

# **USES OF INTESTINES IN UROLOGY - OUR INSTITUTE EXPERIENCE**

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# **INTRODUCTION**

Bowel is frequently used in reconstructive urology for bladder augmentation, bladder replacement , as ureteral substitutes. Less commonly intestines may be used as urethral or vaginal substitutes(1). Our institute is a 25 years old urological service institute having vast experience in all open surgeries, endo urology and laparoscopic procedures having two units with experienced teachers.

We frequently encounter lot of patients with genito urinary tuberculosis and carcinoma bladder. Many of the patients with extrophy epispadias complex patients presenting late are also managed effectively. I study through my dissertation work how we select, plan, and use intestines to augment, replace, substitute bladder and the early complications we faced. Comparing small intestine and large intestines also studied.

## **HISTORICAL REVIEW**

Augmentation cystoplasty

Ileocaecocystoplasty- open Mainz, Lebag, Indiana pouch

Colocystoplasty – intact or open

Ileocystoplasty- open: tasker patch, Goodwin cup, hemikoch

Substitution

First urinary diversion into a segment of bowel – Simon 1852.

Ureterosigmoidostomy in an exstrophy bladder patient.

Ileal conduit – popularized by Bricker since 1950. Established and reliable type of urinary diversion. In 1990s remained “gold standard”.

Lemoine ( 1913) – performed first orthotopic reconstruction in a patient.

Pioneering work of Camey and Le Duc ( 1979 ) with orthotopic diversion.

Laparoscopic surgery – Puppo 1995, Simonato, Gill 2002.

## **AIMS OF THE STUDY**

To analyse various procedures done using intestines.

To analyse immediate and early complications.

To compare the various types of intestinal complications

To compare the results

To analyse the problems that can be rectified

# REVIEW OF THE LITERATURE

Commonly used segments are ileum, colon and the rectum. Jejunum is not used because of severe electrolyte abnormalities. Thorough knowledge of surgical anatomy of these segments are very important.

## **Small Intestine (Jejunum And Ileum)**

Total length of jejunum and ileum varies between 15 to 22 feet.  $\frac{2}{5}^{\text{th}}$  is jejunum and  $\frac{3}{5}^{\text{th}}$  is ileum. The wall of the jejunum is thick and double and the ileal wall is thin and single.(2) Blood supply is superior mesenteric artery with its jejunal and ileal branches. Arterial arcades are multiple in ileum. Ileal mesentery is thick. Upto 8 cms of ileum lateral to straight vessel from arcade can survive, practically. The last 2 inches of the terminal ileum and 5 feet of small bowel beginning 6 feet from the ligament of Treitz may be exposed to pelvic irradiation.

## **Colon**

Proximal to distal - caecum, ascending colon, transverse colon, descending or left colon and sigmoid colon. Rectum is also used. The major arteries supplying the colon are ileocolic, right colic, middle colic, all from superior mesenteric artery and left colic, sigmoid vessels from inferior mesenteric artery. Superior, middle and inferior haemorrhoidal arteries supply, the rectum. Sudeck's critical point and other meeting

points of vessels must be kept in mind while anastomosis of intestine.

The mobilization of colon must be learnt thoroughly.

### **How To Select The Segment Of Intestine**

Ileum and colon usage will have bacteriuria upto 60 to 80 %. Jejunum is not used routinely because of severe electrolyte disturbance. Ileum is mobile, with small diameter and constant blood supply. Used as ureteral replacements and in conduits. Disadvantages are : loss of ileum may produce B12 deficiency and diarrhea due to bile salt malabsorption. Fat malabsorption can occur. Post operative bowel obstruction occurs in 10%.

Colon has larger diameter and can easily mobilized. Tunnel making is easy in uretero colonic Anastomosis. Fewer nutritional problems if ileocaecal valve is preserved. Post op bowel obstruction occurs in 4%.

### **Bowel Preparation**

Mechanical preparation of bowel collapses the bowel and decreases the incidence of anastomotic dehiscence. When no preparation is done, increase incidences of wound infection, intraperitoneal abscess, and anastomotic leak are seen.

## **Bowel Preparation**

### **Two types: mechanical and antibiotic**

Conventional three days preparation with liquid diet and sodium phosphate liquid just one day prior to surgery at 6hrs interval. Contraindicated in renal insufficiency, hyperphosphatemia, and hypocalcemia. Polyethylene glycol is also used for mechanical preparation 1 to 1.5 liters /hr for 3 hrs or 25ml/kg/hr x2 for children. Iv fluids containing electrolytes such as RL are given to compensate electrolyte loss.

Antibiotic preparation decreases the postop complications. Oral kanamycin or neomycin and erythromycin or neomycin and metronidazole started 3 days prior to surgery. IV third generation cephalosporin is given 1 to 2 hrs before surgery. Disadvantages are diarrhea due to pseudomembranous colitis. Monilial infection causing oral thrush, stomatitis. Malabsorption of proteins, fat, carbohydrate. Tumour implantation at the sutured sites may be a possibility.

### **Principles Of Intestinal Anastomosis(Cushieri et al)**

Adequate exposure

Maintain good blood supply

Prevention of local spillage

Accurate serosa to serosa opposition

Don't tie sutures too tight

Realignment of the mesentery after entero enteral anastomosis

**Types of anastomosis - intestinal A.open B. laparoscopic**

1. Using sutures

2. Using staples

a.two layer suture anastomosis- all layers absorbable and seromuscular

silk

b.single layer suture anastomosis – especially in colon

c. end to side ileo colic

d. stapler- TA, Circular

post operative care

nil oral for two to four days,

iv nutrition if electrolyte loss and malnutrition suspected,

nasogastric tube, H2 blockers.

**Complications of intestinal Anastomosis.**

1.leak , 2.fistula(4 to 5% faecal ), 3.sepsis, 4.wound infection( 5% morbid), 5. Haemorrhage, 6. Anastomotic stenosis, 7. Pseudo obstruction of colon-Ogilvie syn 8. Intestinal obstruction ( small intestine 10%, large intestine 5%). Most common cause of intestinal obstruction is adhesions, second reason is recurrent carcinoma. Isolated segment may get elongated or stricture formation may occur.



## **Abdominal stomas**

End stoma- 1.nipple or rose bud stoma 2.flush stoma

Loop end stoma

## **Complications of stomas**

1.bowel necrosis 2.bleeding ( varices may be a cause) 3.dermatitis – proper collecting device and acidification of urine important for prevention 4. Parostomal hernia 5. Prolapse 6. Obstruction 7.stomal retraction 8. Stomal stenosis ( ileal conduits 20 to 25%, colon conduits 10 to 20 %) Laparoscopic approaches to radical cystectomy and augmentation cystoplasty described by many .( Gill et al 2000).

**Uretero intestinal anastomosis** - To the ileum or colon -

Refluxing or non refluxing

Lack of ureteric motility , infection, stones, and obstruction at the uretero intestinal anastomosis site may cause deterioration of upper tract.

Deterioration of upper tract occurs 80% in refluxing and 20% of nonrefluxing uretero intestinal anastomosis.

## **Principles of uretero intestinal anastomosis.**

1. Only as much ureter as needed should be mobilized
2. Mobilization should not strip the ureter of its periadventitial tissue.
3. Fine absorbable suture material and watertight mucosa to mucosa anastomosis.
4. Bowel should be brought to ureter and not vice-versa.

5. Bowel should be fixed to abdominal cavity if possible anastomosis should be retroperitonealised.

### **Complications of uretero intestinal anastomosis**

Stricture - due to ischemia, urine leak, radiation, infection.

Urine leak – can be minimized if soft sialastic stents are used.

### **Uretero colonic anastomosis**

1. Combined technique of Leadbetter and Clarke
2. Transcolonic technique of Goodwin
3. Strickler technique
4. Pagano technique
5. Cordonnier and Nesbit technique
6. Nesbit and Coffey technique

### **Ureter small bowel anastomosis**

**A.Bricker anastomosis** – refluxing , end to side simple ,with low complication rate. (Bricker 1950). Full thickness of ureter with mucosa of small intestine with interrupted or continuous absorbable fine suture material. Adventitia of ureter is sutured to serosa of bowel. Stricture rate - 4 to 22%, average 6% Leak rate- 3%.

**B.wallace anastomosis:** Three types.

1.end of one ureter is sutured to the end of the other ureter, and this composite Anastomosis is sutured to the end of the bowel.

2. A Y anastomosis of the ureters is constructed, which is sutured to the end of the bowel.

3. a head to tail uretero ureteral anastomosis is formed which is then sutured to the end of bowel.

C. Tunneled small intestinal anastomosis- a small transverse incision in the small intestine, and a second transverse incision 3 cm lateral to first incision is made. Submucosal is created. A button of mucosa is removed, ureter is drawn through the tunnel and sutured directly to the mucosa.

Adventitia of ureter is sutured to the serosa of small intestine.

D. Split Nipple technique(Griffith) - the ureter is spatulated and turned back on. Created nipple protrudes into the small intestine button hole and adventitia is sutured to all the layers of small intestine.

E. Le Duc technique- ureter is laid onto the interior of the bowel wall, forming submucosal tunnel when reepitheliasation occurs.

F. Hammock anastomosis- small intestine is closed at its proximal end and three 10cms longitudinal incisions separated by 1 to 2mm are made through the seromuscular layer to the mucosa. The incisions are crosshatched by multiple incisions. This acts as a hammock. The ureters are anastomosed as in Wallace technique.

G. uretero intestinal anastomosis – using serosal compression of the extramural ureter as an antireflux technique( Abol-Enein , Ghoneim 2001).

## **Intestinal Antireflux Valves**

Intussuscepted ileocaecal valve

Intussuscepted ileal valve

Nipple valve

## **Complications of Uretero Intestinal Anastomosis**

Leakage /Fistula

Stricture

Reflux

Pyelonephritis

1.urinary fistula- occurs within first 7 to 10 days postoperative period.

Incidence -3 to 9%. Leak can be reduced by soft silastic stents.

2.ureteric stricture – anti reflux procedures show increased incidence. In left ureter, where crosses over the aorta beneath the inferior mesenteric artery. Reason- too aggressive stripping of adventitia and angulation of the ureter at the inferior mesenteric artery. Correction by endo procedures have success rate 50 to 60%.

3.Renal deterioration – 18% in ileal conduits , 13% in colon conduits.

## **Urinary Diversion**

Conduits diversion – fundamentally using small intestine-ileum, large intestine.

Indications – whenever need for urinary diversion arises as in

1.after cystectomy.

2. because of diseased bladder.
3. before transplantation in a patient whose bladder can not receive transplant bladder.
4. dysfunctional bladders that result in persistent bleeding, obstructed ureters, poor Compliance with upper tract deterioration, inadequate storage with total urinary incontinence.

### **Ileal Conduit**

Simplest , fewest intraoperative and immediate post operative complications. Contraindicated in short bowel syndrome, inflammatory bowel disease, ileum received irradiation.

