



**ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH
SCIENCE, DEPARTMENT OF SURGERY
PEDIATRIC SURGERY UNIT**

**OUTCOME OF AUGMENTATION CYSTOPLASTY IN PEDIATRICS
PATIENT : A 10 YEARS EXPERIENCE FROM TIKUR ANBESSA
SPECIALIZED HOSPITAL AND MENILIK II HOSPITAL**

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ADDIS ABABA, ETHIOPIA



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Declaration

This is to certify that the research thesis entitled “Outcome of Augmentation Cystoplasty in Pediatrics Patients : A 10years Experience from Tikur Anbessa Specialized Hospital and Menilik II Hospital”; submitted as partial fulfillment of specialty in Pediatrics Surgery, Addis Ababa University, is a record of my original work and has not been submitted to any other institution for any purpose. The references used for this research thesis are properly cited and the assistance I received has been duly acknowledged.

Name of the candidate_____ Date_____

Approval of Thesis for Defense

I hereby certify that I have supervised, read and evaluated this research thesis titled “Outcome of Augmentation Cystoplasty in Pediatrics Patients: A 10years Experience from Tikur Anbessa Specialized Hospital and Menilik II Hospital” by Dr. Samuel Gashu and under my guidance I recommended the research thesis for oral defence.

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Signature

Date

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List of Abbreviation

| | |
|-------|--|
| AAU | Addis Ababa University |
| AC | Augmentation Cystoplasty |
| ARM | Anorectal Malformation |
| CBEEC | Classic Bladder Exstrophy-Epispadias Complex |
| BUN | Blood Urea Nitrogen |
| CIC | Clean Intermittent Catheterization |
| CKD | Chronic Kidney Disease |
| IRB | Institutional Review Board |
| LMIC | Low and Middle Income Country |
| MH | Menilik II Hospital |
| MMC | Myelomeningocele |
| MACE | Malone Antegrade Continence Enema Procedure |
| NB | Neurogenic Bladder |
| PUV | Posterior Urethral Valves |
| SBO | Small Bowel Obstruction |
| SPSS | Statistical Package for the Social Sciences |
| TASH | Tikur Anbessa Specialized Hospital |
| US | Ultrasound |
| UTIs | Urinary Tract Infections |
| VUR | Vesicoureteral Reflux |

Abstract

Background : Augmentation cystoplasty (AC) is indicated for a variety of reasons to achieve the goal of increasing both bladder compliance and capacity. AC can be performed using a variety of methods. Although this technique has unquestionable benefits, it is not without complications. Data on its indication and complications are extensive in the developed world, but quite poor in developing countries, particularly in Sub-Saharan Africa. So study will be unique in this region of the world.

Objective : The aim of the study was to assess outcome of AC in pediatric age group at Tikure Anbessa Specialized Hospital (TASH) and Menilik II Hospital (MH) over the past 10 years period.

Methods : A 10 year retrospective cross-sectional descriptive study is conducted to evaluate the outcome of AC in pediatric surgical patients who operated from January 2014 to December 2024 G.C. The study is conducted by reviewing the medical charts of all patients operated for AC. The data included demographic information, clinical diagnosis, investigations, surgical procedure, complications, and the outcome of each patient. Data then entered, cleaned, coded, and analyzed using SPSS software.

Results : A total of 20 AC procedures are performed on 19 patients. From this, 2 patients's medical record was lost, so only 17 patients were described and listed. Ten (59%) were boys and 7 (41%) were girls. Age at operation ranged from 3 years to 15 years, with a median of 6 years. Most of the patients (64.7%) had follow up for 2 or more years. Twelve patients (70%) had bladder exstrophy epispadias complex and 11.8 had isolated epispadias (11.8%). Most common segment used was ileum (94.1%). All patients were incontinent before augmentation cystoplasty, but postoperatively 70% achieved continence. 94.1% had stable renal function postoperatively.

Conclusion and Recommendation: Augmentation cystoplasty is a safe and effective method to achieve continence and prevent renal deterioration, in which more than 70% will become continent after the procedure. To improve outcome of patients a large prospective study is needed.

Key Words : Augmentation Cystoplasty, Outcome, Pediatric Population

Chapter 1 : Introduction

1.1 Background

Augmentation cystoplasty (AC) is a surgical procedure that involves enlarging the size of the bladder using different tissue, usually with reconstructed bowel segment. [1-9] The two primary goals of enterocystoplasty are to protect the upper urinary tract and provide socially acceptable urine continence. [1,10]

AC is conducted for a variety of neurogenic and non-neurogenic conditions. Neurogenic bladder (NB) , Bladder exstrophy epispadias complex (BEEC) and posterior urethral valves (PUV) are the leading indications in pediatrics. [2,3,4,7,8,9,10,11]

AC can be performed via various technique. Conventional enterocystoplasty uses detubularized segments of small or large bowel. Gastrocystoplasty, autoaugmentation, seromuscular enterocystoplasty, and ureterocystoplasty are alternative technique used to augment bladder. [1,4,5,7] Despite this vast variety of choice of tissue, the gold standard material for use in AC is not clear. [12]

Normal voiding will not occur after enterocystoplasty, and clean intermittent catheterization (CIC) using urethra or one of reconstructed abdominal wall stoma will be necessary for lifelong. [1] Between 40% and 60% of patients who receive AC will have concomitant procedure either simultaneously or in the near future. Bladder neck closure or reconstruction, ureteric reimplantation, abdominal wall stoma, and cystolithotomy are among the commonest procedure mentioned in different series. [2,11,13,14]

Outcome of AC is usually assessed via improvement of renal function and urine continence rate. Various papers reported acceptable social continence rates between 85 and 100%. [2,4,6,7,11,13] Despite this, some series documented deterioration of renal function. [2,4,11]

