and the child had high-pressure voiding, CIC is added to the management. Night drainage can be an option to avoid overdistention of the bladder during the long hours of night. There are a few sets of data that suggest overnight bladder drainage can bring about profound improvements in the degree of upper-tract hydronephrosis, renal function, or bladder function [70].

Bladder augmentation is an option that needs to be discussed as an ultimate treatment and only if all other measures had failed. In our experience with over 200 patients with PUVs, only two children needed bladder augmentation, and these children were born with severe damage of the bladder and ESRD at birth. Ureterocystoplasty should be considered when augmentation is needed and one of the kidneys is not functioning [71]. Indications for augmentation is limited to few cases of extremely small low compliance bladder with no response to anticholinergic and CIC and with upper urinary tract deterioration.

18.4.2 Renal Transplantation

In children with ESRD secondary to PUVs, bladder evaluation before renal transplantation remains a challenging task to avoid the risk of graft deterioration secondary to bladder dysfunction. In our recent study on long-term evaluation of bladder function in patients with PUVs after renal transplantation, we found an improvement of bladder dysfunction. This is probably the result of reduction of pretransplantation polyuria. Fifteen children aged between 3 and 15 years were transplanted with PUVs between 1989 and 2006 at Robert Debré Children University Hospital. Three children were excluded from the study: one had bladder augmentation before transplantation, and two were lost of follow-up. Mean follow-up after transplantation was 13.1 years [5–20]. The evolution was favorable in these children with a graft survival of 63 % at 10 years. Patients were divided into three groups: (1) group I with no