### **Procedure- Ileal Conduit**

A segment of 10 to 15 cms in length , 10 to 15 cms from ileocaecal valve is selected. The caecum, ileum fixed to the retroperitoneum is mobilized. The major arterial arcade and corresponding segment is selected. The peritoneum overlying both sides of the mesentery from bowel to the base of the mesentery is incised. Vessels ligated preserving blood supply to the isolated segment. The isolated segment is placed caudad, and an ileoileostomy is performed . Mesenteric window is closed with fine silk sutures. The isolated segment is flushed with saline, ureters are mobilized and brought near the segment for anastomosis. Right ureter by caecal mobilization and left ureter is brought over great vessels and beneath the sigmoid mesentery. Uretero ileal anastomosis is performed.

## **Complications**

Urine leak, bowel leak, sepsis, acute pyelonephritis, wound infection, wound dehiscence, GI bleed, Abscess, prolonged ileus, conduit bleed, intestinal obstruction, ureteral obstruction, parastomal hernia, stomal stenosis, stone formation, excessive conduit length, metabolic acidosis, conduit infection, volvulus, conduit stenosis, conduit-enteric fistula.

## **Colon Conduit**

Basically three types: ileo caecal, transverse colon, sigmoid. Ileo caecal conduit is based on the terminal branches of the superior mesenteric artery – ileo caecal artery. The segment is placed caudad and an ileo ascending colon anastomosis is performed. Sigmoid colon is mobilized by incising its peritoneal attachments and the line of Toldt along the descending colon. The isolated segment is placed lateral to the sigmoid.

## **Complications of Ileocaecal Conduit**

Urine leak , bowel leak , GI bleed, wound dehiscence, acute pyelonephritis, bowel obstruction, stomal prolapse, parastomal hernia, stomal stenosis, stones, faecal fistula.

Rare complications are acute renal failure, fulminant hepatitis, pneumonia, gastrointestinal bleeding.

## **Metabolic and Neuromechanical Problems of Urinary Diversion**

### **Using Intestines**

1. METABOLIC
2. NEUROMECHANICAL
3. TECHNICAL –SURGICAL

Metabolic complications are electrolyte abnormalities, altered sensorium, abnormal drug metabolism, osteomalacia, growth retardation, persistent and recurrent infection, renal and reservoir calculi formation,

problems due to removal of portions of gut, development of urothelial and intestinal ca. altered solute absorption across intestinal segment produces complications. Important factors influencing solute absorption and type of absorption are: type of segment of bowel used, the surface area, the amount of time the urine is exposed to bowel.

### **Electrolyte abnormalities:**

Segments used	abnormalities
1.stomach	hypochloremic metabolic alkalosis

2. jejunum

hypochloremic

hyperkalemic metabolic

acidosis

3. ileum

hyperchloremic metabolic

acidosis

Other electrolyte abnormalities are Hypokalemia, hypomagnesemia, hypocalcemia, hyperammonemia, increased blood urea and creatinine. Stomach – hypochloremic metabolic alkalosis manifests as lethargy, respiratory insufficiency, seizures, and ventricular arrhythmias. Serum gastrin correlates with bicarbonate levels in blood-sigmoid relationship. More than 120 ng/L of gastrin, alkalosis develops. Dehydration and stretch of stomach used will increase the gastrin level. **Jejunum** – proximal – hyponatremia, hypochloremia, hyperkalemia, azotemia, and acidosis. Mechanism – increased secretion of sodium and chloride with increased reabsorption of potassium and hydrogen ions. Water is also lost with NaCl, causing dehydration. Symptoms are lethargy, nausea, vomiting dehydration, muscle weakness, and fever. More proximal the segment used, more severe the symptoms. Treatment is rehydrate with normal saline and acidosis with bicarbonate. Diuretic for hyperkalemia.

**Ileum and colon** – hyperchloremic metabolic acidosis Acidosis is mild degree. In ileal conduits, acidosis is severe. Electrolytes disturbances are



mild. Using ileocaecal segment or caecum and ascending colon, serum chloride is high and bicarbonate is low. In Mainz pouch, alkali therapy is needed to maintain normal acid-base balance. Symptoms are lethargy, fatigability, anorexia, weight loss, polydipsia. Mechanism for hyperchloremic metabolic acidosis is due to the ionized transport of ammonium. Ammonium substitutes for sodium in the  $\text{Na}^+ - \text{H}^+$  transport mechanism. Ammonium chloride is exchanged for carbonic acid. Other pathway is ammonium entering through  $\text{K}^+$  channels. The treatment of hyperchloremic metabolic acidosis is - alkalinize urine with oral bicarbonate. Disadvantage is intestinal gas formation. Other measures are sodium citrate and citric acid solution or potassium citrate, sodium citrate and citric acid solution usage. For persistent hyperchloremic acidosis, chlorpromazine or nicotinic acid inhibiting cyclic adenosine monophosphate and chloride transport can be used. Microscopic changes in intestinal mucosa Long term exposure to urine causes villous atrophy and pseudocrypts in ileum. To begin with changes are patchy. In colon, goblet cells size is decreased and transport mechanism may be altered. Decreased number of transporters are noted.

### **Altered Sensorium**

Reasons : ammonium intoxication, drugs, hypomagnesemia  
Hypomagnesemia – nutritional or renal wasting is the cause. Ammonia metabolism alteration is the commonest cause. Cirrhosis and hepatic

dysfunction aggravate. Treatment is draining of urinary intestinal diversion with Foley catheter, neomycin oral, oral lactulose, no protein diet. Arginine glutamate 50 gm in one litre of 5% dextrose iv combines with ammonia and glutamine is formed.

### **Osteomalacia**

Causes : acidosis , excess hydrogen ions are buffered by the bone with calcium exchange. Late stages vitamin D resistance will occur. Increase calcium loss is another reason. Symptoms: lethargy, joint pain, proximal myopathy.

### **Growth and Development**

Diversion has a detrimental effect on growth and development. Long term urinary diversion pts are more susceptible to fractures.

### **Infection**

Intestines for urinary diversion increase infection. Upper tract deterioration following infection with proteus and pseudomonas. Intestine is incapable of inhibiting bacterial proliferation, when compared with urothelium.

### **Stones**

Common composition : calcium, magnesium, and ammonium phosphate. Hyperchloremic metabolic acidosis, preexisting pyelonephritis, urinary tract infection patients are more susceptible. Ileal conduit patients are highly susceptible than colon conduits. Predisposing

causes: staples, nonabsorbable suture materials, alteration in bowel mucosa, with infection, mucus acting as nidus.

### **Nutritional Problems**

Ileum loss - B12 deficiency, malabsorption of bile salts. Ileo caecal valve loss- nutritional deficiency due to small intestinal bacterial overgrowth, mainly fat and bile salts malabsorption. Transit time is shortened leading to malabsorption. Jejunum loss- malabsorption of fat, calcium and folic acid. Colon loss – diarrhea due to fluid and electrolyte malabsorption. Bicarbonate loss is more with water loss. Major portion of intestinal loss – short bowel syndromes, diarrhea, nutritional losses.

**Carcinoma** - Common in ureterosigmoidostomy

Types : adenocarcinoma, transitional cell ca, adenomatous polyps, sarcomas. Cell of origin, transitional cell or intestinal cell is unclear. If the urothelium is left in contact with the intestinal mucosa, even after defunctionalized diversion, adenoca may still develop. Cancer incidence is very high, when both urine and motion are mixed in a common chamber, because of nitrosamines. Example uretero sigmoidostomy.

Periodic colonoscopy is mandatory.

Neuromechanical aspects of intestinal segments

## **Physics**

### **Volume - Pressure**

Depends on the configuration of bowel. The greater the ratio of length to diameter, the greater the volume change when the ends are closed. If the ends are closed when a ratio of 1: 3.5 diameter to length is reached, splitting the segment no longer increases the volume. By splitting most segments, volume is increased by 50%. The goal is to achieve spherical storage reservoir. Sphere has the most volume for least surface area. If the segments are frequently filled, the volume capacity of segments increase.

### **Motor Activity**

Detubularisation of the intestines on its antimesenteric border and reconfiguring will interfere coordinated peristalsis. Becomes adynamic. After three months, coordinated activity returns normal. In general reconfiguration increases volume, long term effect on motor activity and wall tension are unclear.

### **Cutaneous Continent Urinary Diversion**

Most acceptable form of urinary diversion next to orthotopic neobladder. Effective antireflux and continent mechanisms available. Ability to self catheterize is essential. Patients must be assessed for their ability to self care. Patients with neurological illnesses eg. Quadriplegia and very ill patients are poor candidates for continent diversion. Stoma

site selection Stoma site must be free from fat crease, in standing and sitting posture. It should not be close to abdominal scars eg. Umbilicus, operated scars. Should not be close to bony prominences. Usually along the spino umbilical line. Surgeon doing continent urinary diversion should be familiar with more than one type of diversion procedure.

## **CONTINENT NONORTHOTOPIC URINARY DIVERSION**

**1. Variations of ureterosigmoidostomy-** ileo caecal sigmoidostomy, rectal bladder, sigmoid hemi kock operation, sigma rectum pouch-mainz II . Urine is excreted by evacuation.

2. Continent urinary diversions requiring clean intermittent catheterization.

**A. For right colon pouches,** appendiceal techniques, pseudoappendiceal tubes from ileum or right colon or ileo caecal valve plication. Penn pouch –using appendix

**B. Right colon pouches** with tapered ileum and/ or imbricated terminal ileum and ileo caecal valve. Indiana pouch

**C. Intussuscepted nipple valve** or flap valve without intussusception.

Nipple valve complications high. T pouch uses flap valve

**D. Hydraulic valve-** Benckroun nipple Using appendix – insitu appendix or transposed appendix tunneled into the taenia of caecum .  
drawbacks: 1.appendix may be unavailable, 2. Short appendix  
3.appendiceal mechanisms allows only small catheters. Important

measures to follow: intra operative pouch integrity is always performed.

Continence mechanism is checked. Ease of catheter passage is ensured.

**Catheters :** for appendiceal stoma : 14 fr to 16 fr, nipple valve : straight 22 to 24 fr , for ileo caecal plication: 20 to 22 fr coude tip catheter.

Advice clean intermittent catheterization.

Pouch capacity: ileal 150 ml and right colon 300 ml to beginwith.

All patients with catheterized pouches will have bacteriuria which in the absence of symptoms does not need antibiotics. Urinary retention is an infrequent and serious occurrence in catheterizable pouches. Mostly in nipple valves. Pouch urinary retention is a true emergency and requires immediate catheterization by an expert promptly.

### **Continent Ileal Reservoir ( Kock Pouch )**

Proximal 10 cms intussusception ileum serves as continent tube and distal part as patch. High complication rate and technical difficulties involved.

**Double T pouch-** 70 cm ileal segment , proximal isoperistaltic 10 to 12 cms isoperistaltic, distal 12 to 15 cms antiperistaltic. Proximal antireflux mechanism and distal continent mechanisms. Mainz pouch I (mixed augmentation with ileum n caecum )– modified to include intact ileocaecal valve. Catheterizable mainz pouch uses longer segment than orthotopic . 10 to 15 cms of caecum and ascending colon and two equal distal ileal segments with proximal 20 cms ileum. Folded as W and posterior aspects sutured. Proximal ileum intussuscepted and stapled.