AC has several advantages in protecting renal function and achieving urinary continence but short and long-term complications are not uncommon. The most reported complication are wound infection, postoperative urine leak, bowel obstruction, bladder stone, symptomatic urinary tract infections (UTIs), reservoir perforation, stoma related complications, metabolic

derangement and malignancy. Despite these complications, AC remains a safe and necessary procedure for indicated patients. [2,3,4,5,7,9,10,11,13,14,15]

1.2 Statement of the Problem

AC is performed for a variety of reasons in the pediatric age group, most notably for neurogenic bladder and bladder exstrophy. Regardless of the method of cystoplasty, the goal is to protect the upper urinary tract and maintain continence. [2,6,7,11,13] Despite these key goals, AC has serious short and long-term consequences which will affect the quality of life of the patients. Higher complication rate mandates us to have a longer and consistence postoperative follow up. This study will asses the type and complication profile AC in pediatric patients operated in TASH and MH.

1.3 Significance of the Study

AC is not a routine procedure, and the outcome is not straightforward. To our knowledge, no single literature on this topics exists in Ethiopia and other developing countries, despite extensively studied in developed countries . So it will be the first study of its kind in our country and Sub-Saharan Africa.The study will contribute to the scarcity of studies in Sub-Saharan Africa and other low and middle income countries (LMIC). In the near future, it would also pave the door for prospective studies on many aspects of AC.

Chapter 2 : Literature Review

AC is performed for various neurogenic and non neurogenic congenital anomaly. Hemangi R. et al. found that of the 30 patient that needed AC, 16 (53.3%) were having neurogenic bladder and the rest had non neurogenic cause. Bladder exstrophy-epispadias complex (BEEC) were the most common indication in non neurogenic group and anorectal malformation (ARM) with vertebral anomaly were the most common cause in neurogenic group. [13] Multiple series found that most frequent underlying diagnosis that required AC were neurogenic bladder (NB), BEEC, and posterior urethral valves (PUV). [2,4,8,9,10,11,14]

AC can be performed via various technique. Conventional enterocystoplasty uses detubularized segments of small or large bowel. In order to avoid some of the unfavorable side effects of using bowel for bladder augmentation, a number of procedures, including gastrocystoplasty, autoaugmentation, seromuscular enterocystoplasty, and ureterocystoplasty, have been devised to augment the bladder without using bowel segment. [1,4,5,7] Despite advancements in tissue engineering, the optimum material for use in AC has yet to be developed. [12] Most common technique used for AC, as reported by multiple study, were illeocystoplasty followed by sigmoid and ileocecal segment. [2,5,6,8,11,13,14,15]

Normal voiding will not occur after enterocystoplasty, and CIC will be necessary for lifelong. [1,7,13] The key to doing CIC following AC is establishing a catheterizable channel. [10,11] 50% of patient in the study of Ross JPJ et al. recieved catheterizable channels. [2] Kispal Z et al. found that all 86 patients emptied their bladders via CIC. Thirty patients use their native urethra, whereas 56 patients have a catheterizable abdominal wall stoma constructed via a Mitrofanoff principle, Yang-Monti's tube, or ureter. [9]

Patients who receive AC frequently have concurrent operations simultaneously or in the future. Between 40% and 60% of patient had additional procedure in most series, commonest would be bladder neck closure/reconstruction, ureteric re implantation, Mitrofanoff procedure .[2,11,13,14]

Mostly outcome of AC is assessed using improvement of renal function and achievements of urine continence. [13] Many publications showed acceptable social continence rates between 85

and 100%. [2,4,6,7,11,13] AC stabilize renal function in 85-97% of patients. Some series documented deterioration of renal function at a rate of between 3% and 10%, however worsening is usually linked to pre-operative renal insufficiency.[2,4,7,11]

Despite AC has unquestionable advantages, it is not devoid of short and long-term complications. Overall, 15% of patients had AC-related postoperative complications in report of Ross JPJ and his colleague . However, the majority were mild in nature and only required very little intervention. [2] In contrast, Kispal Z et al found 65% of complications in the study of 86 patients who underwent AC and bladder substitution. [9]

Wound infection is one of the most frequent complication following AC , although the majority of these are minor and will heal with adequate wound care. Taghavi K. et al. reported 7% of wound infection rate in his series of 71 patients with AC. [10]

Peri-operative urine leak or Vesicocutaneous fistula can also occurred in the immediate postoperative period. Taghavi K. et al. found 13% rate of urine leak and is most common in those having AC via colonic tissue (50%). Half of them resolve with out the need of surgery. [10]

Intestinal obstruction after augmentation is a rare yet dangerous consequence. Shekarriz B et al observed a small bowel obstruction (SBO) rate of 4.5% after AC, with 83% occurring in the iliocectoplasty group. [7] 4%-6% of children had episode of SBO and mostly was due to adhesion. [8,10] Kispal Z et al reported 9% rate of adhesive bowel obstruction. [9]

Bladder stone formation is typically one of the most common long-term complication after AC. The majority of published research indicate that the incidence of stone development ranges between 10% and 25%. [2,4,8,9,10,16,17] Risk factors for stone development is attributed to mucus retention, bacteriuria, urinary stasis, foreign body retention and metabolic factors. [2,3,4,9,10,16]. Many reported that bladder stone was also significantly higher in those utilizing Mitrofanoff stoma and in those who didn't performing regular bladder irrigation [4,9,16] Different study showed that risk of stone is lower in gastrocectoplastyas compared to ileocectoplasty and colocectoplasty. [8,16]