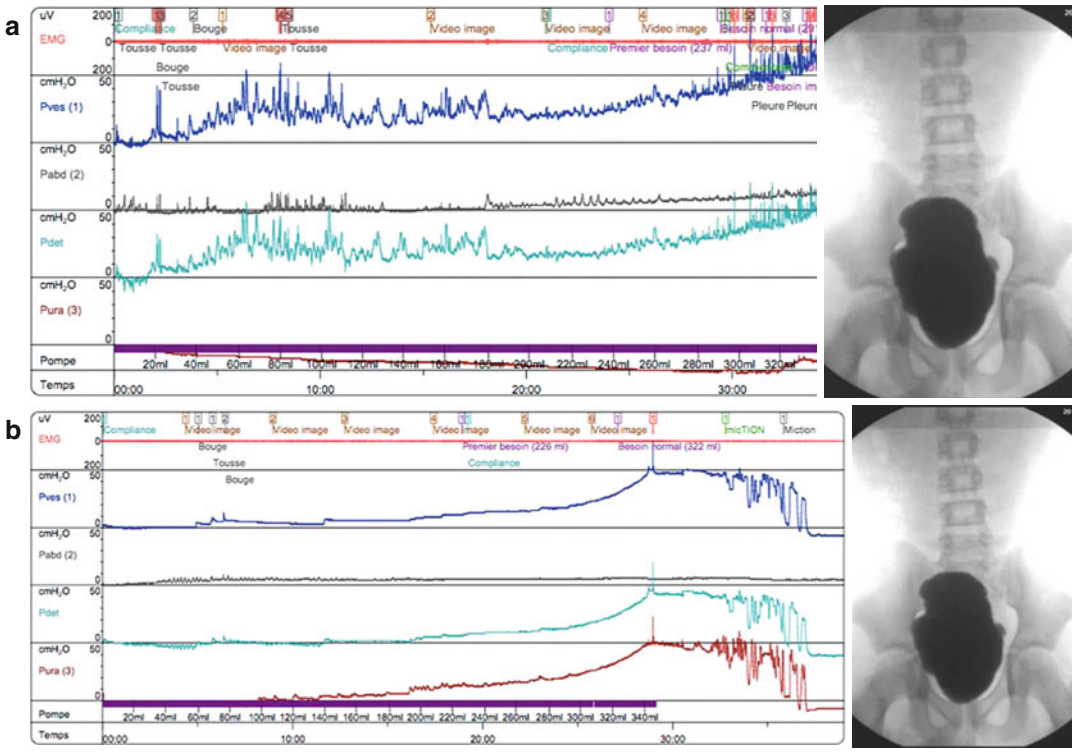

Fig. 18.5 (**a**) Ten-year-old boy treated in infancy for posterior urethral valves. Current symptoms: increasing hydronephrosis, incontinence, and recurrent febrile urinary tract infection. The video-urodynamics study showed bladder capacity at 320 mL, overactive bladder, and poor compliance. Parents and the child were advised bladder management by clean intermittent catheterization and anticholinergics. (**b**) The family did not come back, and they did not follow the advised management; 20 months later, they came for follow-up. The child had no febrile urinary tract infection and became dry between voiding. The ultrasonography showed improvement of the hydronephrosis. Video-urodynamics showed significant improvement with