Antimesenteric border opened. Uretero colonic anastomosis done. Anterior side walls suturing completes pouch formation. Stomal failure, calculus formation, B12 deficiency, metabolic acidosis are important complications. 50% of complications can be corrected by percutaneous procedure.

### **Important continent mechanisms**

1. Mitrofanoff principle using appendix
2. Montie procedure using 2 to 3 cms of ileum
3. Woodhouse tapered ileum
4. Using caecal tube
5. Seromuscular trough of caecum

Right colon pouches with intussuscepted terminal ileum

### **Using nipple valve mechanism of terminal ileum and**

#### **ileo caecal valve.**

1. Continent caecal reservoir ( mansson )
2. UCLA pouch ( Raz )
3. Duke pouch ( Webster and king )
4. Le bag ( Light and scardino )
5. Indiana pouch ( Rowland et al , Indiana university ) – uses entire right colon and terminal ileum. Appendectomy is done. Entire right colon is opened along its antimesenteric border and uretero taenial implants are fashioned. Ileo caecal junction is buttressed using

interrupted lembert sutures 3 to 4 cms in two rows. Pouch is closed in a Heinke –Mickulicz configuration.

6. Modifications of Indiana pouch are
  - a. Miami pouch- purse string sutures in ileum
  - b. Florida pouch ( lockhart )

Indiana pouch – early complications, pouch related are 3.7% . At one year, day and night time dry intervals of 4 hrs or greater in 98% patients.

One of the most reliable of all catheterizable reservoirs.

7. Penn pouch – first continent diversion using appendix continence mechanism - Mitrofanoff principle. Two types. A.excising appendix with button of caecum and reversing upon itself and used as tunneled reimplant. B. appendix is tunneled and buried it into adjacent caecum. Ileo caecal pouch is created by isolating a segment of caecum and terminal ileum with blood supply. Open antimesenteric border and sutured to one another to form neotubularised pouch. Appendix with caecal button is circumcised with intact blood supply. Caecal button is brought to the anteriorabdominal wall and distal part of appendix is spatulated until it allows 12 to 14 fr catheter, tunneled appendiceal – taenial implantation is carried out. Appendiceal length if inadequate, base of caecum can be utilized. Versatile and increased continence rate- 90% . reoperation rate for tube complications -33%.



## **Gastric pouches**

Advantages- electrolyte reabsorption is absent. potential reservoir for preexisting metabolic acidosis or renal insufficiency. Patients in whom shortening of bowel is contraindicated, stomach can be used. Acid pH reduces the bacterial colonization. Lower bowel irradiated, stomach provides nonirradiated segment.

Types- 1. using wedge of gastric pouch based on left gastro epiploic or right gastro epiploic artery. 2. Using long segment of stomach based on right gastro epiploic artery and stapler resection.

## **ORTHOTOPIC CONTINENT URINARY DIVERSION**

Relies on rhabdosphincter for continence. Most of the patients are continent and able to void to completion without the need for intermittent catheterization. Indications : patients considered appropriate candidates for cystectomy Contraindications : mental and physical impairments. Long followup – 45% may require CIC. Renal function must be normal. In borderline renal function patients, gastrocystoplasty is an option which has less mucus secretion. Obesity and age are not contraindications for orthotopic diversion. A good orthotopic urinary diversion will have a reservoir that accommodate large volume of urine under low pressure, without the reflux or absorption of urinary constituents.

## **Important principles of reservoir reconstruction**

Configuration – determines geometric capacity. Volume = height x radius<sup>2</sup> Accommodation – relates pressure and volume to mural tension ( Laplace law,  $T = P \times \text{radius}^3$  ) Compliance – concerns the physical characteristics of intestinal wall.

## **Which segment of bowel is better for urinary diversion ? why?**

The ileum – has less contractility, greater compliance, provides increased continence rates. The caecum and colon are muscle walled and are less compliant than ileum and store urine at higher pressures. ( Berglund et al 1987). Urodynamic characteristics of ileum are superior to colon. Several studies support ileum.(Davidson et al 1992 ). Ileal reservoir has larger capacity, lower filling pressures, lower maximum capacity pressures, and better compliance.(Schrier et al 2005). Animal models also show ileum circular muscles are most distensible, followed by colonic circular and ileal longitudinal layers. The colonic longitudinal muscle is relatively nondistensible.( Hohenfellner et al 1992). Santucci et al clearly showed that ileal urinary diversion is superior urodynamically. They evaluated six different forms of continent urinary reservoir and noted significant difference in continent rates and urodynamics. Colonic segments have higher storage pressures than ileal segments. Mucosal atrophy, with less reabsorption of urinary constituents – more reliable in small bowel than in large bowel reservoirs( Norlen and Trasti 1978, Mills

and Studer 1999). Small intestine is easy to manipulate surgically. Considering above discussion, ileum is preferred in orthotopic diversion (Stein and Skinner 2007).

The rhabdosphincter must be intact to provide a continent mechanism. Cancer surgery must be radical and intra operative frozen section of distal surgical margin (proximal urethra) must be negative. The clinical goal of most neobladders is to allow volitional voiding four to six times daily. ( every 3 to 4 hours ) with a capacity range of 400 to 500 ml of urine at low pressures ( < 15 cm of H<sub>2</sub>O ). Nocturnal incontinence is more commonly observed. Day time incontinence is common in elderly > 65yrs, use of colonic segments, and in nerve injury.( non nerve sparing surgery ). Urinary incontinence management must be done only after allowing time to enlargement of neobladder. Minimum 6 months. For men, artificial urinary sphincter and for women, pubovaginal sling may be favoured for correction. Use of excess length of intestines will cause urinary retention.(more than 60 cms). Best managed by intermittent catheterization. A unique voiding dysfunction is hypercontinence in women with orthotopic reconstruction.

Videourodynamics demonstrate the retention as mechanical in nature due to the pouch falling back causing acute angulation of posterior pouch urethral junction. Continence mechanism is preserved by manipulating rhabdosphincter minimally. Dissection in pelvic floor and

anterior urethra are minimized. Distal urethral margin is frozen section analyzed. If no tumour, orthotopic diversion is performed.

The overall risk of a urethral recurrence of transitional cell ca after cystectomy is approximately 10% in men. Invasive prostatic tumour involvement and the form of urinary diversion are important risk factors in men. Whenever a patient who has undergone lower urinary tract reconstruction presents with any change in voiding function, consider a urethral recurrence. Bladder neck and anterior vaginal wall are the two important recurrence sites for women. Local pelvic recurrence rate is 10%. Orthotopic urinary diversion after pelvic irradiation can be performed in selected male and female patients.

### **Antireflux mechanisms required or not ?**

#### **Antireflux mechanism is not required because**

1. As a result of detubularisation and reconfiguration, the neobladder should accommodate a large volume of urine at low intra reservoir pressure.
2. Urinary constituents in neobladder are sterile.
3. Complete emptying in neobladder is routinely by valsalva manever and relaxation of rhabdosphincter.
4. Technically more challenging and time consuming procedures.
5. Higher complications, eg. Obstruction.

6. Good results can be observed with isoperistaltic long afferent segment of an ileal neobladder, eg. Studer pouch.

### **In favour of antireflux mechanism**

1. Protects upper urinary tract as in normal human beings.
2. Significant , indirect clinical and experimental evidence support antireflux procedures.
3. Newer improved techniques with less complications available. ( Abol-Enein, Ghoneim, 2001, Stein et al 1998) With combination of high pressures, obstruction, and chronically infected urine, renal insufficiency occurs. Upper urinary tract deterioration may occur late also. ( between 10 to 20 yrs). In chronically infected continent reservoir, antireflux mechanism is included. Intermittent catheterization in 40 to 45% patients may be needed and all will harbor organisms.

Important complications of nipple valve are calculi, nipple stenosis, extussuception.

Serous lined tunnel is an effective flap valve technique. (Abol-Enein, Ghoneim). Advantages: Significantly less bowel is used. Decreased metabolic complications. Ureters are anastomosed with spatulation and mucosa to mucosa approximation, stenosis is less.

Stein et al – T mechanism. Flap valve, versatile antireflux mechanism.

Advantages: even in grossly dilated ureters and short ureters , T mechanism is used. No metallic staples are required.

### **Various techniques of orthotopic neobladder.**

1. Camey II
2. VIP- vesica ileale padovana ( pagano et al 1990)
3. Ileal S Bladder ( Schreiter and Noll 1989)
4. Ileal neobladder ( Hautmann 1988) W or M
5. Studer ileal substitute ( Studer et al 1989)
6. Orthotopic Kock ileal reservoir ( Kock et al 1982, Skinner 1991 )
7. Serous lined extramural tunnel ( Abol Enein and Ghoneim 1993 )
8. T Pouch ileal neobladder ( Stein et al 1998 )
9. Orthotopic Mainz pouch
10. Ileo colonic pouch ( Le Bag )
11. Right colon pouch ( Goldwasser et al 1986, Mansson 2003 )
12. Sigmoid pouch ( Reddy and Lange 1987 )
13. Stapled Sigmoid neobladder ( Olsson 1995 )
14. Gastric substitute ( Mitchell )

**1. Camey II** –modified Camey I by Barre 1996. Ileal loop is folded thrice –Z shaped incised on antimesenteric border. Reservoir closed with running stitches. Urethro enteric anastomosis is made.

2.**VIP** vesica ileale padovana – pagano 1990. More spherical . 60 cms ileum. Spatulated bowel is closed in jellyroll fashion to produce a posterior plate which is then closed anteriorly.

3.**S Bladder**- schreiter and Noll. 75 cms ileum. S shaped. Opened antimesenteric border. Distal 5cms and proximal 15 cms are kept intact. Proximal for afferent antireflux procedure. Kock nipple. The ureters are spatulated and anastomosed to the proximal portion of antireflux nipple. Distal 5 cms are tapered down to urethral size.

4.**Ileal Neobladder** ( Hautmann ) Large capacity spherical bladder. W configuration. Attempt to reduce night incontinence. 70 cms of ileum. I ncision on antimesenteric border except 5 cms along traction suture where the incision is directed toward the anterior mesenteric border to make a U shaped flap. Ileum in M or W with four limbs sutured to one another. In the center of previously developed flap, a segment of the ileal wall approx the diameter of the little finger is made. The ileo urethral anastomosis is made. Sutures tied inside the neobladder. The ureters are implanted by Le Duc technique.

5.**Studer ileal bladder** substitute 54 cms to 60 cms ileum segment 25 cms proximal to ileocaecal valve. Distal 40 cms is placed in a U shape and opened along the antimesenteric border. The posterior plate is formed. The ureters are split and anastomosed in an end to side fashion to the proximal nonincised afferent tubular portion of ileum. The ureteral

stents are brought out through a separate stab wound. The reservoir is folded and oversewn( anterior wall ). Before complete closure, a button hole is made in the most dependent ( caudal ) portion of reservoir. The urethroenteric anastomosis is performed. Cystostomy tube is kept and the reservoir is closed completely.

**6.Orthotopic Kock** ileal reservoir First used as continent cutaneous ileal reservoir incorporating intussuscepted nipple valves for both the afferent antireflux and efferent continence limbs. For orthotopic reservoir only the afferent limb is retained. Important complications are calculus on exposed staples ( 5% ), stenosis of afferent limb ostium(4%) , extussusception or prolapse of the afferent limb ( 1% ). Technical difficulties and complications made “kock reservoir” as historical interest.

