Journal of Pediatric Urology (2017) 13, 274.e1–274.e7

Bladder perforation after augmentation cystoplasty: Determining the best management option

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Keywords
Augmentation cystoplasty; Perforation; Conservative; Non-operative management; Prevention

Received 12 June 2016
Accepted 21 December 2016
Available online 10 February 2017

Summary

Introduction
Delayed bladder perforation is a well-described complication after augmentation cystoplasty. Although the frequency, risk factors, and diagnostic challenges are well documented, discussions regarding management strategies are sparse.

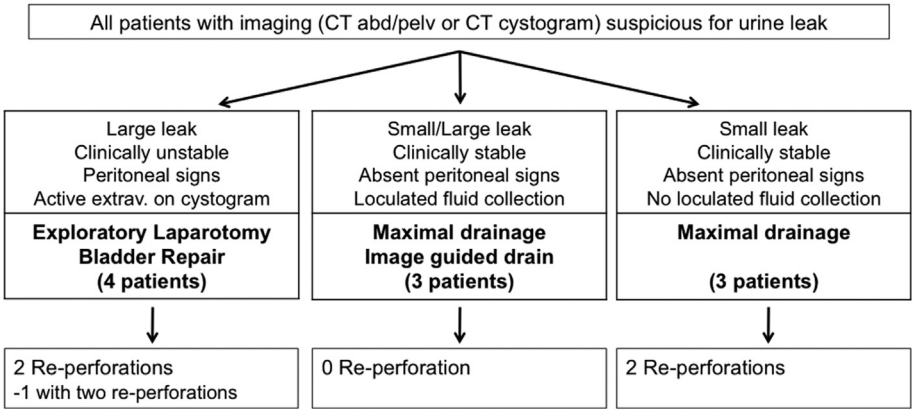
Objective
We evaluated our experience of managing augmented bladder perforation to interrogate the hypothesis that non-operative management can be used effectively.

Study design
We retrospectively evaluated the management of 10 patients with augmented bladder perforations over a 16-year period (Jan 2000–Jan 2016). Patients who demonstrated clinical deterioration, severe peritonitis, or extensive extravasation on imaging underwent exploratory laparotomy and primary closure. Clinically stable patients with minimal extravasation were managed non-operatively with maximal bladder drainage, and those with loculated fluid collections in feasible locations for drainage underwent an image-guided percutaneous drain placement.

Results
Underlying diagnoses included four patients with myelomeningocele, three with sacral agenesis, two with spinal cord injuries, and one with bladder exstrophy. Three of the four patients with myelomeningocele had concomitant ventriculoperitoneal shunts. Six patients had continent catheterizable channel creation and two patients had bladder neck reconstructions during the original operation. Four patients were managed with exploratory laparotomy and primary closure. Among the six patients managed non-operatively, three underwent image-guided drain placement in addition to maximal bladder drainage. Four patients developed re-perforation. Two of the four surgically managed patients developed re-perforation. Two of the three patients managed only with maximal bladder drainage developed re-operation. None of the patients managed non-operatively with drain placement suffered from re-perforation. Four perforation episodes were alcohol-related, two occurred after high-impact sporting activity, and two patients reported non-compliant catheterization.

Discussion
Non-operative management with maximal bladder drainage and selective image-guided drain placement can be successfully deployed in clinically stable patients with limited extravasation. Ensuring low intraluminal detrusor pressures and empty bladder with maximal drainage is critical for spontaneous sealing of the perforation site. Exploratory laparotomy and primary closure remains our approach for those presenting with clinical deterioration or significant extravasation on imaging. The majority of our perforations and re-perforation episodes seemed to stem from preventable behavioral risk factors.

Conclusions
Our findings support the hypothesis that non-operative management with maximal bladder drainage and image-guided drain placement can be effective in stable patients with limited extravasation.



Summary figure Management decision and results.

http://dx.doi.org/10.1016/j.jpurol.2016.12.027
1477-5131/Published by Elsevier Ltd on behalf of Journal of Pediatric Urology Company.

Introduction

Delayed bladder perforation is a serious complication of augmentation cystoplasty, occurring in 5–13% of patients [1–6]. There is a clear association between perforated augmented bladders and reservoir fullness. Other possible contributing factors include ischemic necrosis, type of bowel segment, detrusor spasms, weak abdominal wall musculature, catheterization injury, and chronic infection [2,7,8].