a normoactive low-pressure bladder (10 cmH_2O/300 mL) with a voiding detrusor pressure at 50 cmH_2O and without post-voiding residual. Management was advised by voiding diary every 3 h and to avoid over distended bladder. (**c**) Eighteen months after the last video-urodynamics, his clinical status was stable with regular voiding, dryness, and stable normal renal function at 50 µmol/L and without any anticholinergics. Urodynamics showed a bladder capacity of 400 mL, hyposensitive bladder, and efficient voiding without residual. Note that the morphology of the bladder and the bladder neck did not change over this period of puberty; meanwhile a significant improvement was achieved in bladder function

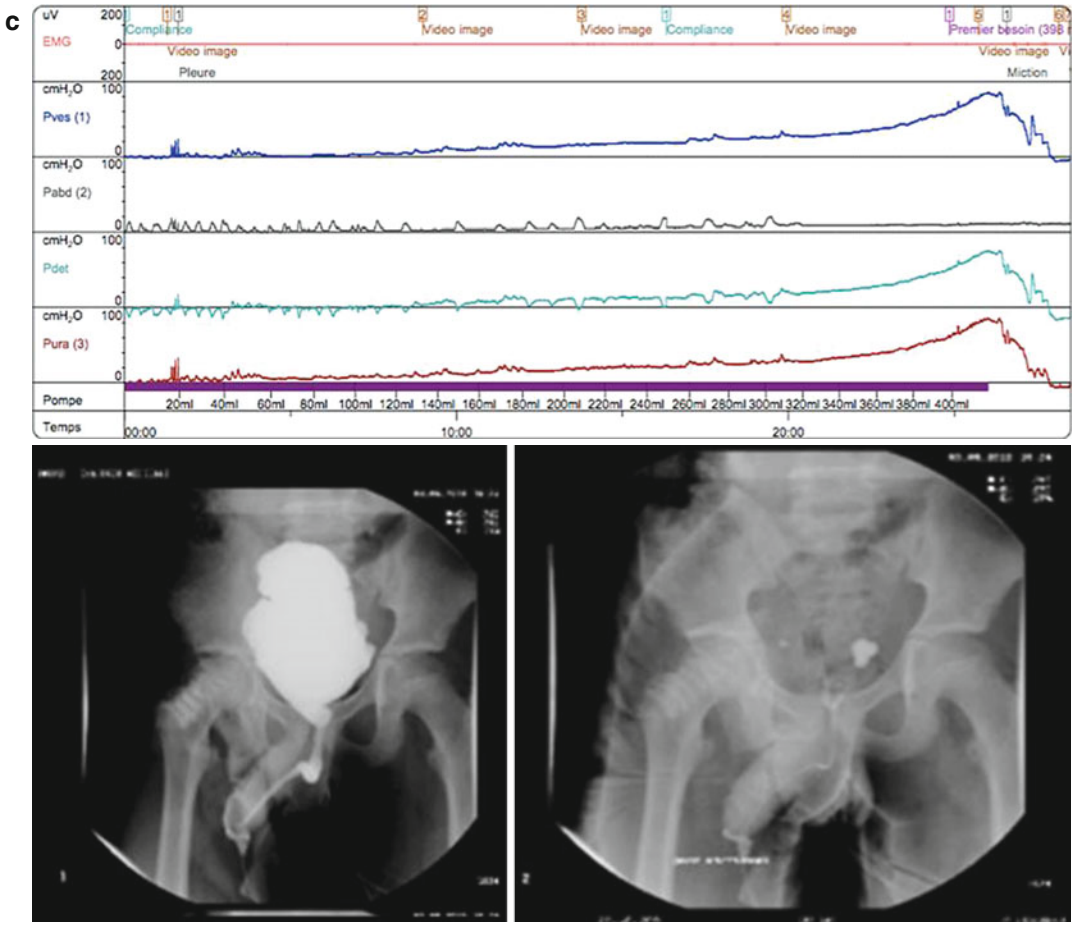

Fig. 18.5 (continued)