**7.Serous lined extramural tunnel** ( Abol-Enein and Al Ghoneim ) The ureters are brought into a reservoir through extramural serous lined tunnels. Metallic staples or synthetic materials are not required. 40 cms ileum fashioned into a W configuration and opened along its antimesenteric border. Incised mucosa is joined in the middle with running suture. The two lateral ileal flaps are joined by a seromuscular continuous suture to make the serous lined intestinal troughs. The spatulated ureters are laid into each trough, anastomosed to the intestinal mucosa, and stented. The tunnel is closed over the implanted ureter. The



anterior wall of the reservoir is formed by folding the ileum side to side. The reservoir is then anastomosed to the urethra. Advantages: Sound healing of uretero intestinal anastomosis. Extralong intestine is not required. Procedure is versatile and not technically difficult.

#### **8.T pouch** Ileal neobladder ( Stein et al 1998 )

An afferent ileal segment is incorporated within the serous lined tunnel. Geometric configuration is similar to the kock reservoir. Requires smaller ileal segment for antireflux mechanism. 44 cms of ileum forms V reservoir, each limb of V is 22 cms . proximal 10 cms forms afferent antireflux segment. Entire mesentery is intact to provide blood supply. Proximal end of antireflux segment is closed with absorbable suture. The antireflux mechanism construction starts with opening of windows of Deaver. Penrose drain placed in each window in distal 3 to 4 cms for easy identification. A series of interrupted silk sutures are placed to approximate the serosa of the adjacent 22 cms limbs, cephalad portion sutures passed through the corresponding window of Deaver in horizontal mattress not affecting blood supply. The anchored portion of afferent limb is tapered on the antimesenteric border. The ileal segments are opened adjacent to the mesentery and carried upward to the ostium of the afferent limb. Once the incision reaches the ostium of afferent limb, the incision direction changes to antimesenteric border and then upward. This gives excellent flap to cover the afferent ileal segment that is

anchored into the serous lined trough. The incised ileal mucosa is oversewn. The ostium of the afferent segment is sutured to the ileal flaps. The ileal flaps are then brought over and oversewn to cover the tapered afferent ileal segment. Now, Posterior wall is completed and antireflux flap valve is formed. The reservoir is folded and closed in the opposite direction from which it was opened. The uretero intestinal anastomosis is performed to the proximal portion of the afferent ileal segment. The anterior suture is stopped just short of right side which is the most mobile and dependent portion of the reservoir used for urethroenteric anastomosis.

**9.Orthotopic Mainz pouch**( Thuroff et al. 1986 ) Mixed Augmentation of Ileum and Caecum- 10 to 15cms of caecum and ascending colon with 20 to 30 cms of ileum is isolated. Ascending colon ileal anastomosis is done. Bowel is placed in W configuration. Entire segment is opened along antimesenteric border. Posterior plate construction is done by joining opposite three limbs, continuous running sutures. Antireflux implantation of ureters in colon by submucous tunnels and stenting done. Button hole in dependent caecum for urethroenteric anastomosis. Reservoir is closed side to side with cystostomy tube and stents through separate stab wound.

**10.Ileo colonic pouch - Le Bag** 20 cms of ascending colon and caecum and 20 cms of ileum are isolated and bowel continuity restored. The

antimesenteric border is incised for the entire length to make two flat sheets. One large and one small bowel. These sheets are sewn to one another to form posterior plate. The reservoir is folded and rotated 180 degrees into the pelvis with the most proximal portion of ileum( 2 cm non detubularised ) anastomosed to the urethra. Modified Le Bag pouch is complete detubularisation and then anastomosis to urethra. Another modification is by Baniel and Tal 2004 in which a Studer like ileal chimney is incorporated as the afferent limb.

**11.Right colon pouch** ( Goldwasser et al 1986, Mansson et al 2003 )

Entire right colon and caecum are isolated, and a transverse ileocolonic anastomosis is done. The ileal stump at the ileocaecal valve is closed with a running absorbable suture. Appendectomy is done. Colonic segment is opened along the anterior taenia, leaving the proximal 2 to 3 inches of caecum intact. The ureters are implanted in an antireflux fashion within the reservoir. The colon is then folded in a Heineke – Mikulicz manner and closed with a running absorbable suture. The urethroenteric anastomosis is done.

**12.Sigmoid pouch** ( Reddy and Lange 1987 )

A 35 cms of descending colon and sigmoid is isolated and arranged in a U configuration. The medial Taenia is incised down to an area just short of the urethral anastomosis. The incised medial limbs of the U are then brought together with an absorbable suture. Ureteral implantation is performed in a tunnel

antireflux fashion. A small button of colon is removed from the most dependent portion of reservoir, and the urethra enteric anastomosis is performed. The reservoir is then closed side to side. The author uses Valtrac ring , a biodegradable anastomotic ring on two sides of colon with purse string for colo colic anastomosis and handsew the detubularised segment by running stitch with 3-0 SAS to decrease intraoperative time.

13. **UCLA-** University of California Los Angeles. Type I and II. UCLA Type I- 10 to 15 cms of caecum and ascending colon with 20 cms of terminal ileum is isolated. Ileo ascending colon anastomosis is done to restore intestinal continuity. Detubularisation of right colon and caecal portion is through its anterior taenia down to the ileo caecal valve and ileum through its antimesenteric border. Posterior plate is formed by suturing the medial walls of the caecum and ileum. Appendectomy is performed. In the most dependent portion of caecum , an one cm incision is made for urethroenteric anastomosis. Uretero colonic anastomosis by Le Duc method. Neobladder construction completion by anterior wall suturing with supra pubic tube.

14.**UCLA Type II** Ileum is 30 cms ( 10 cms longer than the UCLA Type I ) with ascending colon and caecum. The proximal 10 cms of ileum is kept without detubularisation. The neobladder formation is similar to type I. The ureter is anastomosed to proximal ileum by Bricker ureteral

anastomosis. The intact proximal ileum is rotated to the right retroperitoneum.

15. **Using absorbable Stapling techniques.** The process of detubularization and refashioning of the bowel is a time consuming procedure. To reduce the operative time, the absorbable staples have been described by Olsson et al,1995; Kirsch et al 1996). A GIA instrument with 75 mm configuration which delivers four rows of absorbable vicryl with a knife mechanism incising the intestine between the second and third rows of staples. This allows two layers on each side with water tight anastomosis. Using absorbable staples many types of neobladders are constructed. Some of examples are 1.sigmoid neobladder- Olsson, 2. W-shaped ileal neobladder –Montie 3.Y-shaped ileal neobladder- Fontana. Hand sewn orthotopic W configured ileal neobladders are better than the stapled W configured ileal neobladders as reported by Montie et al 1996. The important reasons are failure to distend due to configuration, ischemia in the reservoir, reactions to staple material. The staples applications learning curve is short and operative time is very minimal.

### **Laparoscopic anastomoses**

Laparoscopic cystectomy and augmentation cystoplasty have been described. (Gill et al 2002). The technique primarily involves the use of endoscopic linear cutting and stapling devices,used to divide intestines and its mesentery. Reanastomosis can be done purely intracorporeally

with endo GIA stapler to anastomose intestine with side to side functional end to end anastomosis. An endoscopic TA stapler is used to close the intestines. Laparoscopically, intestines can be mobilized and intestines are exteriorized and proper techniques are used extracorporeally. Complete laparoscopic ileal neobladder has been reported. (Gill et al 2002). Laparoscopic assisted ileal conduit( Puppo 1995, A.Hemmal 2004) , laparoscopic assisted sigmoid pouch(Denewer 1999), laparoscopic assisted orthotopic diversion extracorporeal (Abdel-Hakim 2002, Simonato 2003, Mani Menon 2003, Basillote 2004).

Gill et al in their series described 22 laparoscopic urinary diversions with purely intracorporeal Ileal conduit 14, orthotopic intracorporeal diversion 6, Indiana pouch 2. Mani Menon described all procedures with Robot assisted approach- 17. All these experts claim minimal blood loss, decreased post operative ileus, decreased hospital stay, quick recovery and time to work. Mean follow up is 18 months with minimal complications and morbidity. The pioneers in laparoscopic urology ( Gill, Turek, Van Velthoven, Simanato and Basillote) compared the complications between intracorporeal reconstruction and extracorporeal reconstruction and concluded that prolonged ileus, bowel obstruction, deep vein thrombosis, bowel perforation, anastomotic leak are more common in intracorporeal reconstruction.

Finally, these authors predict the future directions of radical cystectomy and urinary diversion as below. “The laparoscopic radical cystectomy in the future will evolve in to a technically optimal combination, with intracorporeal performance of the radical cystectomy, including extended pelvic lymphadenectomy, ureteral mobilization, and selection of the appropriate intestinal segment. The majority of intestinal work, construction of the intestinal reservoir, uretero enteric anastomosis are done extracorporeally through minilap incision. For orthotopic diversion, the urethro enteric anastomosis is completed intracorporeally.” Careful prospective and longterm evaluation of oncological and functional outcomes will be necessary to define the role of open vs laparoscopic procedures.

### **Quality of life after Urinary diversion**

Evolution from incontinent cutaneous ( conduit ) form, to continent cutaneous diversion, to recent orthotopic diversion. Continent cutaneous diversion in the initial stages give improved quality of life. But they are complicated procedures with disadvantages also. Technically more challenging and time consuming. Diarrhea and B12 malabsorption are more common where ileocaecal region is used. All the patients surveyed were generally satisfied with their diversion and adapted reasonably well socially, physically, and psychologically. The preoperative education and discussion about the diversion satisfies patient. The current literature is

insufficient for concluding that any form of urinary diversion is superior to another on the basis of health related quality of life outcomes. Orthotopic neobladder is considered gold standard against which all other procedures are compared.

### **Gastric pouches**

Theoretical and real advantages . 1. Electrolyte reabsorption is greatly diminished, in metabolic acidosis patients or renal insufficiency patients. Hyperchloremic acidosis will not occur. Barrier to absorption of chloride and ammonium. Secretes chloride. In patients in whom shortening of bowel is a problem, the stomach is an alternative. Bacterial colonization is reduced by acid pH. If entire intestinal area is irradiated, stomach provides nonirradiated segment for diversion. Conduit conversion to a continent reservoir

### **Non secretary intestinocystoplasty**

Deepithelialised bladder augmentation, 183 patients using sigmoid and ileal segments without mucosa over a mold was reported. (S.lima et al JU 2007). The authors claim significant increase in compliance and capacity. The complications due to mucosa are less compared with traditional augmentation cystoplasty. Patient's desire for improved quality of life.

