Original Article

Effect of gastrocystoplasty on height and bone density in children

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Abstract

Introduction: Gastrointestinal tissue in the urinary tract results in numerous metabolic changes. This study investigates the effects of augmentation gastrocystoplasty on the height and bone mineralization in bladder exstrophy patients.

Aim and Objective: To analyze the long-term outcome following gastrocystoplasty in terms of height, bone mineral density, acid base changes, and complications.

Materials and Methods: Cross-sectional study was done after obtaining institutional ethics committee clearance. Inclusion criteria included retrospective analysis of all cases who had undergone gastrocystoplasty since 1992 and prospective analysis of all cases who are undergoing gastrocystoplasty during the study period from June 2008 to December 2010. Exclusion criteria included follow up period of less than 2 years and cases lost to follow up. Indian standard charts were used for anthropometric measurement, and bone density scan of lumbar vertebrae and upper end of femur were done for bone matrix and mineral density.

Results: A total of 23 patients were included in the study. Out of 23 patients, 16 were males and 7 were females. Mean age at gastrocystoplasty was 8.28 years, and mean follow up period was 60 months. The median pre-augmentation and post-augmentation percentile height and weight were 56, 59 and 59, 61 respectively. Mean bone density value was 0.654.

Conclusion: Augmentation gastrocystoplasty is a safe and viable option without any adverse effect on height or bone mineral density without altering metabolic or acid base homeostasis.

Keywords: Bone mineral density, exstrophy bladder, physical growth

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INTRODUCTION

Sinaiko *et al.*, in 1956, first reported the use of gastric segments for bladder reconstruction in an animal model.[1] It was not used regularly in pediatric patients until 1988 when Adams *et al.* published their experience as an alternative use of intestine for bladder reconstruction.[2] Initially, it was used for patients with renal insufficiency, acidosis, or short bowel syndrome, but later, neurogenic cases were also benefitted from this procedure. However, recognition of complications prompted a reduction of its use at many centers, and gastrocystoplasty was kept as an alternative to ileal or sigmoid bladder reconstruction only in a minority of selected cases. In this study, we have reviewed our experience

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with gastrocystoplasty in a tertiary pediatric referral center and tried to assess the effect of gastrocystoplasty on height and bone density in children who underwent gastrocystoplasty because of various reasons.

AIM AND OBJECTIVE

To analyze the long-term outcome following gastrocystoplasty in terms of height, bone mineral density, acid base changes, and complications.

MATERIALS AND METHODS

This study is a cross-sectional study done after obtaining institutional ethics committee clearance. Inclusion criteria included retrospective analysis of records of all cases who has undergone gastrocystoplasty since 1992 and prospective analysis of all cases who are undergoing augmentation during the study period from June 2008 to December 2010. Exclusion criteria included cases of enterocystoplasty, follow up period of less than 2 years, patients not giving consent, and lost to follow up. Preoperative investigations included a general physical examination with regards to the height, weight, blood pressure, anemia, and features of rickets. Biochemical investigations included renal function test (RFT), serum electrolyte, serum calcium, serum phosphate, alkaline phosphate levels, and 24-hour urine analysis. Radiological investigations included USG abdomen, MCU, DMSA, DTPA, glomerular filtration rate (GFR), urodynamic (UDS), and EMG of bladder sphincter. GFR was calculated by clearance method. For obtaining the 'measured' GFR, plasma clearance of Tc99m-DTPA was calculated by obtaining two venous blood samples at 60 and 180 minutes post-injection of Tc99m-DTPA. Radioactivities in the samples were counted using a γ-well counter, and glomerular filtration rate was calculated using Russell's algorithm by a computer-assisted program. Obtained GFR values were corrected for height and weight (body surface area) and results were expressed in milliliters per minute per 1.73 square meter body surface area. The calculated GFR was used as the measured GFR. All patients underwent gastrocystoplasty by a single surgeon. All cases underwent Technetium-99m ((99m) Tc) pertechnetate scintigraphy to look for gastric patch viability and bone density scan of lumbar vertebrae and upper end of the femur for detecting the bone matrix and mineral density standardizes for the age and sex (Z value) using QDR 4500A model dual x ray absorptiometry. Anthropometric measurements were taken as percentile height and weight for the age as per Indian standard charts. For Statistical analysis, mean, standard deviation was computed for all the measurable variables, and student paired *t* test or non-parametric signed ranked tests were applied for comparing the results. For qualitative variables, Mc Nemar sqi square test was applied.

RESULTS

A total of 30 cases underwent gastrocystoplasty during this period. Record of 7 cases was not available hence excluded from the study. Out of these 23 cases, which form the study group, 16 were males and 7 were females. Primary pathology includes bladder exstrophy in 17, neurogenic bladder in 5, and vesicoureteric reflux with high pressure systems in 1. Additional procedures done at the time of gastrocystoplasty includes bladder neck repair in 8, ureteric reimplantation in 7 cases. Mean age at gastrocystoplasty was 8.28 years (range 4-15 years). Mean follow up period was 60 months (range 26-180 months). The median pre-augmentation and post-augmentation percentile height and weight were 56, 59 and 59, 61 respectively. Most of our patients were within 50-75th percentiles [Tables 1 and 2]. The mean

Table 1: Pre- and post-augmentation height percentile (*n*=23)

Percentile height	Number of case (percentage)	
	Pre-augmentation	Post-augmentation
Below 50	6 (26.1)	3 (13)
50-70	16 (69.6)	16 (69.6)
Above 75	1 (4.3)	4 (17.4)
Median	56	59

Table 2: Pre-and post-augmentation weight percentile (*n*=23)

Percentile height	Number of case (percentage)	
	Pre augmentation	Post augmentation
Below 50	7 (30.4)	3 (13)
50-70	13 (56.5)	16 (69.6)
Above 75	3 (13)	4 (17.4)
Median	59	61