Symptomatic UTIs were frequent in the postoperative period. One explanation for this is the high rate of bacteriuria in patients using CIC. Within this AC population, there is disagreement about the appropriate definition and management of UTIs, clear distinction between asymptomatic bacteriuria and significant or symptomatic UTIs, and accurate differentiation between upper and lower UTI. Approximately between 50% and 70% of patient experienced at least one symptomatic UTI. [2,10]

Spontaneous perforation is an uncommon but serious complication of AC that can lead to peritonitis, sepsis and death. [4,18] Reported incidence of bladder perforation in different series was between 3% and 8.6%. [2,4,18,19] Main cause of perforation was bladder over distension causing elevated intravesical pressure due to delayed catheterization, noncompliance, and mucus blockage of the suprapubic tube. Perforation usually occurred almost usually in the bowel segment, and it is most common in the neurogenic bladder group. [4,19] Late perforation can be caused by ischaemia from high intravenous pressure, abdomen and catheter trauma, chronic transmural infection, or overdistension due to delayed catheterization. [9]

Stoma related complication in those who undergo construction of catheterizable abdominal stoma is undeniable. There is dispute on which catheterizable channel creates more problems during performing CIC. [13] According to Narayanaswamy et al, catheterization is more difficult with a Yange Monti than an appendix conduit. The study found that 26% of appendicovesicostomy patients experienced catheterization issues, while 60% of illeovesicostomy patients did. [20] But castellan et al. showed no difference in the occurrence of difficulties between Yange Monti channels (23%) vs. appendix conduits (21%). [21] Between 40% and 65% of patient had had catheterizable channel complications, including stomal stenosis, difficult catheterization (redundancy), incontinence, prolapse, and bleeding. [2,9,10]

Metabolic complication after AC is well known medical complication. Electrolyte absorption can lead to electrolyte imbalance in patients who have undergone lower urinary tract reconstruction with intestinal segments. Most study reported between 5.5% and 33% developed some sort of electrolyte abnormality after AC. [2, 22] Chronic acidosis is associated with impairment of calcium reabsorption in the kidney which results to bone demineralization which

is most problematic in pediatric age group since it affects growth.[3,9] Metabolic disturbances differ depending on the segment of the colon utilized. Ileocystoplasty is widely known for its hyperchloremic metabolic acidosis, whereas gastrocystoplasty is associated with hypochloremic hypokalemic metabolic alkalosis. [5]

AC-associated malignancy is a well recognized, but a possibly underestimated complication. [11] Biardeau X et al. found 64 cases of malignant bladder cancer after AC after reviewing 57 article and reported there was no substantial difference in cancer incidence between bowel segment types (gastric, ileal or colonic). Most study reported the median latency period was between 14 and 19 years from surgery and 50% located at bladder-bowel interface. Most recommended endoscopic surveillance 10 years after AC. [6,9] Soergle et al. reviewed the literature and found 28 cases of malignancy. Adenocarcinomas found in 52% and transitional cell carcinomas seen in 39% and all located at the bladder-intestinal junction. [23] Patients with augmented with ileum or colon and stomach had a 7-8-fold and 14-15-fold increased chance of developing cancer, respectively. [24]

Repeat augmentation cystoplasties may rarely needed if the initial procedure is not successfully achieve its goal. Approximately 4% of patients required repeat AC due initially failed AC . [2,10] Although there is a risk associated with AC, it is an useful procedure that can help patients attain relative continence and maintain renal function by increasing the functional capacity of small, poorly compliant bladder. [2,3,5,7,9,10,11,13,14,15]

Chapter 3 : Objectives

3.1 General Objective:

To assess the outcome of AC in pediatric surgical patients operated at TASH and MH over the past ten years.

3.2 Specific Objectives:

- ❖ To describe different indications of AC in pediatric patients
- ❖ To describe different methods of AC and type of concurrent procedure along with AC
- ❖ To assess the outcome of AC in pediatric patients
- ❖ To identify complication patterns of AC in pediatric patients

Chapter 4 : Research Methodology

4.1 Study Area and Period

The study is conducted at TASH and MH. TASH is one of the largest and oldest hospitals in Addis Ababa, Ethiopia. The hospital is a pioneer in the field of pediatric surgery service and training in the country. It is the pioneer center to start AC procedures in the country. MH is also located in Addis Ababa, Ethiopia and has been an affiliate of TASH for the last 10 years. The study is conducted from January 2024 to December 2024 by conducting medical chart review of all patients who underwent AC in the study period.

4.2. Study Design

A retrospective cross-sectional descriptive study is used to assess the outcome of patients who underwent AC in the mentioned study area and period.

4.3. Population

4.3.1 Source Population: All pediatric surgical patients who underwent elective surgery at TASH and MH.

4.3.2 Study Population: All pediatric surgical patients who underwent AC for whatever indication.

4.4 Eligibility Criteria

4.4.1 Inclusion Criteria

All pediatric surgical patient who underwent AC during the study period

4.4.2 Exclusion Criteria

Pediatric surgical patients which were found to have incomplete medical records.

4.5. Sample Size and Sampling Technique/Sampling Procedures

Since the procedure is uncommon, our study had no enough sample size. Therefore we included all pediatric surgical patients who underwent AC that fulfill our eligibility criteria.

4.6 Data Collection Procedures

A list of pediatric patient who underwent AC is obtained from the operation room logbook. Using the list, the charts is collected from the card room. Data is collected from the chart using our structured questionnaire data collection tool. Additional direct data is collected from patients via phone call. The data is collected by the researcher and colleagues under the continuous supervision of the supervisor.