In an analysis by prof NP Gupta AIIMS, a national survey was conducted among urologists in our country to find the preference for



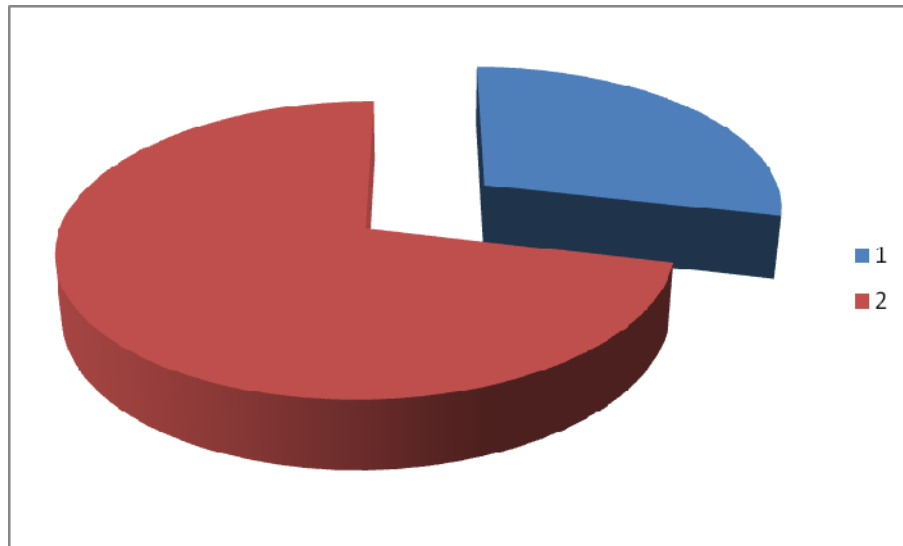
urinary diversion after radical cystectomy. All are USI members. The results were 50% did not prefer orthotopic diversion. Among the institutions carrying out neobladder, majority perform ileal conduit in more than 50% of the cases. Ileum 66%, ileo caecal segment 17% were the segments of choice by most of Indian urologists. Only three institutions used sigmoid colon.

Finally, he concluded that ileal conduit still remains the urinary diversion of choice following radical cystectomy among most of the urologists in our country. Orthotopic neobladder reconstruction is practiced only in selected centres. Wound infection, urinary leak and obstruction at uretero intestinal anastomosis are the main complications. Clean intermittent catheterization is required at an average of 50% of the patients to ensure complete emptying of the neobladder. Important complications are wound infection 5-25%, burst abdomen 5%, urinary fistulas 3-25%, faecal fistulas 2-5%, bladder neck stenosis 5-25%, and uretero enteral anastomosis stenosis 5- 25% (International urological nephrol. 2007 , 143 -8 Gupta NP, Ansari MS , Nabi. G)

## MATERIALS AND METHODS

The study period is between September 2005 to April 2008. The study design is Prospective study analyzing the intestinal uses and early complications in our department of Urology, GRH and KMCH. Total number of patients included in this study are 21. Among twenty one patients : sex distribution Male patients : 15 Female patients : 6

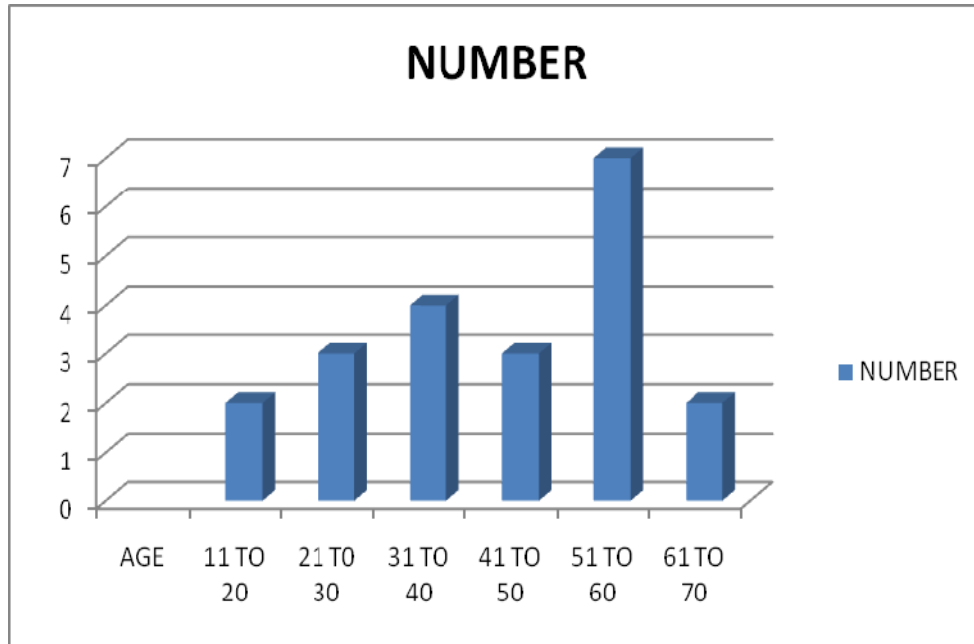
### 1.Female 2.Male



Male patients predominant in my study with history of smoking, occupation risks such as painting , agriculturists with pesticides direct contact, history of tuberculosis.

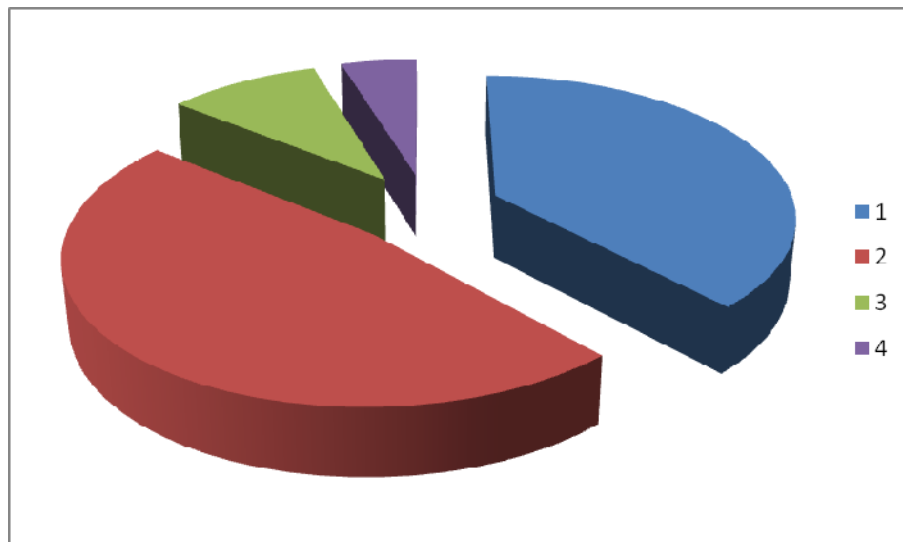
### Age distribution

11 to 20 years = 2 , 21 to 30 years = 3, 31 to 40 years = 4, 41 to 50 years= 3, 51 to 60 years= 7, 61 to 70 years = 2.

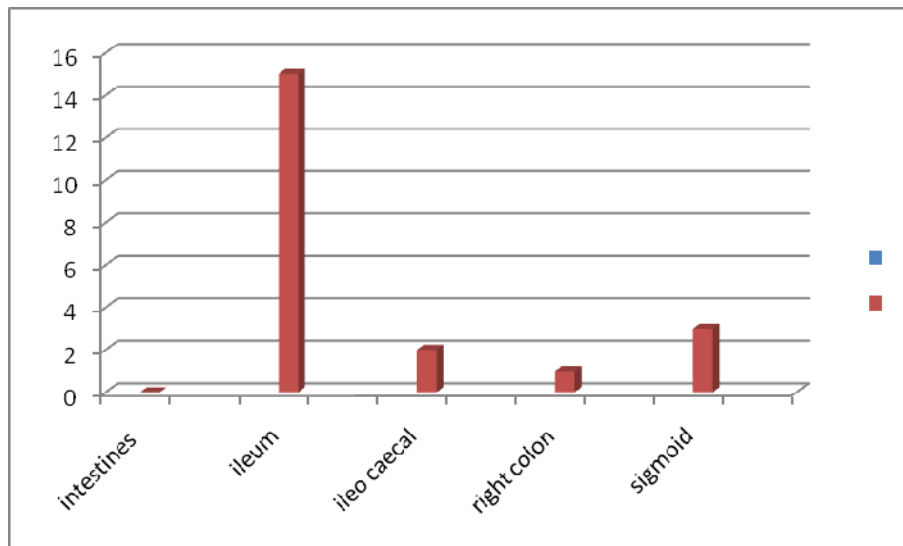


Patient selection criteria : Patients with Genito Urinary TB requiring augmentation cystoplasty suffering from thimble bladder. Patients with muscle invasive ca bladder undergoing Radical cystectomy Patients with exstrophy of bladder, late presentation

**Disease pattern:** 1. GU TB = 8, 2. Ca Bladder= 10 , 3. Exstrophy of Bladder=2 4. Ileal replacement =1.

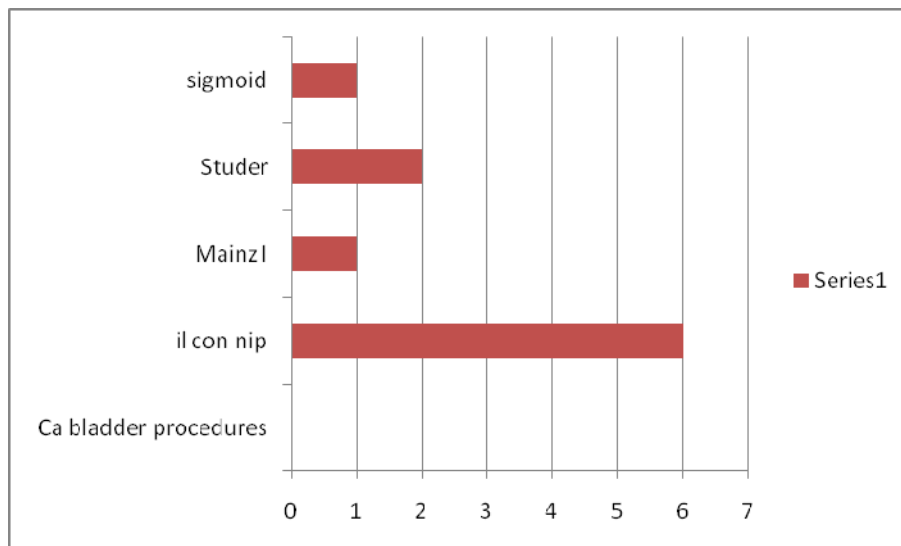
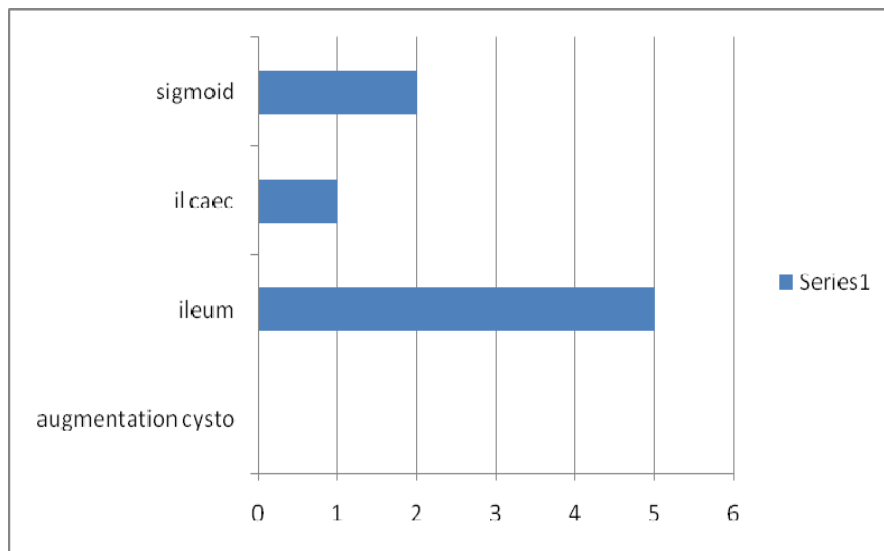


Procedures for diseases patients had undergone 1. Augmentation cystoplasty using ileum, right colon, sigmoid colon 2. Radical cystectomy with ileal conduit 3. Ileal substitution in multiple ureteric stricture 4. Ileal pouch in exstrophy of bladder, late presentation. In my study small intestines were used in 15 patients. Large intestines were used in 6 patients. Ileum alone was used in 15 patients, ileo caecum 2 patients, right colon alone in one patient, and sigmoid colon. in 3 patients.

