



Enterocystoplasty: The long-term effects on bone mineral density



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Keywords
Enterocystoplasty; Osteoporosis; Bone mineral density

Received 26 October 2015
Accepted 27 February 2016
Available online 28 March 2016

Summary

Background

Studies show that enterocystoplasty has a negative effect on bone mineral density (BMD). The aim of this study was to investigate the long-term impact of enterocystoplasty on BMD. We used dual energy x-ray absorptiometry (DEXA) scans to determine BMD and identify patients with osteopenia and osteoporosis who are at potential long-term risk for fracture.

Materials and methods

We reviewed our database of >200 individuals, who had undergone enterocystoplasty or continent diversion for both neurogenic and non-neurogenic reasons during childhood. We chose to study the non-neurogenic group first for a number of technical reasons, and identified 24 individuals who had undergone the procedure for non-neurogenic reasons, and had more than 15 years of follow-up. In addition we had a control group of 10 individuals born with

bladder exstrophy, who had undergone primary closure before the year 2000, without enterocystoplasty. We used DEXA scan T- and Z-scores to identify patients with osteopenia and osteoporosis.

Results

Eleven of 24 patients had normal DEXA scans with normal T- and Z-scores; seven had identifiable osteopenia and increased long-term risk for fracture. Six had osteoporosis; three of whom had reduced glomerular filtration rate (GFR). Eight of the 10 individuals in the control group had a normal DEXA scan.

Conclusions

Enterocystoplasty during childhood can lead to loss of BMD. This does not seem to be related to the enterocystoplasty alone. It is more pronounced in individuals who have other risk factors, such as reduced GFR. The identification of BMD loss makes it possible to intervene before osteoporosis occurs and leads to pathologic fracture.

Introduction

Historically, there has been concern over the interposition of bowel into the urinary tract in children and its potential impact on skeletal growth [1,2]. The literature suggests that enterocystoplasty may have a negative impact on both skeletal growth and bone development [3–5]. Some early studies in myelodysplastic patients showed growth retardation secondary to their spinal cord defect, making it difficult to determine the impact of the metabolic effects of enterocystoplasty. More recent data suggest that urinary intestinal interposition alone is not associated with growth retardation [6–8]. However, other risk factors may play a role in growth retardation as well as defects of bone mineral density (BMD). In patients with both neurogenic and non-neurogenic primary lesions, enterocystoplasty may have an adverse effect on BMD [9–12].

We used dual energy x-ray absorptiometry (DEXA) scans to examine the long-term effects of the interposition of bowel into the urinary tract in patients who had undergone enterocystoplasty for non-neurogenic reasons during childhood and adolescence. We also identified those at risk for osteopenia and osteoporosis, and determined their potential long-term risk for fracture. In patients who had either enterocystoplasty or continent urinary diversion during childhood, the loss of BMD can be secondary to chronic metabolic acidosis. This outcome is a result of intestinal absorption of ammonium ions from the urine and co-absorption of chloride ions leading to hyperchloremic metabolic acidosis [13].

Chronic metabolic acidosis alters calcium metabolism by increasing urinary calcium excretion without corresponding increases in intestinal calcium absorption [14]. In turn, this leads to depletion of skeletal bone or BMD. In response to chronic acidosis, bone stores release both carbonate and phosphate to buffer the excess hydrogen ions. Thus, skeletal calcium content is decreased and BMD is replaced by osteoid that leads to a loss in bone strength [15]. This can increase the risk for osteopenia, osteoporosis, and fracture.

Materials and methods

We reviewed our database of >200 individuals who had either enterocystoplasty and continent urinary diversion during childhood for both neurogenic and non-neurogenic reasons. We chose to study the non-neurogenic group first, largely because this group consists of patients that one of the authors continued to see on a regular basis into adulthood. We identified 24 individuals in the non-neurogenic group who had operations performed >15 years ago with regular follow-up. They ranged in age from 18 to 60 years, with 12 females and 12 males. We used DEXA scans to measure BMD and identify bone characteristics in each patient. In addition we had a control group of 10 individuals born with bladder exstrophy, who had undergone primary closure before the year 2000, without enterocystoplasty.

In the study group, 12 patients were born with classic bladder exstrophy, three with posterior urethral valves, three with bilateral ectopic ureters, and four with bladder/

Table 1 Underlying diagnosis (n = 24).

| | No. of patients |
|---------------------------|--------------------------|
| Classic exstrophy | 12 |
| Bilateral ectopic ureters | 3 |
| Rhabdomyosarcoma | 4 (3 bladder/1 prostate) |
| Posterior urethral valves | 3 |
| Trauma | 2 |

prostate rhabdomyosarcoma. Two individuals lost their bladders secondary to trauma (Table 1).

We reviewed the clinical records and metabolic panels of each patient. We measured height, weight, and age, and calculated their BMIs. Each patient underwent a DEXA scan, the gold standard for diagnosing osteopenia and osteoporosis [16,17]. We did not measure vitamin D or parathormone levels in our study group.

Table 2 lists the surgical procedures performed. These included enterocystoplasty in 13 patients, using the ileum in 10, ileum plus a gastric patch in two, and colon in one. A right colon pouch was created in 11 other patients. Additional surgeries included nephrectomy in two patients and colovaginoplasty in two. Four patients underwent a bladder neck closure, and four others had bladder neck plasty. Thirteen had a Mitrofanoff procedure; six had a revision using a Monti modification. All 24 individuals remained on clean intermittent catheterization.

Surgical complications included catheterization difficulties in nine of the 24 patients, with stomal stenosis in three. Some of the complications overlapped. Obstruction of the small bowel affected two patients. Two others had ureteral obstruction, and one developed a vesicocutaneous fistula. Three patients developed pouch stones over time.

Results

The 24 patients ranged in age from 18 to 60 years. They had bowel as part of their urinary tract from 15 to 33 years. The group consisted of active adults and included 12 males and 12 females. Four were students, 16 were actively employed, three were full-time homemakers with children, and one was retired. Only one patient had evidence of metabolic acidosis on electrolyte screening.

According to WHO BMI Guidelines, four males were obese and four other males were underweight. Four of those in the study group had evidence of growth retardation: three had mild to moderate evidence of renal insufficiency, and one had rhabdomyosarcoma of the prostate

Table 2 Surgery.

| Type | No. of patients |
|-------------------|-----------------|
| Enterocystoplasty | 13 |
| Ileum | 10 |
| Ileum/stomach | 2 |
| Colon | 1 |
| Right colon pouch | 11 |

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