voiding disorders ($n=3$), (2) group II with voiding disorders who received pharmacological treatment ($n=6$, three hyperreflexic bladders, two myogenic failures, one poor compliant bladder), and (3) group III with severe bladder dysfunction requiring intermittent catheterization ($n=3$), all had small overactive poor compliant bladders. After transplantation, in group II, five of six patients had improved their voiding disorders, and bladder treatment was stopped. In group III, two of three patients had improved their bladder function, and CIC was no more needed (Fig. 18.6). In borderline cases, bladder augmentation before transplantation must be reconsidered under condition of having prudent post-transplantation follow-up [72].

18.4.3 Renal Function

Prenatal diagnosis has allowed categorizing newborns with high risk of renal failure. When negative parameters were absent and fetal urine biochemistry predicted good outcome, there were no cases of ESRD in early infancy [23]. Gestational age at diagnosis and volume of amniotic fluid are significant predictors of long-term renal function [7]. But other parameters like renal parenchyma or presence of renal cysts need to be also considered. Fetal urine includes sodium and beta-2 microglobulin measurements [7, 23, 29]. It is difficult to compare the results of different published series because of wide variation in regard to the availability of obstetrical service to

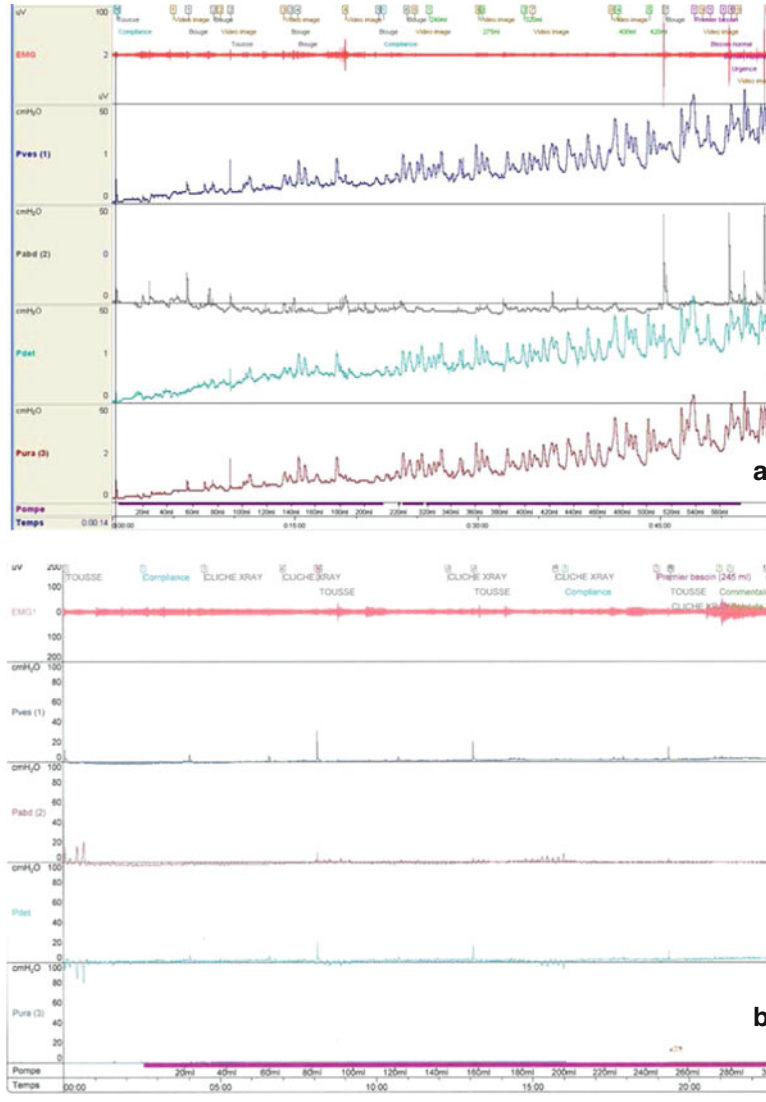

Fig. 18.6 Case of a boy included in group III. (**a**) Before transplantation, he had a small overactive poor compliant bladder. (**b**) Eight years after transplantation, he had a normocompliant bladder with normal capacity and without overactivity