4.7 Study Variables

4.7.1 Dependant Variable

- ❖ Primary Outcome : Postoperative Urinary continence rate
- ❖ Secondary Outcome :
 - ✧ Presence of postoperative complication
 - ✧ Postoperative renal function status

4.7.2 Independent Variable

1. Age
2. Sex
3. Age at operation
4. Associated anomaly (ARM, VUR, Vertebral)
5. Etiology/ Indication for AC
6. Previous lower urinary tract surgery
7. Type of AC

8. Concurrent/Additional procedure
9. Duration of follow up
10. Preoperative renal function
11. Preoperative urinary continence rate

4.8 Operational Definitions

- ❖ **Pediatric age group:** Age from birth to 13 years
- ❖ **Augmentation Cytosoplasty :** Urological reconstruction procedure comprising incorporation of reconfigured bowel segment into urine bladder with the goal of enhancing compliance and capacity.
- ❖ **Clean intermittent Catheterization :** Method of draining urine via a catheter inserted into the urethra or surgically reconstructed abdominal wall stoma.
- ❖ **Urinary continence :** Being dry during day and night on 4hr schedule of clean intermittent catheterization with out the need of pads.
- ❖ **Renal function deterioration :** Development of CKD following AC in the context of documented normal renal function . Increment of serum creatinin above normal age adjusted value.
- ❖ **Symptomatic Urinary tract infection :** History of treatment for culture positive UTI. Any positive urine culture with at least one of the following symptoms : dysuria, abdominal pain, hematuria, or fever.
- ❖ **Preoperative Investigation :** Latest investigation done immediately before operation
- ❖ **Postoperative Investigation :** Latest investigation done at last follow up.
- ❖ **Short term Complications :** Complication occurred with in 1 month postoperative.
- ❖ **Long term Complications :** Complication occurred after 1 month postoperative.

4.9 Data Quality and Management and Data Analysis

Data is collected by other trained residents. The data is checked for completeness. Any error in the data is corrected by principal investigator by going back to the data collection form used in the data collection, checking the patient record, calling the patient if necessary, or any other method to correct the information. After the data has been collected, it is coded and entered into SPSS version and analyzed.

4.10 Ethical Consideration

Ethical clearance is sought from the AAU Institutional Review Board (IRB) of the Faculty of Medicine, with cooperation letters sent to TASH's medical recording department. Health facility records is classified and kept secure. During the phone call, the patient is asked to provide informed consent. The information gathered is used solely for the purposes stated.

4.11 Limitation of the Study

Retrospective nature of the study represents a potential source of selection bias and limit generalizability. We also had a relatively small sample size. There was also a relatively short mean followup period which may have under-reported certain long-term complications. Our study also examined the outcomes of bladder augmentation at only a single tertiary center, which may limit the applicability to a broader pediatric population. Certain bladder dynamics and capacity cannot be accurately assessed because we do not conduct pre- and post-operative urodynamic studies as part of the analysis. Inconsistency in our chart records and a high percentage of insufficient documentation may also have contributed to the inaccuracy of report of short-term complications.

4.12 Dissemination Plan

The primary investigator will draft a study report. All feedback from the advisor and pediatric surgery unit will be reviewed and incorporated into the final report. The final report will be submitted to the Pediatric Surgery division and publication of the study's findings in a reputable journal will be taken into consideration.

Chapter 5 : Results

5.1 Socio-Demographics Characteristics

A total of 20 AC procedures are performed on 19 patients in the included study period (2014-2024) at TASH and MH. The follow up and other characteristics of 2 patients was not found due to lost patient medical records, so data of only 17 patient were described and listed. From the total 17 patients, 10 (59%) were boys and 7 (41%) were girls. The age of the patients at the time of operation ranged from 3 years to 15 years, with a median of 6 years. Duration of follow up was in the range of 4 month to 8 years with median of 2 years. Most of the patient (64.7%) had follow up for 2 or more years (**Table 1**).

| Table 1 : Socio-Demographics Characteristics | | | |
|---|--------------|----------------------|--------------------|
| Characteristics | | Number (n=17) | Percent (%) |
| Sex | Male | 10 | 59 |
| | Female | 7 | 41 |
| Age at Operation | <5 years | 3 | 17.6 |
| | 5-10 years | 10 | 58.9 |
| | >10 years | 4 | 23.5 |
| Duration of follow Up | < 6mon | 2 | 11.8 |
| | 6 mon-2years | 7 | 41.2 |
| | >2 years | 8 | 47.0 |

5.2 Preoperative Patient Characteristics

The most common indication or etiology for having AC was BEEC, which comprises of 12 patients (70%) followed by isolated epispadias (11.8%). Post MMC repair NB, bladder exstrophy variant (covered bladder exstrophy) and grade V VUR with small bladder capacity was other remaining indication which had each one patient. Most of the patient had ileocystoplasty (94.1%). One patient (5.9%) had ureterocystoplasty. 16 (94.1%) patients had concurrent catheterizable channel reconstruction and bladder neck closure procedures at the time of AC. Nine patients out of 17 (53%) had previous lower urinary tract surgery in the form of either bladder exstrophy repair or epispadias repair. All patient were incontinent before AC (**Table 2**).

5.3 Preoperative and Postoperative Investigation Status

All patient had abdominopelvic ultrasound (US) and laboratory investigation in the form of renal function test and serum electrolyte both in the preoperative and postoperative period. Four patient had VCUG and from this 2/17 (50%) were normal and 2/17 (50%) had VUR. Abdominal US were abnormal in 5 patients (29.4%) in the preoperative periods. Postoperatively this abnormal US study were reduced to only 4 patients (23.5%) . One patient (5.9%) had abnormal elevated serum creatinine value both in preoperative and postoperative period each but different patient. But most patients had stable or normal renal function. No significant electrolyte abnormality were found and other metabolic panels like acid base status and arterial blood gas analysis were not determined (**Table 3**).