Table 3: Mean pre-augmentation and post augmentation renal parameters (*n*=23)

Variables	Mean±SD		*P* value
	Pre-augmentation	Post-augmentation	
Blood Urea (mg/dl)	34.08±29.66	32.04±12.76	0.78
Serum Creatinine (mg/dl)	1.13±1.05	1.15±0.49	0.48
GFR (ml/min/1.73)	84±27.4	89.52±26.81	0.09
Serum Sodium (meq/l)	140.26±3.74	140.08±3.05	1.0
Serum Potassium (meq/l)	4.94±0.66	4.74±0.63	0.13
Serum Chloride (mmol/dl)	108.91±3.30	108.47±2.21	0.65
Serum Calcium (mg/dl)	9.69±0.84	0.49±0.52	0.18
Serum Phosphate (mg/dl)	4.99±0.89	5.02±0.86	0.82
Alkaline Phosphate (IU)	204.08±175.60	211.17±192	0.83
Arterial pH	7.38±0.98	7.41±0.50	0.06
Arterial HCO_3	24.27±5.30	25.63±4.85	0.44
$PaCo_2$ (mmHg)	40.95±8.02	35.33±7.56	0.65
Base excess	−3.03±4.74	−0.08±2.75	0.05

SD: Standard deviation

Table 4: Bone mineral density

Category	Bone mineral density (mean+SD)
Normal Indian children (*N*=15)	0.665 (+0.062)
Exstrophy children (*N*=12)	0.612 (+0.10)
Augmented children (*N*=16)	0.654 (+0.15)

SD: Standard deviation

Table 5: Incidence of complications compared with various studies

Complications	DeFoor *et al.*,[3] (%)	Leonard *et al.*,[4] (%)	Kurzrock *et al.*,[5] (%)	Our study (%)
Stone formation	2	5	2	4
Febrile UTI	20	10	15	8
Metabolic alkalosis	0	0	6	0
Hematuria dysuria	18	25	27	13

UTI: Urinary tract infection

pre-augmentation and post-augmentation renal, biochemical, and ABG parameters are shown in Table 3. Bone density values were available in 16 patients post-augmentation. The mean value post-augmentation gastrocystoplasty was 0.654 [Table 4]. The overall rate of complication in our study group was 26%, the most common being Hematuria–dysuria syndrome seen in 13% [Table 5]. Four percent of our cases developed vesical calculi and 8% developed febrile UTI six months post-augmentation. None of our patients developed severe hypochloremic metabolic alkalosis.

DISCUSSION

Over the decades, the use of gastric tissue for lower urinary tract reconstruction has decreased significantly. Most pediatric cases were done mainly in the 1990s. Initial indications included patients with renal insufficiency and short bowel syndrome, but later indications also expanded to patients with neurogenic bladder and others.[5-8] Benefits of the use of stomach included decreased mucous production, avoidance of hyperchloremic metabolic acidosis, and decreased rate of bladder stone formation. Other anatomical advantages were availability and the possibility of performing cystoplasty without detubularization. In addition, the gastric wall thickness allowed ureteral reimplantation or reimplantation of catheterizable channels when necessary. Likewise, gastric tissue has been combined with other intestinal segments as a composite urinary reservoir to decrease the disadvantages of each individual segment. The augmentation procedure is carried out to reduce the intravesical pressure, to preserve the upper tracts, and to improve the continence reservoir function of the bladder and hence the quality of life. The association between enterocystoplasty and a reduction in the growth and development was noticed in 1992 by Wagstaff *et al.*, but this was a retrospective study and had unclear definition of growth rate; hence, the results remained provocative yet unsubstantiated.[9] Although Wagstaff initially reported growth failure in 12 patients, subsequent follow up 10 years later had refuted the initial findings. In our study, we could not find decrease in the percentile heights or weight of children post-augmentation when compared with pre-augmentation values. There was no decrease in the linear growth as well. Mingin *et al.* had reported no change in linear growth among 33 augmented children, a finding in concordance with our study.[10] Only few studies are available regarding the bone mineral density in augmented children. Mingin *et al.* and Kockum *et al.* reported no significant change in bone mineral density in exstrophy bladder cases after a follow up period of 3.7 years.[11] Ugur Boylu *et al.* have evaluated bone mineral density in children with and without myelomeningocele and concluded that after augmentation, the bone mineral density was lower in cases of myelomeningocele, may be because of underlying neurologic pathology and its locomotor consequences.[12] In our study group, results of 16 post-augmented children were compared with normal Indian children and exstrophy patients who were not augmented, and we found no significant difference among the groups. Mucous production and bladder stone formation are both complications related to the use of bowel for urinary reconstructions. In our study group, the incidence of stone formation was found to be 4%, which was comparable to other studies.[3,4] In our study, none of the 23 patients had bothersome mucus production and none needed routine bladder drainage. Our policy is to keep all patients under routine chemoprophylaxis for 6 months. Two (8%) of our patient had febrile UTI 6 months after augmentation. In our study group, hematuria–dysuria syndrome which was first described by Nhuyen *et al.* and broadly defined as one or a combination of bladder spasm, suprapubic, penile or periurethral pain, coffee brown or bright red hematuria without infection, skin irritation or excoriation was seen in 3 (13%) patients.[13] All three cases were managed on an outpatient basis with oral sodium bicarbonate and proton pump inhibitors, and none of them required hospitalization. None of our patient developed severe hypochloremic metabolic alkalosis.

CONCLUSION

Hence, we can conclude from our study that augmentation gastrocystoplasty is a safe and viable option without any adverse effect on height or bone mineral density without significantly altering metabolic or acid base homeostasis.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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