account for in utero mortality, the routine practice of early prenatal US in all pregnant women, postnatal indicators of renal function, duration of follow-up, type of surgical procedure, and patient age at treatment. Mortality has dropped from 50 to 3 % thanks to medical management and the reduction of urinary sepsis and electrolyte complications. Renal failure ranged from 10 to 60 % in the literature. Serum creatinine above 80 µmol/L 7 days after valves ablation and at 1 year is predictive of ESRD [73, 74]. Renal transplantation is possible for boys with PUVs and ESRD. Good allograft survival is good if valve bladder is well managed before and after transplantation in using adequately anticholinergic and CIC thanks to video-urodynamics data.

18.4.4 Fertility

Different factors may contribute to the impairment of fertility in adolescents with treated PUVs. Libido and potency can be already affected by the renal failure in PUVs patients. Sexual function and fertility remain a matter of speculation and require further investigation owing to the scarcity of studies on these issues and the discrepancies in some of the results of semen analysis

observed in the published series with small number of patients [69]. However, in the recent review by Lopez-Pereira et al., it would seem that these patients have normal sexual function (some with slow ejaculation). They have normal semen counts, but viscosity, pH, and liquefaction time can be increased, and there may also be abnormal sperm agglutination. The ability to father children appears to be more dependent on renal failure than on PUVs.

Conclusion

Prenatal diagnosis of PUVs has been a major factor of postnatal management of these children with this congenital bladder outlet obstruction. Gestational age at diagnosis and volume of amniotic fluid are significant predictors of long-term renal function. Nevertheless, other parameters need to be also considered. Early valve ablation can be considered as the primary treatment in the majority of cases without the need of preoperative drainage or diversion. Endoscopic treatment is feasible safely in the neonatal period if experienced surgeons use specific minimally sized pediatric cystoscopies. Early bladder management is the best option even if bladder prognosis seems unpredictable but could be possibly improved in a long-term period. Any early bladder surgery should be avoided. In fact the surgical management of PUVs became minimally interventional but intensively focused on bladder evaluation and closed follow-up. In conclusion, multidisciplinary approach is advocated for the long-term management of patients with PUVs.

References

1. Jee LD, Rickwood AM, Turnock RR (1993) Posterior urethral valves. Does prenatal diagnosis influence prognosis? Br J Urol 72(5 Pt 2):830–833
2. Casale AJ (1990) Early ureteral surgery for posterior urethral valves. Urol Clin North Am 17(2): 361–372
3. Merguerian PA, McLorie GA, Churchill BM, McKenna PH, Khoury AE (1992) Radiographic and serologic correlates of azotemia in patients with posterior urethral valves. J Urol 148(5):1499–1503
4. Yohannes P, Hanna M (2002) Current trends in the management of posterior urethral valves in the pediatric population. Urology 60(6):947–953
5. López Pereira P, Martinez Urrutia MJ, Jaureguizar E (2004) Initial and long-term management of posterior urethral valves. World J Urol 22(6):418–424
6. Denes ED, Barthold JS, González R (1997) Early prognostic value of serum creatinine levels in children with posterior urethral valves. J Urol 157(4):1441–1443
7. Sarhan O, Zaccaria I, Macher M-A, Muller F, Vuillard E, Delezoide A-L et al (2008) Long-term outcome of prenatally detected posterior urethral valves: single center study of 65 cases managed by primary valve ablation. J Urol 179(1):307–312; discussion 312–313
8. Chertin B, Cozzi D, Puri P (2002) Long-term results of primary avulsion of posterior urethral valves using a Fogarty balloon catheter. J Urol 168(4 Pt 2):1841–1843
9. Farhat W, McLorie G, Capolicchio G, Khoury A, Bägli D, Merguerian PA (2000) Outcomes of primary valve ablation versus urinary tract diversion in patients with posterior urethral valves. Urology 56(4):653–657
10. Smith GH, Canning DA, Schulman SL, Snyder HM 3rd, Duckett JW (1996) The long-term outcome of posterior urethral valves treated with primary valve ablation and observation. J Urol 155(5):1730–1734
11. Walker RD, Padron M (1990) The management of posterior urethral valves by initial vesicostomy and delayed valve ablation. J Urol 144(5):1212–1214
12. Bolduc S, Upadhyay J, Sherman C, Farhat W, Bagli DJ, McLorie GA et al (2002) Histology of upper pole is unaffected by prenatal diagnosis in duplex system ureteroceles. J Urol 168(3):1123–1126
13. Hendren WH (1971) Posterior urethral valves in boys. A broad clinical spectrum. J Urol 106(2):298–307
14. Bhatnagar V, Agarwala S, Lal R, Mitra DK (2000) Fulguration of posterior urethral valves using the Nd: YAG laser. Pediatr Surg Int 16(1–2):69–71
15. Diamond DA, Ransley PG (1987) Fogarty balloon catheter ablation of neonatal posterior urethral valves. J Urol 137(6):1209–1211
16. Tank ES (1986) Experience with endoscopic incision and open unroofing of ureteroceles. J Urol 136(1 Pt 2):241–242
17. Duckett JW Jr (1974) Current management of posterior urethral valves. Urol Clin North Am 1(3):471–483
18. Myers DA, Walker RD 3rd (1981) Prevention of urethral strictures in the management of posterior urethral valves. J Urol 126(5):655–657
19. Nijman RJ, Scholtmeijer RJ (1991) Complications of transurethral electro-incision of posterior urethral valves. Br J Urol 67(3):324–326
20. Sarhan O, El-Ghoneimi A, Hafez A, Dawaba M, Ghali A, Ibrahiem E-H (2010) Surgical complications of posterior urethral valve ablation: 20 years experience. J Pediatr Surg 45(11):2222–2226
21. Crooks KK (1982) Urethral strictures following transurethral resection of posterior urethral valves. J Urol 127(6):1153–1154