| Table 2 : Preoperative Patient Characteristics | | | |
|---|--|----------------------|--------------------|
| Characteristics | | Number (n=17) | Percent (%) |
| Etiology or Indication | CBEEC | 12 | 70.5 |
| | Isolated Epispadias | 2 | 11.8 |
| | Grade IV VUR with small bladder capacity | 1 | 5.9 |
| | Covered exstrophy variant | 1 | 5.9 |
| | Post MMC repair NB | 1 | 5.9 |
| Types of AC | Ileocystoplasty | 16 | 94.1 |
| | Ureterocystoplasty | 1 | 5.9 |
| Concurrent Procedures | Stoma for CIC | 16 | 94.1 |
| | -Mitrofanoff Tube | 13 | 76.5 |
| | -Yange Monti Tube | 3 | 17.6 |
| | Bladder Neck Closure | 16 | 94.1 |
| | Epispadias Repair | 3 | 17.6 |
| | Ureteral Reimplantation | 3 | 17.6 |
| | MACE Procedures | 1 | 5.9 |
| Previous Surgery Status | Bladder Exstrophy Repair | 6 | 23.5 |
| | Epispadias Repair | 2 | 11.8 |
| | MMC Repair | 1 | 5.9 |
| | None | 8 | 47 |
| Preoperative Continence status | Continent | 0 | 0 |
| | Incontinent | 17 | 100 |
| Associated Anomaly status | Vertebral | 3 | 17.6 |
| | ARM | 2 | 11.8 |

Table 3 : Preoperative and Postoperative Investigation

| Characteristics | | | Preoperative | | Postoperative n=17 | |
|-----------------|------------------------|------------------|--------------|---------|-----------------------|---------|
| | | | No. n=17 | Per (%) | No. n=17 | Per (%) |
| Abdominal US | Hydronephrosi s | None | 11 | 64.7 | 13 | 76.5 |
| | | Mild to Moderate | 2 | 11.8 | 4 | 23.5 |
| | | Sever | 3 | 17.6 | 0 | 0 |
| | Paranchyma | Normal | 15 | 88.2 | 17 | 100 |
| | | Thinned out | 2 | 11.8 | 0 | 0 |
| Creatinine | Normal | | 16 | 94.1 | 16 | 94.1 |
| | Abnormal (Elevated) | | 1 | 5.9 | 1 | 5.9 |
| VCUG | Normal (No VUR) | | 2 | 11.8 | 0 | 0 |
| | Abnormal (VUR Present) | | 2 | 11.8 | 0 | 0 |
| | Not done | | 13 | 76.4 | 17 | 100 |

5.4 Postoperative Outcome and Complication Status

Postoperatively continence status was assessed at the surgical referral clinic and phone call made for those patients information was not documented at follow up visit. Status of 2 (11.8%) patient was not known because it was not documented on the chart and phone call was not available. From the total patients, 12 (70.6%) were continent. Three (17.6%) patients are incontinent and are currently waiting for next plan of intervention. Renal function of most of the patients were stable and there is only one documented increment in the serum creatinine level (**Table 3**).

Complication were documented and assessed based on timing of presentation. The most complication in immediate postoperative period were wound infection which occurred in 58.8% (10/17), followed by symptomatic UTIs (52.9%), urine leak from surgical site which occurred in 5 patients (29.4%) and stoma related complication seen in 23.5% (4/17). Three patients (17.6%) has failed augmentation cystoplasty in terms of achieving continence and they are waiting for next management. No documented reservoir perforation, intestinal obstruction, metabolic derangement, malignancy and death found (**Table 4**).

| Table 4 : Postoperative Outcome and Complication Status | | | | |
|--|-------------------------|----------------------|--------------------|-------|
| Characteristics | | Number (n=17) | Percent (%) | |
| Continence Status | Continent | 12 | 70.6 | |
| | Incontinent | 3 | 17.6 | |
| | Unknown Status | 2 | 11.8 | |
| Complication profile | Wound Infection | 10 | 58.9 | |
| | Urine Leak | 5 | 29.4% | |
| | Vesicocutaneous Fistula | | | |
| | Symptomatic UTI | 9 | 52.9 | |
| | Intestinal Obstruction | 0 | 0 | |
| | Reservoir Perforation | 0 | 0 | |
| | Stoma Complication | 4 | 23.5 | |
| | Metabolic Complication | 0 | 0 | |
| | Bladder Stone | 2 | 11.8 | |
| | Malignancy | 0 | 0 | |
| | Failed Augmentation | 3 | 17.6 | |
| | Death | 0 | 0 | |
| | Need of second surgery | Redo AC | 1 | 5.9 % |
| | | Stoma Refashioning | 2 | 11.8 |
| Bladder stone removal | | 1 | 5.9% | |

Chapter 6 : Discussion

This institutional based descriptive study tried to assess indication, different methods, type of concurrent procedures, outcome and complication profile of AC. Study evaluate diverse complication profile and renal outcome. We tried to compare our result from this study to the preexisting body of literature.

Our study found that a total of 20 procedure done on the 19 patients. Medical record of 2 patient were lost, so study was conducted on 17 patients only. The age at surgery was in the range of 3 years to 15 years, with median age of 6 years. 59% (10/17) were boys and 41%(7/17) were girls. Median of follow up was 2 years. Obermayr F study reported 19 AC procedures with median of age at operation with 7.2 years and median follow up of 5.5 years. [11] Athawale HR et al. mentioned similar sex and age of participant with 46.7% of patient are male and 53.3% are female and mean age at operation of 7 years and mean follow of 4 years . [13] Ross JPJ et al. study in Canada had 54 patients and 28 (51%) were boy and 26 (49%) were girls. [2]

AC is the procedure used to increase the capacity and compliance of dysfunctional bladder after exhausting medical management. Report from Ross JPJ et al. showed most common indication were NB (59.3%), followed by BEEC (16.7%) and PUV (7.4%). [2] Most other study also found NB as the most common indication to have AC (30-66.7%), followed by BEEC (15-30%) and PUV (7-23%). [3, 10, 11, 13,14,17,23]. In our study the most common indication to have AC was BEEC, which occurred in 12/17 (70%), followed by isolated epispadias in 2/17 (11.8%). Post MMC repair NB, bladder exstrophy variant (covered bladder exstrophy) and grade V VUR with small bladder capacity was the remaining indication which had 1/17 patient (5.9% each). This showed that our patients are a bit different from most reported series.

