Authors from London evaluated 20 women with treated and reconstructed congenital urinary tract abnormalities, and assessed the effect this might have on renal function, pregnancy and delivery. They found that pregnancy had no long-term effect on renal function and did not compromise reconstruction. However, there was a substantial complication rate and an increased need for Caesarean section. Nevertheless they felt pregnancy in women such as these is safe for mothers and baby.

Pregnancy after lower urinary tract reconstruction for congenital abnormalities

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OBJECTIVE

To evaluate the effect of pregnancy on renal function, and the effect of congenital urinary tract abnormality and reconstruction on pregnancy and delivery.

PATIENTS AND METHODS

The case notes were reviewed of 20 women (median age 32.5 years) who had had 29 live babies. Data collected included patient demographics, congenital urological abnormality, urological reconstructive procedure(s) and any subsequent urological complications. Pregnancy details, including urological and obstetric complications, presentation and mode of delivery, were obtained via a postal questionnaire from the relevant obstetrician.

RESULTS

Seven patients had exstrophy-epispadias, seven spinal dysraphism, two sacral agenesis, and one each cerebral palsy, epispadias, imperforate anus and small bladder with vesico-ureteric reflux and congenital incontinence. They had had a mean (range) of 5.7 (1–12) urological reconstructive procedures each. Patients with exstrophy-epispadias had significantly more operations (mean 7.8) than those with spinal dysraphism (mean 4.14) or other diagnoses (mean 2.6) ($P < 0.01$). At the last follow-up 13 patients had an enterocystoplasty, six a neobladder and one an ileal conduit. Pregnancy-related urological complications were urinary tract infection in 15, upper tract obstruction requiring nephrostomy and stent in three, Mitrofanoff difficulties in two and pyelonephritis in one. There was no significant deterioration in glomerular filtration rate or serum creatinine after pregnancy. Only 10 of the births were normal or assisted vaginal deliveries. Seven patients had emergency and 12 had elective Caesarean sections for obstetric indications, including four breech births in the seven patients with vesical exstrophy.

CONCLUSIONS

Pregnancy has no long-term effect on renal function and does not compromise reconstruction. Although there is a substantial complication rate and an increased need for Caesarean section, pregnancy in women with lower urinary tract reconstruction for congenital urological abnormalities is ultimately safe for both mother and baby. Interdisciplinary co-operation is desirable for a successful outcome.

KEYWORDS

enterocystoplasty, lower urinary tract reconstruction, pregnancy, nephrological complications

INTRODUCTION

More children born with complex urogenital anomalies are being successfully reconstructed and developing into socially well-adjusted young adults. Pregnancy is an increasingly common event. There has been little information published on the fertility of these patients, the consequences of pregnancy or the mode of delivery. We evaluated the effect of pregnancy on renal and lower urinary tract (LUT) function, and the effect of congenital urinary tract abnormality and reconstruction upon pregnancy and delivery.

PATIENTS AND METHODS

Patients with intestinal reservoirs to reconstruct congenital anomalies of the LUT have been followed according to a prospective protocol since 1983 [1]. Parous patients were identified from the database. With ethics committee approval, the case notes of 20 patients having 29 live births were reviewed. Information was collected on patient demographics, diagnosis, previous urological operations, and renal function (GFR) and serum creatinine before and after pregnancy and LUT reconstruction. A questionnaire was mailed to all of the patients' obstetricians to collect relevant information on problems of fertility before pregnancy, before delivery, during labour and after delivery. Further information was obtained by telephone interview by the nurse specialist for LUT reconstruction.

The results were assessed statistically using Student's *t*-test for paired samples with a parametric distribution and the Mann–Whitney *U*-test for paired samples with a nonparametric distribution. Where data were incomplete the number on whom data was obtainable is shown in parentheses.

RESULTS

Thirty-seven pregnancies were identified in 20 patients (median age 32.5 years, range 20–48) at the time of the last review. Most patients had a diagnosis of exstrophy or spinal dysraphism (Table 1). The mean (range) number of previous urological procedures was 5.7 (1–12) (Table 2). Patients with exstrophy/epispadias had had significantly more procedures (mean 7.8) than those with spinal dysraphism (mean 4.14) ($P < 0.02$) or other diagnoses (mean 2.6) ($P < 0.01$). At the last follow-up, 13 patients had an enterocystoplasty, six a neobladder and one an ileal conduit. At the last follow-up after delivery all except the patient with a conduit were continent and using clean intermittent self-catheterization to empty their urinary reservoirs.