Prompt diagnosis of augmented bladder perforation is critical. Delay in diagnosis can lead to rapid clinical deterioration, with mortality rates of up to 25% [9]. Diagnosis is often delayed in neuropathic patients whose symptoms may be blunted by neurologic deficits. Computed tomography (CT) cystogram is the diagnostic imaging modality of choice, in which bladder perforation and degree of urinary extravasation can be assessed accurately [4,7]. Re-perforation rates are high, with some studies reporting a re-perforation rate of 25%.

Many studies concluded that perforations should be managed with exploratory laparotomy and primary closure [1,2,4,7,8]. Non-operative management with maximal drainage with or without image-guided drain placement has been reported but not widely accepted. Although the frequency, risk factors, and diagnostic challenges of augmented bladder perforation are well described, discussions regarding management strategies are sparse in the literature. We hypothesized that non-operative management of bladder perforation after augmentation cystoplasty could be used effectively in clinically stable patients when combined with maximal bladder drainage and image-guided drain placement.

Methods

Patients

Following institutional review board approval, we retrospectively identified 10 patients with documented bladder perforations over a 16-year period (Jan 2000–Jan 2016). All patients had radiographic evidence of intra-peritoneal perforation (CT cystogram or intravenous contrast CT of abdomen and pelvis). We used institutionally based electronic health record search tools to assist in identifying this cohort.

Patient demographics, details of original augmentation cystoplasty, clinical presentation (systemic inflammatory response syndrome (SIRS) criteria, physical exam), radiologic findings (radiologist's characterization or measurement of ascites), operative and procedural details, hospital course (duration of bladder drainage catheter, intra-peritoneal drain, antibiotics), and long-term outcomes (re-perforation) were interrogated. The length of follow-up was from the time of perforation to last known urologic appointment at our institution.

Management strategies

The decision for surgical versus non-operative approach was based on clinical stability, peritoneal signs, and radiologic findings. Patients who demonstrated severe peritonitis, signs and symptoms of deterioration (hypotension, worsening fever), and extensive extravasation on imaging underwent exploratory laparotomy and primary closure of the perforation site. All non-operative patients were managed with maximal bladder drainage and broad-spectrum intravenous antibiotics. Maximal drainage included insertion of the largest possible catheter in the stoma and/or urethra and gentle lavaging ("push fluid in and pull fluid out") with 30 mL of sterile saline every 1–2 h to ensure patency and prevent mucus plugging. In those who had loculated fluid collections in locations accessible for drainage, an image-guided percutaneous drain was placed by an interventional radiologist. Indwelling drainage catheters were removed in the outpatient setting after confirming lack of contrast extravasation on standard cystogram.

Results

Mean duration between original augmentation cystoplasty and time of perforation was 3.8 $\pm$ 3.2 years. Underlying diagnoses included four patients with myelomeningocele, three with sacral agenesis, two with spinal cord injuries, and one with bladder exstrophy. Ileum was used as the bowel segment for all augmentation cystoplasty procedures. Six patients had continent catheterizable channel creation, five patients had Malone antegrade continence enema procedure (appendicocecostomy), and two patients had bladder neck reconstructions during the original operation.

At presentation, seven patients met SIRS criteria (pediatric SIRS criteria if under 18 years of age). Four patients were initially managed with exploratory laparotomy and primary closure. All of these patients met SIRS criteria, and two presented with signs and symptoms of severe peritonitis. Among six patients managed non-operatively, three were managed with maximal bladder drainage only while the other three received image-guided intra-peritoneal drains in addition to maximal drainage (two trans-abdominal, one trans-rectal).

The demographics of patients managed with exploratory laparotomy and non-operative intervention is described in Table 1. Patients who underwent non-operative management were more likely to be younger ($p = 0.03$).

Mean length of hospital stay was 11 $\pm$ 5 days. Mean length of indwelling catheter(s) was 26 $\pm$ 18 days. Mean length of antibiotic treatment was 23 $\pm$ 12 days. Mean length of follow-up after the initial perforation was 4.6 $\pm$ 4.3 years. Four patients (40%) suffered from re-perforations. Two of the four surgically managed patients developed re-perforation. One of these patients had two re-perforations. Two of the three patients managed with maximal bladder drainage only developed re-perforations. None of the patients managed with bladder drainage and image-guided drains suffered re-perforation. The mean length of time between the original perforation and re-perforation was 3.0 $\pm$ 3.7 years. All five re-perforation episodes were managed surgically. Four repeat exploratory laparotomies were performed. A rupture was not identified intraoperatively in one exploration; it was thought that the