AC usually performed using a variety of gastrointestinal segments. Ross JPJ et al. study found 87.5% had ileocystoplasty, followed by Ileo-colocystoplasty and gastrocystoplasty in 3.6% each. [2] Another series by Taghavi K et al. showed that ileocystoplasty performed in 58% and ureterocystoplasty done in 30% of patients. [10] Most other series reported the most common tissue used were ileum followed by sigmoid colon or gastric segments. [11, 13, 15,16,17]. Report from our patients series revealed 16/17 (94.1%) patients had ileocystoplasty. Only 1/17 (5.9%) patient had ureterocystoplasty.

Patient having AC usually undergo simultaneous or concurrent procedure that may be mandatory or important to achieve goal of AC. Most of the patient also had previous lower urinary or spinal surgery, especially patient with BEEC and MMC. 16/17 (94.1%) of our patients had concurrent catheterizable channel reconstruction [13/17 (76%) were mitrofanoff and 3/17 (17.6%) were yang monti tube] and bladder neck closure procedures. 9/17 (53%) had previous lower urinary tract surgery in the form of either bladder exstrophy repair or epispadias repair.

84% of Obermayr F et al. group of patients had concurrent catheterizable channel reconstruction. [11] Mehmood S et al. also reported 50% of their patient had previous lower urinary or spinal surgery before having AC, a finding similar to our patients. 50% of patients also had concurrent procedure in the form of bladder neck closure, continent catheterizable channel or urteral reimplantation which is lower than our series. [3] Only 40.7% of patients had concurrent procedure in Ross JPJ and co. study, most common were ureteric re implantation which is lower than our findings [2]. Another series also reported 43.3% of patients had concurrent bladder neck division which is lower than our series. 6.7% had urteral reimplantation. [13]

Mehmood S and co also had all of their patient with varying degree of incontinence. [3]. Similarly all of patient were incontinent before AC. This study revealed 5/17 (29.4%) patients had abnormal abdominal US result in the preoperative period (hydronephrosis and/or thinned out cortex). Only 1/17 (5.9%) had elevated serum creatinin in both preoperative and postoperative period. That mean most of our patient had stable or normal renal function.

Patient having AC with enteric segment are at risk of varying metabolic problems due to the absorptive property of the intestinal mucosa. Patient having iliocystoplasty are at risk of hyperchloremic metabolic acidosis. [1] Mehmood S and et al study found no significant electrolyte and metabolic abnormality in their 12 years of follow up, so as Chang JW et al. [3, 15] Similarly no significant electrolyte abnormality or metabolic derangement were found in our study and other metabolic panels like acid base status and arterial blood gas analysis were not determined. In contradictory to this Nurse DE et al. found higher rate of metabolic abnormality (33%). [22] Ross JPJ and co reported 5.6% rate of metabolic abnormality especially hyperchloremic metabolic acidosis.

After having AC, most series reported 80-100% of patient had improvement or stabilization of renal function. [3,7,11,13] Renal function of most of our patients were stable and there is only one documented increment in the serum creatinine level. Some study found renal deterioration rate of 4.5-9.5% after having AC. [2,3]

Urinary continence is one of the major measuring tool for success of AC. Most study reported 81- 95% rate of acceptable social continence after AC. [3, 11,15] Study by Athawale HR et al. found a higher rate of relative continence in which 97% of patient were continent. [13] From the total patients, 12 (70.6%) were continent. Three (17.6%) patients are incontinent and are currently waiting for next plan of intervention. Status of 2 (11.8%) of our patient was not known because it was not documented on the chart and phone call was not available.

Despite its invaluable use in protecting upper urinary tract and achieving continence, AC is not free of major complication. [1] The most common immediate complication are wound infection and urine leak or formation of vesicocutaneous fistula. Taghavi K series documented wound infection rate of 4% and perioperative urine leak of 13%. [10] Our series marked that wound infection occurred in 10/17 (58.8%) patient. Urine leak from surgical site seen in 5 of our patients (29.4%). But all were minor and resolved with wound care and prolonged supra pubic drain. Finding contradict Ross JPJ et al. report of wound infection rate of only 5.6%. [2] Another study reported lower rate of vesicocutaneous fistula (4.5-6.7%). [13,15]

UTIs are also common in the early postoperative periods. But most were asymptomatic bacteruria and predominate in those performing CIC. Symptomatic UTIs are also possible to occur after AC [1] 68.5% of patients experienced at least one episode of symptomatic UTI in Ross JPJ et al. report. [2] Taghavi K et al. also reported 51% rate of symptomatic UTIs [10], which is most comparable with our series which revealed 52.9% (9/17) of symptomatic UTIs. Some series reported lower rate of symptomatic UTIs. Athawale HR et al. and Chang JW et al. had similar lower rate of symptomatic UTIs (13.3% and 13.6% respectively). [13,15]

Spontaneous voiding is less likely after having AC, so most will undergo reconstruction of catheterizable abdominal wall stoma. Stoma related complication is the most common cause of morbidity and repeat operation. [1] 46.4% of Ross JPJ et al. study patients had stoma related problem, most of which is stenosis. [2] Taghavi K et al. also reported 50% rate of stoma stenosis

in which most need revisions or dilatational intervention. [10] Our study also showed stoma related complication seen in 4/17 (23.5%), which is relatively less than most reported series. Another report by Obermayr F et al. had 29% rate of stoma related complication, which is comparable to our finding. [11]

Bladder stone formation is another worth mention complication of AC. Most cause are related to recurrent UTI and stasis of urine. [1] Chang JW et al. and Kispal Z et al had higher rate of bladder stone in their series (22% and 23% respectively), which is higher than most reports. [15, 9] Most published reports mentioned rate of bladder stone after AC in the range of 5-25%. [2,3,4,10,13,16,17]. Two patients (11.8%) from our study developed bladder stone. One had open cystolithotomy and removal of bladder stone but stone were small and spontaneously disappeared in the other one.