The eight 'lost' pregnancies (Table 3) were secondary to spontaneous loss in six and therapeutic termination in two. All spontaneous losses were in the first trimester; four of them occurred in two patients with exstrophy and known Müllerian duct anomalies, and two further exstrophy patients reported difficulty with initial conception requiring clomid treatment. One other patient reported fertility difficulties (spinal dysraphism) and none had Müllerian duct abnormalities. The 29 live births comprised 14 girls and 15 boys, with a mean birth weight of 2.84 kg (14 babies) and mean (range) gestation at the time of delivery of 36.9 (35–40) weeks.

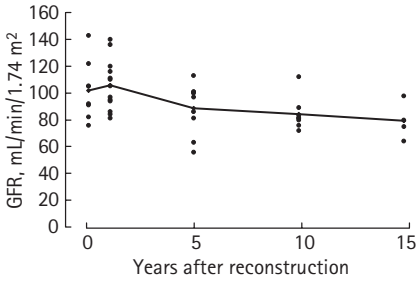
Neither the reconstruction nor the pregnancy significantly affected renal function when assessed by GFR or serum creatinine (Fig. 1). The mean corrected GFR was 98.4 mL/min/1.74 m^2 before pregnancy and 99.7 afterward ($P = 0.84$; nine). The respective mean serum creatinine levels were 73.8 and 73.4 μmol/L ($P = 0.95$). Whilst there was a trend for GFR to deteriorate with time this was not significant, with a mean corrected GFR at reconstruction of 98.5 and of 81 mL/min/1.74 m^2 10 years after reconstruction ($P = 0.07$; 13); the respective mean serum creatinine levels were 78.5 and 79.9 μmol/L.

Urological complications of pregnancy were UTI in 15 (52%), symptomatic and/or worsening upper tract obstruction requiring nephrostomy and stenting in three (10%, only one of whom had had previous ureteric reimplantation), difficulty with catheterization of the Mitrofanoff channel in two (7%) and pyelonephritis in one (3%). Complete procidentia complicated three of the eight pregnancies in patients with exstrophy (two in the same patient), gestational diabetes occurred in one (3%) (resolving after delivery) and cholestasis in one (3%). Overall, pre-eclampsia developed in three (10%) pregnancies and hypertension in two (7%). Most patients delivered by Caesarean section (seven emergency and 12 elective for obstetric indications, including four breech births in the seven patients with exstrophy). A urologist was present at half the Caesarean sections; there were no complications associated with the procedure. Only one of the emergency Caesarean sections was performed during labour, the rest being before the onset of labour. The decision was made to allow vaginal delivery in 11 women (38%) and all but one resulted in a normal or assisted vaginal delivery (Table 4).

TABLE 1 The distribution of urogenital anomalies

Anomaly	N (%)
Vesical exstrophy	7 (35)
Spinal dysraphism	7 (35)
Sacral agenesis	2 (10)
Epispadias	1 (5)
Cerebral palsy	1 (5)
Imperforate anus	1 (5)
Congenital VUR, small bladder and incontinence	1 (5)

FIG. 1. GFR changes with time after urogenital reconstruction (scatter plot with mean line)



DISCUSSION

Neither pregnancy nor reconstruction significantly affected renal function in patients with reconstructed congenital urogenital anomalies. Likewise, neither pregnancy nor delivery adversely affected LUT function. There was a very high rate of breech presentation in the exstrophy-epispadias group (57%), and a high rate of UTI (53%), upper tract obstruction requiring intervention (10%) and of pre-eclampsia (10%) in the group in general.