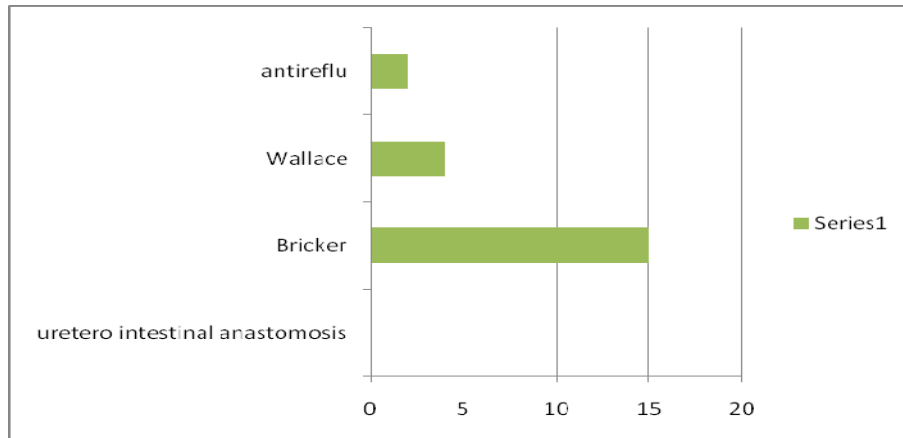


Procedures which were done using above mentioned intestinal segments are: Genito urinary Tuberculosis= 8 Augmentation cystoplasty using Ileum – 5 Augmentation cystoplasty using ileocaecal region -1 Augmentation cystoplasty using sigmoid colon – 2 Carcinoma bladder muscle invasive – following radical cystectomy and bilateral pelvic Lymphadenectomy = 10 Ileal conduit with nipple stoma or rose bud stoma- 6, Mainz I Pouch – 1 Studer pouch with proximal isoperistaltic

ileal segment – 2, Sigmoid colon – 1. In exstrophy bladder late presentation, for 2 patients we have excised the exposed bladder portion and created ileal pouch ileal pouch with tapering ileum – 1, ileal pouch with rosebud stoma -1. A patient presenting with multiple ureteric stricture – proximal, mid and lower ureteric strictures, ureter was substituted with ileum, Ileal substitution of ureter- 1.



**Ureteric anastomosis with ileum** – methods Bricker – majority of the cases =15 Wallace – some cases=4 antireflux procedures in our series- 2



Among 15 patients who had Bricker type of uretero intestinal anastomosis, two cases of urine leak. Because of DJ stent placement and regular irrigation and mucolytic agents protocol, the urine leak was treated. In wallace type , one urine leak was noted , settled conservatively. One patient with antireflux procedure showed ureteroenteric stenosis which made us to switch over to Bricker or wallace.

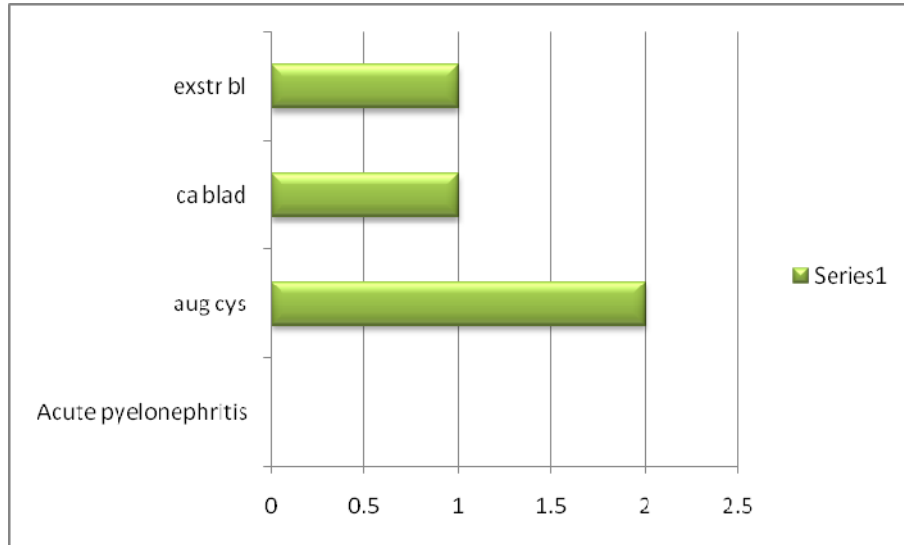
### **Postoperative protocol**

SPC was clamped on 2<sup>nd</sup> week, pouchogram was done on 3<sup>rd</sup> week, DT removal based on study and observation, SPC was removed on 3<sup>rd</sup> week, foley catheter removal after SPC.

### **Acute pyelonephritis**

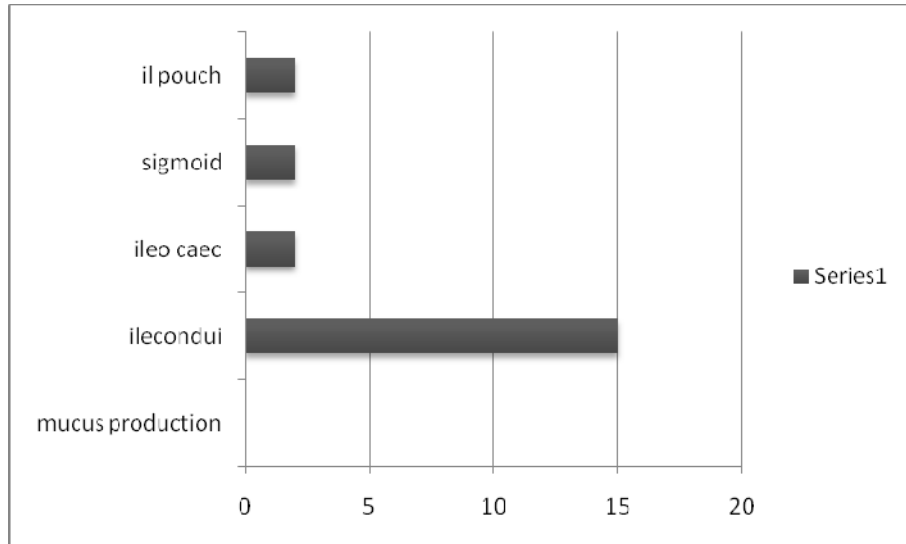
Upper tract infections in my series Augmentation cystoplasty with ileal conduit – 2 . both patients were diabetic Radical cystectomy with ileal

conduit-1 urine culture positive for E.Coli with repeated mucus Block.  
Exstrophy bladder excision with ileal pouch with continent cutaneous diversion-1 Acute pyelonephritis was treated with parenteral antibiotics which were culture sensitive.



### **Mucous production and related complications.**

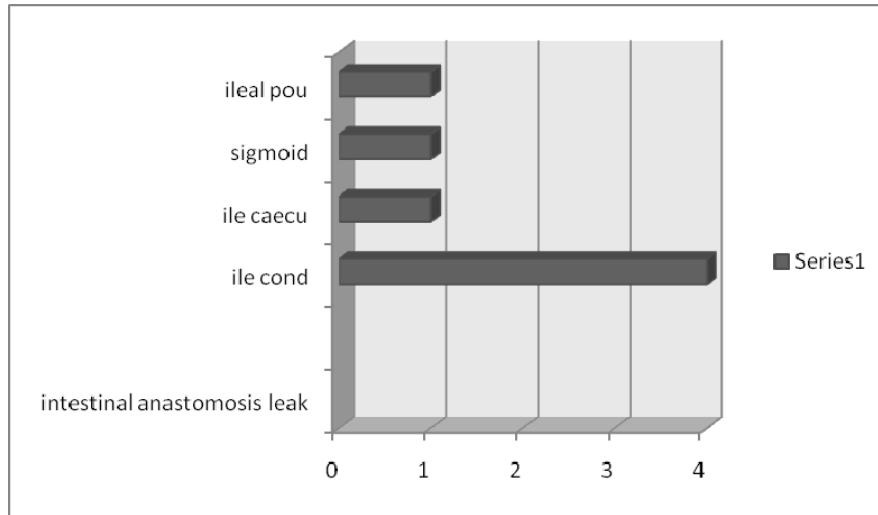
Intestinal mucosa secretes mucus which is tenacious and obstructs the urine outflow. To combat the mucus secretion, in early post operative period gentle aspiration of the intestinal foley catheter is done and saline irrigation with NaHCO<sub>3</sub> and aspiration is done. When oral fluids or diet is started, sodium bicarbonate tablets are given 333 mgs tid. Dairy products and onion are avoided.



Anastomotic leak or urine leak was seen in my study : reasons were 1. Compromise in water Tight anastomosis 2. Mucus block 3. Distal obstruction 4. Ischemia to the anastomotic site. Patient with ileal conduit usually have DJ or 5 Fr Infant feeding tube in the ureter fixed with catgut, foley catheter 20 fr in ileal conduit, Malecot catheter or wide foley catheter as supra pubic catheter from conduit. In latter part of my study, the leak rate was minimal due to strict adherence to the principles and lesson learnt from early cases. All leaks were seen in within 7 to 10 days of immediate post operative period. Usage of multiple catheters and stents reduced the incidence or complications of leak.