Bladder perforations following AC is a serious and life threatening complication that can cause sepsis peritonitis and death. [1] The exact cause is unknown and there are several speculation including traumatic catheterization , in ability to catheterize abdominal wall stoma, chronic UTI and ischemic necrosis due to distension of the augmented bladder. [18] Study by Guven A et al. and DeFoor W et al. found rate of 8.6% and 5% respectively. [18, 19] Most other series also mentioned similar incidence in the range of 3.6-13%. [2,4,9,10,15]. None of our patient had bladder perforations. Like wise Mehmood S et al. study also found no case of bladder perforation. [3]

Intestinal obstruction is another dreadful complication after entropasty procedure. [1] Shekarriz B and his colleagues reported intestinal obstruction in in 4.5% patients. [4] Athawale HR et al. had 6.7% of adhesive intestinal obstruction. [13] Kispal Z et al reported 9% risk of intestinal obstruction in the early postoperative periods. [9] We didn't find any documented case of intestinal obstruction in our series.

Malignancy after AC is a well known complication with average latent period of 20 years. Reported incidence of malignancy is 5-6% for ilioecystoplasty and 10-12% for gastrocystoplasty. [23,24] Different etiology of bladder malignancy mentioned in different series like nitrosamine and free oxygen radical production from bacteria, direct toxic effect of urine on intestinal epithelium, diversion and starvation enteritis on enteric segment and abnormal mesenchymal-

epithelial interaction at anastomosis site [24]. A systemic review by Biardeau X and co. showed incidence of malignancy was in the range of 0-5-5% from which the most common was adenocarcinoma at enterourinary anastomotic site. [6]. In contrast, Mehmood S et al. study found no case of malignancy. [3] Similarly other studies also Reported no malignancy [10,15]. Like wise our study reported no malignancy. Short duration of follow up and small number of data may be responsible for this finding.

Sometimes AC will not be achieving its goals and require subsequent repeat AC. Taghavi K et al. reported 4% rate of need of repeat AC in their series of 71 patients [10]. Our study revealed that 3/17 patient (17.6%) had failed augmentation cystoplasty in terms of achieving continence and they are waiting for next management.

Chapter 7 : Conclusion and Recommendation

Augmentation cystoplasty is an important, safe and effective procedure, with major goal of achieving continence and protecting renal deterioration. With its significant mentioned benefit, it is usually associated with potential and long term complication. Despite the controversy on the follow up schedule and choice of investigation, lifelong surveillance is recommended until standard guideline is formulated.

The variability of the patient population and outcome mandate a future well organized possibly prospective study to determine the exact outcome and complication profile of AC. Physician and any person care for patient having AC should document each and every aspect of followup information to make sure not to miss any important input.

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Chapter 9 : Annexes - Data Collection Tool

| A. Sociodemographic Data | | |
|---------------------------------|---|--|
| No | Variables | Response |
| 1 | Name | |
| 2 | Card No (MRN) | |
| 3 | Age | _____ Years |
| 4 | Sex | <input type="checkbox"/> Male <input type="checkbox"/> Female |
| 5 | Phone No | |
| 6 | Address | <input type="checkbox"/> Urban <input type="checkbox"/> Rural |
| 7 | Age at Operation | <input type="checkbox"/> <5 Years <input type="checkbox"/> 5-9 Years <input type="checkbox"/> >10 Years |
| 8 | Duration of Follow Up | _____ Years |
| B. Preoperative Data | | |
| 1 | Etiology (Indication) | <input type="checkbox"/> Neurogenic Bladder <input type="checkbox"/> Post MMC <input type="checkbox"/> Post ARM repair <input type="checkbox"/> Sacral Agenesis <input type="checkbox"/> Trauma <input type="checkbox"/> Other Specify <input type="checkbox"/> BEEC <input type="checkbox"/> Isolated Epispadias <input type="checkbox"/> PUV <input type="checkbox"/> Other Specify |
| 2 | Types of Augmentation Cystoplasty the child had | <input type="checkbox"/> Ileocystoplasty <input type="checkbox"/> Sigmoid cystoplasty <input type="checkbox"/> Gastrocystoplasty <input type="checkbox"/> Ureterocystoplasty <input type="checkbox"/> Combined |