There were no adverse fetal outcomes, in particular infants were of normal birth weight and had no congenital anomalies. Most

TABLE 2 Previous urogenital surgery in the three groups

Procedure	Vesical exstrophy/ epispadias	Spinal dysraphism	Other diagnoses
Bladder closure	10	–	–
Enterocystoplasty	4	5	6
Vaginal dilatation	2	–	–
Bladder neck reconstruction	5	–	2
Revision enterocystoplasty	3	1	2
Vaginoplasty	3	–	–
Bladder neck closure	2	1	–
Neobladder	3	–	1
Monsplasty	1	–	–
Bladder neck AUS	1	1	2
Ureterosigmoidostomy	2	–	–
Ureteropexy	2	–	–
Colposuspension	2	3	1
Ileal/colonic conduit	3	2	1
Hemihysterectomy	1	–	–
Macroplastique	1	–	1
Redo ileal/colonic conduit	5	1	–
Herniotomy	2	–	–
Urethral dilatation	2	–	–
Mitrofanoff/Monti	5	4	1
Incisional hernia repair	3	–	–
Cystolitholopaxy	4	3	–
Revise Mitrofanoff/Monti	6	8	–
Nephrectomy	2	–	–
Cystolithotomy	2	1	–
Ureteric reimplantation	7	2	3
Cystectomy	1	1	–
Nephrolithotomy	1	–	–
Transuretero-ureterostomy	2	2	1
Trigonal manipulation	1	–	–
Urethrectomy	–	1	–
Remove bladder neck AUS	–	1	–
Neobladder	–	2	–
Urethrovaginostomy	–	1	–
Antegrade continence enema	–	2	–
TUR bladder neck	–	1	–
Revise antegrade continence enema	–	2	–
Pyeloplasty	–	1	–
Stamey	–	1	–
Pubovaginal sling	–	–	1
Take down pubovaginal sling	–	–	1
Pena repair	–	–	1

AUS, artificial urinary sphincter.

infants were delivered by Caesarean section for obstetric indications, although many (eight) of the obstetric indications were 'previous Caesarean section'.

The absence of deterioration in renal function with pregnancy and of significant deterioration in renal function with time after LUT reconstruction is gratifying and probably reflects intensive monitoring. All patients with a reconstructed congenital urogenital anomaly attend a specialist follow-up clinic initially 3-monthly for 1 year, then 6-monthly for 1 year and thereafter annually for life. At this clinic they are followed by a protocol with regular renal and LUT function assessment. After a diagnosis of pregnancy it has been policy to review all patients at 20 weeks of gestation and thereafter 2-weekly until 28 weeks of gestation with ultrasonography of their upper tracts, blood pressure measurement, urine analysis and MSU sampling. Thereafter they return to the routine follow-up. This period of intensive monitoring has been determined by experience; no new cases of upper tract problems have been diagnosed after 28 weeks. Pregnancy must be diagnosed by serum hCG measurement in this group of patients, as urine-based methods yield high false-positive rates, most probably because of an interaction between reservoir mucus and the urine test reagents [2].

All patients have easy telephone access to our specialist nurse (R.L.) to discuss any problems or worries, and are offered the option of combined obstetric care with a gynaecologist who has a special interest in women with congenital urogenital tract anomalies (S.C.). However, half prefer to have their obstetric care nearer to home.

There was a very high rate of breech presentation in the exstrophy-epispadias group (57% vs 4% in the general population) [3] which, along with the tendency for first-trimester miscarriage, is likely to be a consequence of the Müllerian duct abnormalities associated with exstrophy-epispadias in 29% of these patients [4]. The fertility difficulties noted in 29% of the exstrophy patients may also be related to Müllerian duct anomalies, but are more likely to be a consequence of extensive peritoneal adhesions and potential tubal damage arising from the previous and many complex operations. The development of procidentia in a third of term pregnancies in this group has been previously reported and is an expected consequence of pregnancy in this group [5]. When prolapse occurs it is greatly disabling and difficult to treat even after birth, with a tendency to recur despite the best surgical efforts [6]. The presence of prolapse and a weak pelvic floor in the exstrophy group may make vaginal delivery easier. However, vaginal delivery is likely to make any prolapse worse and far harder to treat, and is best managed by elective Caesarean section at 36 weeks.

The rate of UTI (52%) in the group as a whole is far higher than that seen in the general

population (2%) [7]. It reflects the incorporation of gastrointestinal segments into the LUT and the universal need to use intermittent self-catheterization in this group. A similarly high rate of UTI in pregnancy was reported in 43 patients with ileal conduits [8].