22. Duel BP, Mogbo K, Barthold JS, Gonzalez R (1998) Prognostic value of initial renal ultrasound in patients with posterior urethral valves. J Urol 160(3 Pt 2):1198–1200; discussion 1216
23. El-Ghoneimi A, Desgrippes A, Luton D, Macher MA, Guibourdenche J, Garel C et al (1999) Outcome of posterior urethral valves: to what extent is it improved by prenatal diagnosis? J Urol 162(3 Pt 1):849–853
24. Reinberg Y, de Castano I, Gonzalez R (1992) Prognosis for patients with prenatally diagnosed posterior urethral valves. J Urol 148(1):125–126
25. Dinneen MD, Dhillon HK, Ward HC, Duffy PG, Ransley PG (1993) Antenatal diagnosis of posterior urethral valves. Br J Urol 72(3):364–369
26. Connor JP, Burbige KA (1990) Long-term urinary continence and renal function in neonates with posterior urethral valves. J Urol 144(5):1209–1211
27. Hutton KA, Thomas DF, Arthur RJ, Irving HC, Smith SE (1994) Prenatally detected posterior urethral valves: is gestational age at detection a predictor of outcome? J Urol 152(2 Pt 2):698–701
28. Al-Hazmi H, Dreux S, Delezoide A-L, Dommergues M, Lortat-Jacob S, Oury J-F et al (2012) Outcome of prenatally detected bilateral higher urinary tract obstruction or megacystis: sex-related study on a series of 709 cases. Prenat Diagn 32(7):649–654
29. Muller F, Dommergues M, Mandelbrot L, Aubry MC, Nihoul-Fekete C, Dumez Y (1993) Fetal urinary biochemistry predicts postnatal renal function in children with bilateral obstructive uropathies. Obstet Gynecol 82(5):813–820
30. Elder JS, O'Grady JP, Ashmead G, Duckett JW, Philipson E (1990) Evaluation of fetal renal function: unreliability of fetal urinary electrolytes. J Urol 144(2 Pt 2):574–578; discussion 593–594
31. Hulbert WC, Rosenberg HK, Cartwright PC, Duckett JW, Snyder HM (1992) The predictive value of ultrasonography in evaluation of infants with posterior urethral valves. J Urol 148(1):122–124
32. Casella DP, Tomaszewski JJ, Ost MC (2012) Posterior urethral valves: renal failure and prenatal treatment. Int J Nephrol 2012:351067
33. Kitagawa H, Pringle KC, Koike J, Zuccollo J, Sato Y, Sato H et al (2004) The early effects of urinary tract obstruction on glomerulogenesis. J Pediatr Surg 39(12):1845–1848
34. Ruano R (2011) Fetal surgery for severe lower urinary tract obstruction. Prenat Diagn 31(7):667–674
35. Kitagawa H, Pringle KC, Koike J, Nagae H, Zuccollo J, Sato Y et al (2006) Early bladder wall changes after creation of obstructive uropathy in the fetal lamb. Pediatr Surg Int 22(11):875–879
36. Nagae H, Kitagawa H, Pringle KC, Koike J, Zuccollo J, Sato Y et al (2006) Pressure-limited vesicoamniotic shunt tube for fetal obstructive uropathy. J Pediatr Surg 41(12):2086–2089
37. Harrison MR, Golbus MS, Filly RA, Callen PW, Katz M, de Lorimier AA et al (1982) Fetal surgery for congenital hydronephrosis. N Engl J Med 306(10):591–593
38. Biard J-M, Johnson MP, Carr MC, Wilson RD, Hedrick HL, Pavlock C et al (2005) Long-term outcomes in children treated by prenatal vesicoamniotic shunting for lower urinary tract obstruction. Obstet Gynecol 106(3):503–508
39. Kim SK, Won HS, Shim JY, Kim KS, Lee PR, Kim A (2005) Successful vesicoamniotic shunting of posterior urethral valves in the first trimester of pregnancy. Ultrasound Obstet Gynecol 26(6):666–668
40. Springer A, Fartacek R, Reck CA, Horcher E, Bettelheim D (2010) Major complication after intrauterine vesico-amniotic shunting. Afr J Paediatr Surg AJPS 7(3):200–202
41. Won H-S, Kim S-K, Shim J-Y, Lee PR, Kim A (2006) Vesicoamniotic shunting using a double-basket catheter appears effective in treating fetal bladder outlet obstruction. Acta Obstet Gynecol Scand 85(7):879–884
42. Brown C, Morris RK, Daniels J, Khan KS, Lilford RJ, Kilby MD (2010) Effectiveness of percutaneous vesico-amniotic shunting in congenital lower urinary tract obstruction: divergence in prior beliefs among specialist groups. Eur J Obstet Gynecol Reprod Biol 152(1):25
43. Jouannic J-M, Hyett JA, Pandya PP, Gulbis B, Rodeck CH, Jauniaux E (2003) Perinatal outcome in fetuses with megacystis in the first half of pregnancy. Prenat Diagn 23(4):340–344
44. Elder JS, Duckett JW Jr, Snyder HM (1987) Intervention for fetal obstructive uropathy: has it been effective? Lancet 2(8566):1007–1010
45. Coplen DE (1997) Prenatal intervention for hydronephrosis. J Urol 157(6):2270–2277
46. McLorie G, Farhat W, Khoury A, Geary D, Ryan G (2001) Outcome analysis of vesicoamniotic shunting in a comprehensive population. J Urol 166(3):1036–1040
47. Clark TJ, Martin WL, Divakaran TG, Whittle MJ, Kilby MD, Khan KS (2003) Prenatal bladder drainage in the management of fetal lower urinary tract obstruction: a systematic review and meta-analysis. Obstet Gynecol 102(2):367–382
48. Morris RK, Malin GL, Khan KS, Kilby MD (2010) Systematic review of the effectiveness of antenatal intervention for the treatment of congenital lower urinary tract obstruction. BJOG Int J Obstet Gynaecol 117(4):382–390
49. Quintero RA, Johnson MP, Romero R, Smith C, Arias F, Guevara-Zuloaga F et al (1995) In-utero percutaneous cystoscopy in the management of fetal lower obstructive uropathy. Lancet 346(8974):537–540
50. Quintero RA, Shukla AR, Homsy YL, Bukkapatnam R (2000) Successful in utero endoscopic ablation of posterior urethral valves: a new dimension in fetal urology. Urology 55(5):774
51. Morris RK, Ruano R, Kilby MD (2011) Effectiveness of fetal cystoscopy as a diagnostic and therapeutic intervention for lower urinary tract obstruction: a systematic review. Ultrasound Obstet Gynecol 37(6):629–637