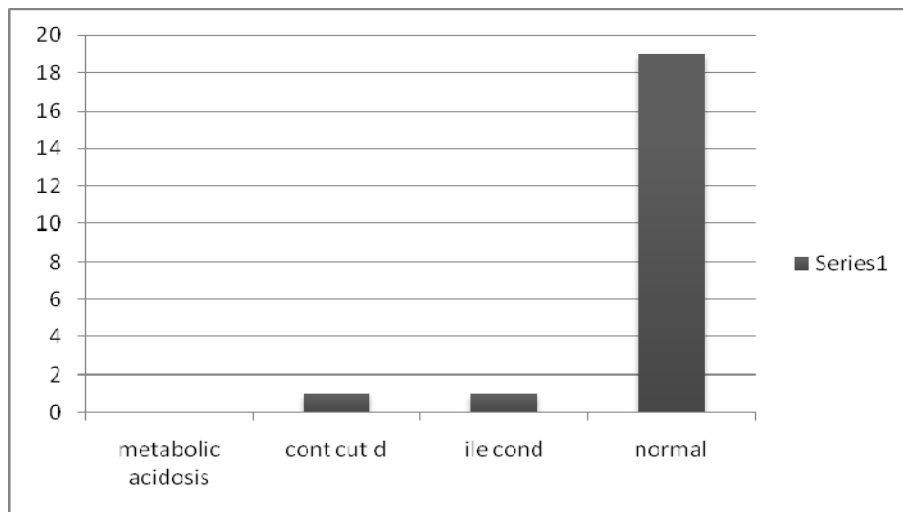
## Intestinal anastomosis leak – Urine



Effective mucolytic agents reduced the mucus formation and increased the urine flow through catheter. Agents used are bromhexine, sodium bicarbonate tabs, N- acetyl cysteine.

**Elevated Renal parameters** were seen in four of my patients pre operatively who had augmentation cystoplasty. Early post operative protocol to assess the acid base balance and electrolyte imbalance were effective. Estimation of serum sodium, potassium, bicarbonate, chloride were done. Blood gas analysis were done when we suspected acidosis or in patients manifesting with lethargy, tiredness, easy fatigue. Ammonium substitutes for Na in the  $\text{Na}^+ - \text{H}^+$  antiport. Ammonium chloride is absorbed, salt is lost. Sodium bicarbonate was given to all my patients as a prophylactic measure in acidosis as well as to decrease mucus. Citrate solution is used as an alternative.( annexure )

we had two patients with **hyperchloremic metabolic acidosis** with low bicarbonate (below 20mg%, low pH- below 7.4 , increased chloride – more than 108 mgs % with hyponatremia. Both patients were effectively treated with sodium bicarbonate. One case was with cutaneous continent urinary diversion, another ileal conduit with block. Hyperchloremic metabolic acidosis

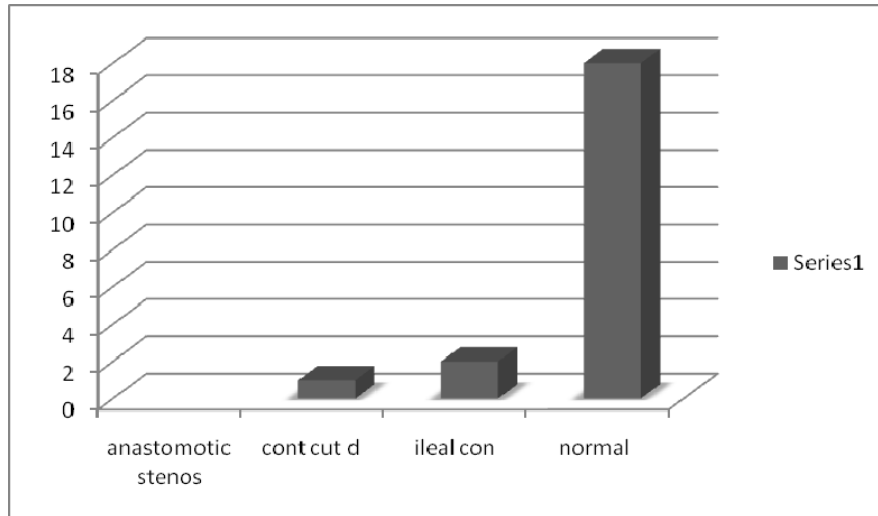


After catheter removal, specifically watched for metabolic complications and urine flow.

**Stomal stenosis** was seen in three of my patients. One patient was with continent cutaneous diversion with ileal pouch. In this patient, appendix was used as a continent mechanism using Mitrofanoff principle. Other two patients with ileal conduit where rose bud was not effectively done. For first patient, 14 fr catheter was introduced, advised clean intermittent catheterisation. Other two patients, revision of stoma was done. First

patient after 6 months developed pouch Calculus because of infrequent catheterisation and decreased fluid intake.

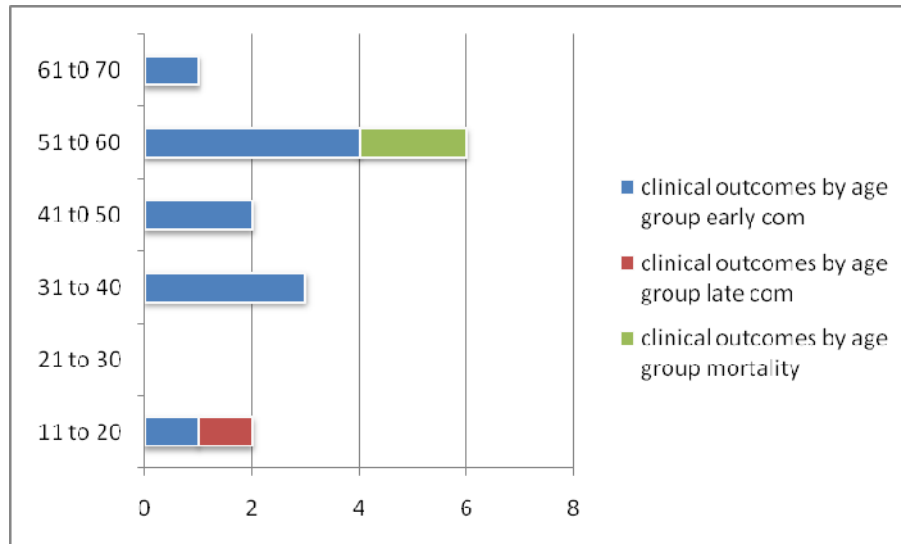
### **Anastomotic stenosis**



Pouch calculus is usually seen as a late complication. In my above mentioned case, because of ineffective drainage and decreased fluid intake, patient was presenting with pouch calculus, the stoma could be entered through 8 fr ureteroscope, because of decreased field of vision and large capacity pouch , stone was not identified. Hence pouch was opened and stone removal done. Stoma was made bigger by converting continent to incontinent conduit.

**Pouch calculus** . number of cases – one. Treated by surgery. Patient was advised to have plenty of liquids and frequent follow up. Sodium bicarbonate tablet 2 gms in divided doses. Clinical outcomes by age group Age distribution in my study shows the majority of elderly patients after 50 years were suffering from ca bladder with smoking history and

significant occupational history. If Karnofsky performance status was above 80%, the surgery was performed.



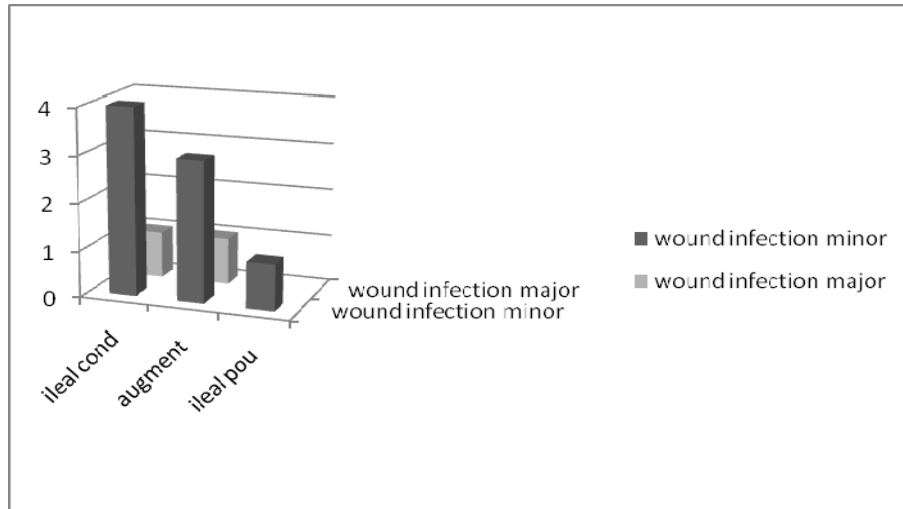
Pulmonary complications were seen in age group above 40 predominantly. Ranging from severe LRI to atelectasis. Many of our surgeries were done under general anaesthesia or epidural Anaesthesia. Post operatively , these complications were recognized, properly investigated with chest x-ray , sputum examination and treated with appropriate antibiotics and chest physiotherapy. Some of my augmentation cystoplasty patients had history of pulmonary TB treated and now presenting with decreased pulmonary functional capacity. Preoperatively they were taught respiratory exercises to increase the reserve volume using spirometer.

**Deep vein thrombosis** was seen in two patients. One patient is a known diabetic with obesity, Hypertension and hypercholesterolemia who had

undergone augmentation cystoplasty for gu TB. Another patient with moderate obesity who underwent radical cystectomy with ileal Conduit. Our regular protocol to avoid DVT in pelvic surgeries were elastocrepe stockings during and after surgery and using low molecular weight Heparin on the day of surgery and three days immediate postoperatively. Patient is advised to have lower limbs exercise to have effective peripheral pump by soleus.

Deep vein thrombosis has been treated with low molecular weight heparin, fibrinolytic agents Streptokinase or urokinase and strict bed rest. Patients were presenting with swelling of lower limb, pain, edema, Homan's sign and Moses sign positive. With the help of vascular surgeon, doppler study proved DVT and immediate measures saved both patients. After this incidence, we use low dose heparin 2500 IU on the day of surgery and postoperatively for three days. Peroperatively meticulous haemostasis and preventive steps for DVT are followed for every patient undergoing prolonged pelvic surgery.

**Wound infection** - malnourished with tuberculosis and carcinoma bladder, Immunologically highly prone to get infections. In spite of antibiotic prophylaxis, strict adherence to aseptic precautions and postoperative care still wound infection is seen due to host factors, microbial factors.



post operative wound infection were treated with culture sensitive antibiotics and thorough wound cleaning with hydrogen peroxide and betadine. Major infections were presenting with wide wound gap and latter after subsidence of infection they required secondary suturing.

In my study mortality - 2 cases. One patient expired due to myocardial infarction postoperatively. Another patient with urachal carcinoma, asymptomatic for an year. Latter developed liver metastasis and expired in his native place. Clean intermittent self catheterisation During counselling of the patients itself, we explain about the course of the disease, surgery, pros and cons of each procedure. Patients whoever undergoes augmentation cystoplasty we explain about the function of bladder, the nature of voiding differing from normal bladder.

Nearly 25% of my patients who underwent augmentation cystoplasty required **CIC** in their early phase and long run. When patient comes for regular followup, ultrasonogram prevoid and postvoid, renal

parameters, uroflow and intravenous urogram if required single shot 20 minutes film is taken. Patients showing poor voiding pattern with large capacity are taught Clean intermittent self catheterisation. For females small infant feeding tube 10 fr or 12fr and for males 12 fr tieman coude tip catheter are used.