| | | |
|---|--------------------------------------|--|
| 3 | Previous Lower urinary tract surgery | <input type="checkbox"/> Ureteric Re Implantation <input type="checkbox"/> Epispadias Repair <input type="checkbox"/> Mitrofanoff Procedure <input type="checkbox"/> Yang-Monti's Tube <input type="checkbox"/> Augmentation Cystoplasty <input type="checkbox"/> Other Specify |
| 3 | Additional or Concurrent Procedure | <input type="checkbox"/> Bladder Neck Closure <input type="checkbox"/> Bladder Neck Reconstruction <input type="checkbox"/> Ureteric Re implantation <input type="checkbox"/> Mitrofanoff Procedure <input type="checkbox"/> Yang-Monti's Tube <input type="checkbox"/> Re-do Augmentation Cystoplasty <input type="checkbox"/> Other Specify |
| 4 | Associated Anomaly | <input type="checkbox"/> Vesicouretral Reflux (VUR) <input type="checkbox"/> Anorectal Malformation (ARM) <input type="checkbox"/> Vertebral Anomaly <input type="checkbox"/> Other Specify |
| 5 | Preoperative Urinary Continence | <input type="checkbox"/> Continent at day and night <input type="checkbox"/> Continent at day time only <input type="checkbox"/> Incontinent |
| 6 | Preoperative Investigation | <input type="checkbox"/> Abdominal US <input type="checkbox"/> Degree of Hydronephrosis_____ <input type="checkbox"/> Paranchymal Thickness_____ <input type="checkbox"/> AP diameter of pelvis_____ <input type="checkbox"/> RFT <input type="checkbox"/> Serum Creatinin_____ <input type="checkbox"/> BUN/Urea_____ <input type="checkbox"/> Serum Electrolyte <input type="checkbox"/> Potassium_____ <input type="checkbox"/> Chloride_____ <input type="checkbox"/> Calcium_____ <input type="checkbox"/> Sodium_____ |

| | | |
|--|--|--|
| | | <input type="checkbox"/> Voiding Cystourethrography (VCUG) <ul style="list-style-type: none"> <input type="checkbox"/> Degree of Vesicouretral Reflux _____ <input type="checkbox"/> Ectopic Ureter _____ <input type="checkbox"/> Other finding _____ <input type="checkbox"/> Intravenous Pyelography (IVP) <ul style="list-style-type: none"> <input type="checkbox"/> Degree of Hydronephrosis _____ <input type="checkbox"/> Ectopic ureter _____ <input type="checkbox"/> Other Finding _____ <input type="checkbox"/> Computed Tomography <ul style="list-style-type: none"> <input type="checkbox"/> Degree of Hydronephrosis _____ <input type="checkbox"/> Ectopic ureter _____ <input type="checkbox"/> Duplex system _____ <input type="checkbox"/> Other Finding _____ <input type="checkbox"/> Other investigation Specify _____ |
|--|--|--|

C. Postoperative Data

| | | |
|---|----------------------------------|---|
| 7 | Method of Performing CIC | <input type="checkbox"/> Mitrofanoff Procedure <input type="checkbox"/> Yang-Monti's Tube <input type="checkbox"/> Transurethral <input type="checkbox"/> Not doing CIC |
| 8 | Interval of performing CIC | <input type="checkbox"/> Every 1-2 hr <input type="checkbox"/> Every 3-4 hr <input type="checkbox"/> Every 6 hr <input type="checkbox"/> Twice a day <input type="checkbox"/> Daily <input type="checkbox"/> Not doing CIC |
| 9 | Postoperative Urinary Continence | <input type="checkbox"/> Continent day and night <input type="checkbox"/> Continent at day time only <input type="checkbox"/> Incontinent |

| | | |
|----|---|---|
| 10 | Postoperative Investigation | <input type="checkbox"/> Abdominal US <input type="checkbox"/> Degree of Hydronephrosis _____ <input type="checkbox"/> Paranchymal Thickness _____ <input type="checkbox"/> AP diameter of pelvis _____ <input type="checkbox"/> RFT <input type="checkbox"/> Serum Creatinin _____ <input type="checkbox"/> BUN/Urea _____ <input type="checkbox"/> Serum Electrolyte <input type="checkbox"/> Potassium _____ <input type="checkbox"/> Chloride _____ <input type="checkbox"/> Calcium _____ <input type="checkbox"/> Sodium _____ <input type="checkbox"/> Voiding Cystourethrography (VCUG) <input type="checkbox"/> Degree of Vesicouretral Reflux _____ <input type="checkbox"/> Ectopic Ureter _____ <input type="checkbox"/> Other finding _____ <input type="checkbox"/> Intravenous Pyelography (IVP) <input type="checkbox"/> Degree of Hydronephrosis _____ <input type="checkbox"/> Ectopic ureter _____ <input type="checkbox"/> Duplex system _____ <input type="checkbox"/> Other Finding _____ <input type="checkbox"/> Computed Tomography <input type="checkbox"/> Degree of Hydronephrosis _____ <input type="checkbox"/> Ectopic ureter _____ <input type="checkbox"/> Other Finding _____ <input type="checkbox"/> Other investigation Specify _____ |
| 11 | Postoperative Complication Early complication | <input type="checkbox"/> Wound Infection <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Peri-operative urine leak or Vesicocutaneous fistula <input type="checkbox"/> Yes <input type="checkbox"/> No |

| | | |
|----|--|---|
| | | <input type="checkbox"/> Intestinal Obstruction <ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Symptomatic UTIs <ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Reservoir Perforation <ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Stoma Related Complication (Stenosis, Prolapse, Difficulty) <ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Metabolic Complication <ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> No |
| 12 | Postoperative Complication Late Complication | <input type="checkbox"/> Intestinal Obstruction <ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Bladder Stone <ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Symptomatic UTIs <ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Reservoir Perforation <ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Stoma Related Complication (Stenosis, Prolapse, Difficulty) <ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> No |

| | | |
|--|--|---|
| | | <ul style="list-style-type: none"><input type="checkbox"/> Metabolic Complication<ul style="list-style-type: none"><input type="checkbox"/> Yes<input type="checkbox"/> No<input type="checkbox"/> Malignancy<ul style="list-style-type: none"><input type="checkbox"/> Yes<input type="checkbox"/> No<input type="checkbox"/> Failed Augmentation<ul style="list-style-type: none"><input type="checkbox"/> Yes<input type="checkbox"/> No<input type="checkbox"/> Death<ul style="list-style-type: none"><input type="checkbox"/> Yes<input type="checkbox"/> No |
|--|--|---|