52. Abbott JF, Levine D, Wapner R (1998) Posterior urethral valves: inaccuracy of prenatal diagnosis. Fetal Diagn Ther 13(3):179–183
53. Robyr R, Benachi A, Daikha-Dahmane F, Martinovich J, Dumez Y, Ville Y (2005) Correlation between ultrasound and anatomical findings in fetuses with lower urinary tract obstruction in the first half of pregnancy. Ultrasound Obstet Gynecol 25(5):478–482
54. Lewis KM, Pinckert TL, Cain MP, Ghidini A (1998) Complications of intrauterine placement of a vesicoamniotic shunt. Obstet Gynecol 91(5 Pt 2):825–827
55. Holmes N, Harrison MR, Baskin LS (2001) Fetal surgery for posterior urethral valves: long-term postnatal outcomes. Pediatrics 108(1):E7
56. Morris RK, Kilby MD (2009) An overview of the literature on congenital lower urinary tract obstruction and introduction to the PLUTO trial: percutaneous shunting in lower urinary tract obstruction. Aust N Z J Obstet Gynaecol 49(1):6–10
57. Nicolini U, Spelzini F (2001) Invasive assessment of fetal renal abnormalities: urinalysis, fetal blood sampling and biopsy. Prenat Diagn 21(11):964–969
58. Duckett JW Jr (1974) Cutaneous vesicostomy in childhood. The Blocksom technique. Urol Clin North Am 1(3):485–495
59. RICKHAM PP (1962) Advanced lower urinary obstruction in childhood. Arch Dis Child 37:122–131
60. Cendron J, Deburge JP, Karlaftis C (1969) Valvulae of the posterior urethra. J Urol Néphrologie 75(1):15–38
61. Reinberg Y, de Castano I, Gonzalez R (1992) Influence of initial therapy on progression of renal failure and body growth in children with posterior urethral valves. J Urol 148(2 Pt 2):532–533
62. Close CE, Carr MC, Burns MW, Mitchell ME (1997) Lower urinary tract changes after early valve ablation in neonates and infants: is early diversion warranted? J Urol 157(3):984–988
63. Whitaker RH, Sherwood T (1986) An improved hook for destroying posterior urethral valves. J Urol 135(3):531–532
64. Levard G, Aigrain Y, Politi B, Weisgerber G, Boureau M (1986) Rupturing of valves of the posterior urethra in the newborn using a balloon catheter. Results of the technic apropos of a series of 10 children. Chir Pédiatrique 27(4):196–200
65. Lal R, Bhatnagar V, Mitra DK (1999) Urinary continence following posterior urethral valves treatment. Indian J Pediatr 66(1):49–54
66. Bruce J, Stannard V, Small PG, Mayell MJ, Kapila L (1987) The operative management of posterior urethral valves. J Pediatr Surg 22(12):1081–1086
67. Churchill BM, Krueger RP, Fleisher MH, Hardy BE (1983) Complications of posterior urethral valve surgery and their prevention. Urol Clin North Am 10(3):519–530
68. Hoover DL, Duckett JW Jr (1982) Posterior urethral valves, unilateral reflux and renal dysplasia: a syndrome. J Urol 128(5):994–997
69. Lopez Pereira P, Martinez Urrutia MJ, Espinosa L, Jaureguizar E (2013) Long-term consequences of posterior urethral valves. J Pediatr Urol 9(5):590–596
70. Fumo MJ, McLorie GA (2006) Management of the valve-bladder syndrome and congenital bladder obstruction: the role of nocturnal bladder drainage. Nat Clin Pract Urol 3(6):323–326
71. Youssif M, Badawy H, Saad A, Hanno A, Mokhless I (2007) Augmentation ureterocystoplasty in boys with valve bladder syndrome. J Pediatr Urol 3(6):433–437
72. Botto N, Paye-Jaouen A, El Ghoneimi A (2012) Long-term evaluation of bladder function in patient with PUVs after renal transplantation. In: ESPU Annual Meeting. Zurich
73. Bajpai M, Dave S, Gupta DK (2001) Factors affecting outcome in the management of posterior urethral valves. Pediatr Surg Int 17(1):11–15
74. Oliveira EA, Diniz JS, Cabral AC, Leite HV, Colosimo EA, Oliveira RB et al (1999) Prognostic factors in fetal hydronephrosis: a multivariate analysis. Pediatr Nephrol Berl Ger 13(9):859–864