The rate of upper tract obstruction (10%) requiring intervention is also far higher than that of the general population (< 1%) [9]. Interestingly, upper tract obstruction was not limited to individuals who had had previous ureteric reimplantation, a group shown to be at risk during pregnancy in adult VUR [10]. Upper tract obstruction during pregnancy in the reconstructed patients may simply result from increased fetal pressure on the less physically robust enterocystoplasty or neobladder.

There is a high rate of pre-eclampsia in the reconstructed group (10% vs 3% in the normal population) [11]. However, there were few patients and this might reflect sample size rather than a consequence of reconstruction and pregnancy. None of the patients developing pre-eclampsia had documented hypertension or abnormal renal function before pregnancy. Also, all patients developing pre-eclampsia were primigravida and consequently can be expected to have a higher rate of pre-eclampsia.

The difficulties with Mitrofanoff catheterization both occurred in right iliac fossa stomas and were consequent to a change in body habitus, making visualization of the stoma difficult. Both were easily dealt with by placing indwelling catheters. There were no such problems with umbilical stomas but there were too few patients for a meaningful comparison.

The Caesarean section rate of two-thirds in this group is higher than for the general population (22%) [12] and may reflect the higher pregnancy-related complication rate of this group, or reasonable caution on behalf of both patients and obstetricians about the effect of vaginal delivery on reconstruction. A Caesarean section is more likely to be contemplated in this group because of the unpredictability of onset of labour and the availability of appropriate staff in the event of an emergency Caesarean section. The high elective Caesarean section rate also reflects the relatively many women in this group whose urinary continence depended on a successfully reconstructed bladder neck, in whom it was felt inadvisable to proceed with vaginal delivery because of possible risk to this continence mechanism [13]. Another reason for the high rate of elective Caesarean section is that many of the patients, especially those with spinal dysraphism, were unable to have an epidural, with consequent poorer pain relief in labour and a need for general anaesthesia in the event of Caesarean section. When Caesarean section was not indicated, vaginal delivery was associated with no adverse outcomes in most (91%) patients although one required an emergency Caesarean section for failure to progress. A similarly high Caesarean section rate was reported by other groups in patients with an ileal conduit [8], augmentation cystoplasty [14] and continent diversions [15]. Conversely, Creagh *et al.* [16] reported uncomplicated successful pregnancy in 34 patients, of whom only six (17%) required Caesarean section. It is preferable to avoid an emergency Caesarean section in case a supporting urologist is not available. If there is any question of an indication for a Caesarean, an elective operation should be planned.

In conclusion, women with LUT reconstruction for congenital urogenital anomalies are fertile, have normal pregnancies and produce healthy babies. There is a greater need for monitoring and intervention during pregnancy because of a far higher rate of UTI, pre-eclampsia and upper tract obstruction in the group as a whole and of breech presentation in the exstrophy-epispadias group in particular. There is a greater rate of Caesarean section in this group for obstetric indications. In those with no obstetric indication vaginal delivery appears to be safe. Interdisciplinary co-operation is desirable for a successful outcome.

TABLE 3 Conception history

Variable	Exstrophy/ epispadias	Spinal dysraphism	Sacral agenesis	Other diagnoses
Gravidity	16	13	3	5
Parity	12	11	2	4
Miscarriage	4	2	0	0
Termination of pregnancy	0	0	1	1
Fertility problems	2	1	0	0

TABLE 4 Mode of delivery and indication

Mode of delivery	N (%)	Indication
Spontaneous vaginal	4 (13)	Normal labour at term
Ventouse vaginal	2 (7)	Failure to progress
Forceps vaginal	3 (10)	Failure to progress
Induced vaginal	1 (3)	Pre-eclampsia (1)
Elective Caesarean	13 (43)	Premature labour (1)
		Hypertension (2)
		Breech (2)
		Previous Caesarean (8)
Emergency Caesarean	7 (23)	Premature labour (3)
		Chorioamniitis (1)
		Pre-eclampsia (2)
		Failure to progress (1)

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Abbreviations: **LUT**, lower urinary tract.