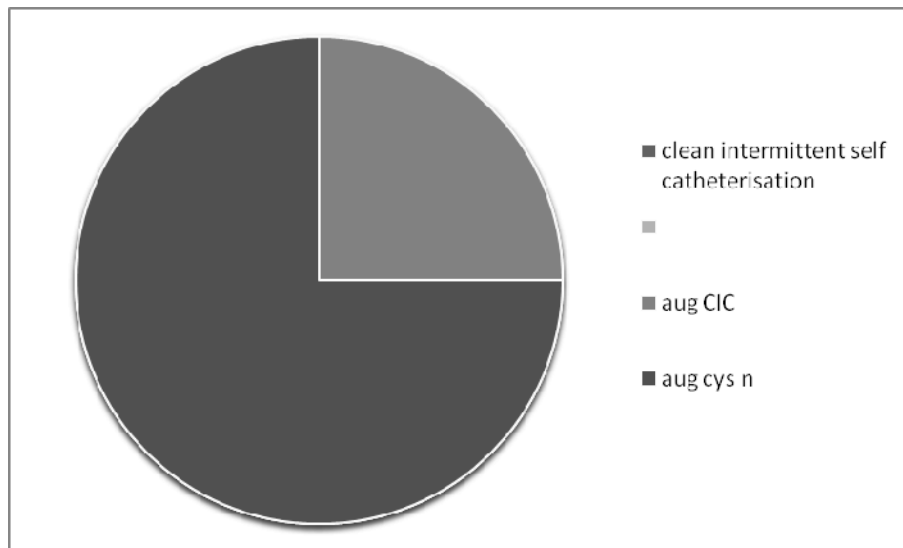


FIG showing percentage of patients required CIC in my study. One patient initially required CIC, latter voids well by abdominal straining.

**Urodynamic evaluation** of augmentation cystoplasty. Ileal augmentation with detubularisation produces hypotonic bladder. Night time continence is better comparing sigmoid neobladder. When detubularisation is not one in large intestine, because of contractile properties of large intestine, the colonic segment is hypercontractile and patient will manifest as requery and incontinence.

## RESULTS AND DISCUSSION

In my two and half years study, I analysed various procedures done by us after proper evaluation of patients. Comparing urologists all over our country, we also prefer ileum as a most suitable segment for bladder substitution and augmentation. Even in majority of conduits we prefer ileum. The compliance, accomodation and decreased contractility makes ileum the best. When it is unavailable or the utility is not possible, other segments are used.

Type of intestine used	Augmentation cystoplasty	Radical cystectomy conduit	Exstrophy bladder
ileum	5	7	2
Ileocaecal	1	1	
Right colon			
sigmoid	2	2	

Ileal replacement for ureter =1. Totally 15/21 , ileum was used. Almost 71% of my cases. This ileal replacement was done for a patient with complete ureteric disease due to tuberculosis. Sigmoid in 4/21, corresponding to 19%. This figure is similar to international and national level Comparison( prof NP Gupta et al 2007). When analysing general



complications such as wound infection, pulmonary complications, thrombo embolic manifestations, the incidence were higher among elderly patients suffering from carcinoma bladder.

Wound infection starting from minimal wound infection to wound dehiscence were present. Minor wound infection was seen in 8 cases. Managed conservatively with antibiotics. Wound dehiscence was seen in 2 cases which required secondary suturing. One patient was suffering from urachal carcinoma and another patient with diabetes mellitus. Literature describes 6% of morbid wound infections such as wound dehiscences, pelvic abscess and these can be avoided by preoperative proper bowel preparation and avoiding contamination of peritoneal cavity ( Loening et al 1992 ). My infection rate is 9% for major and 20% for minor infection. Now, it is decreasing with proper antibiotic and preoperative preparation.

Urinary leak was seen in 3 to 9 % of patients in other series.(Beckley et al 1988, Loening et al ). Soft sialastic stents decrease the incidence in another study. My study showed 7 urinary leak cases from the intestinal segments used for pouch formation, conduits, augmentation or from uretero intestinal anastomosis sites. All cases treated conservatively in the initial postoperative period. Effective mucus aspiration, irrigation and catheterisation successfully avoided sepsis and complications.

Since ureteric stricture rate was higher in antireflux procedures, we performed bricker or wallace uretero enteric anastomosis. So far in my follow up studies, with USG, IVU, no stricture case was reported. Many authors have shown that left ureteric strictures, stricture occurring less than one year, strictures 1.5cms or longer have less favourable outcome.

( poulakis et al 2003, Laven et al 2001 ).

Stomal stenosis usually occurs as a late complication. In my follow up, three of my patients had earlier stenosis two were due to ischemia and faulty technique and another one was mitrofanoff principle. Revision of stoma for first two cases were done. Third case had CIC. Latter developed pouch calculus which was managed as already described. Late stomal stenosis in ileal conduit and sigmoid is 3%.

Hyperchloremic acidosis in long term follow up is 68% in ileal conduits. ( Castro and Ram 1970, Malek et al, 1971). Other authors have shown less incidence 10 to 18% ( Schimidt et al 1980, Whitmore et al 1983, Mcdougal et al 1989 ). All the patients in my study have alkali therapy. We had two cases (10% ) of hyperchloremic metabolic acidosis proved by acid base gas analysis, serum electrolytes, and pH were treated effectively. All cases are followed up carefully after catheter removal. All ileal conduits are treated prophylactically with sodium bicarbonate and preventive measures to avoid blockage of stoma and excess mucus.

Serum electrolytes and renal parameters estimation on regular followup is very important.

Acute pyelonephritis Interposition of intestines produce bacteremia, sepsis, significant morbidity and mortality. Earlier series show 10 to 17% acute pyelonephritis ( Althausen and Hagen et al 1979, Schwartz et al 1975 ). Mortality rate was 4%. We had 4 cases of acute pyelonephritis, have been treated with culture sensitive parenteral antibiotics. Many studies show that bacteriuria is very common and if proteus or pseudomonas positive, must be treated to avoid upper tract deterioration. ( Mcdougal et al 1986, Kock et al 1987 ). 75% of ileal conduits have bacteriuria. Bacteriuria and sepsis are more common in continent urinary diversion. Wullt et al 2004 have shown that intestinal mucosal defence mechanisms are preserved even after isolation. Renal function deterioration occurs in 10 to 60 % when pre operative and post operative deterioration are included. 18 % of ileal conduits and 13 % of colon onduits show renal deterioration. ( Madersbacher et al 2003, Koch et al 1992 ). Patients with ileal conduits 6% of cases death is due to renal failure. In my study 4 cases showed pre operative rise in serum creatinine 1.8 mg % and following surgery carefully being monitored. All these patients require lifelong monitoring of renal functions. Parastomal

hernias, stomal prolapse are long term complications and patients are examined periodically.

I did not come across intestinal obstruction in my patients so far. Pouch calculus – was seen in one patient with ileal pouch and continent Diversion which was managed by open surgery. Incidence in ileal conduit is 10 to 12 %, colon conduit 4 %. Infection, hypercalciuria, metal staples, nonabsorbable suture, altered intestinal mucosa, mucus excess are all predisposing factors.

All my patients are carefully followed for late complications such as osteomalacia, stone formation, malignant change in our mind. 25 % of my patients with augmentation cystoplasty required clean intermittent catheterisation. Steven and poulsen 2000, Stein et al 2004 in their study found that atleast 43 % men and 40 % of women required CIC in their long follow up.

Urodynamic study is done in my augmentation cystoplasty patients to assess the functional status of augmented bladder. Majority of my cases with ileum show hypotonic bladder, good compliance, accomodative bladder. Voiding pattern is by abdominal straining. Ileum is superior than colon because of smooth muscle properties. Less contractile, more compliant, with improved continent rates. Accommodate larger volumes with low pressure. The pressure at maximum capacity is much lower. Anastomosis is easy. Disadvantages: terminal ileum B12 absorption, Bile

salts absorption, mucus. In contrast colon is more contractile , less compliant, decreased continent rates. Accommodate low volumes with high pressure. As the capacity increases, pressure also increases. Colon anastomosis and incidence of faecal fistula are higher. I did not come across faecal fistula in my study.

# CONCLUSION

Intestines are used in many forms as conduits, pouches, augmentation and orthotopic diversion

Meticulous care in anastomosis is the must. Uretero enteric, intestine to intestine, intestine to thimble bladder.

Early complications are avoided by preventive measures,peroperative techniques and postoperative care.

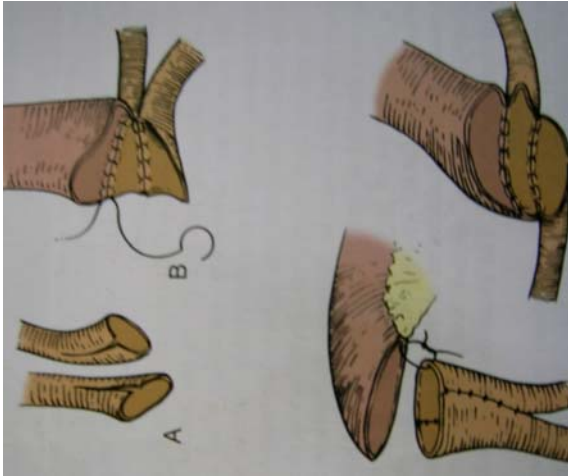
Urologist has to acquire the skills of surgical gastroenterologist and vascular surgeon.

Many patients may need CIC. My study shows 25%.

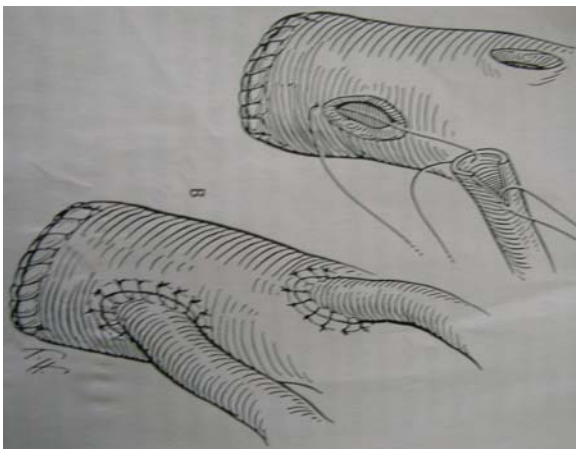
Physiologically and urodynamically, Ileum is superior than colon.

No substitute is better, God's gift Natural urinary bladder can not be conquered by surgeon's bladder( atleast till date ). Still viable option in many GU TB , ca bladder patients.

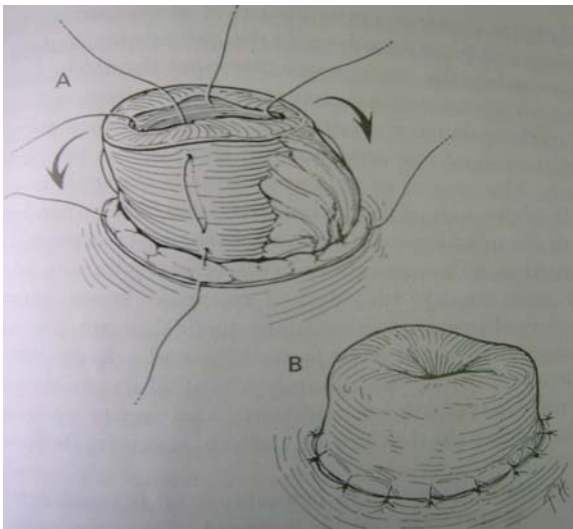
Tissue engineering and genetics may take over.



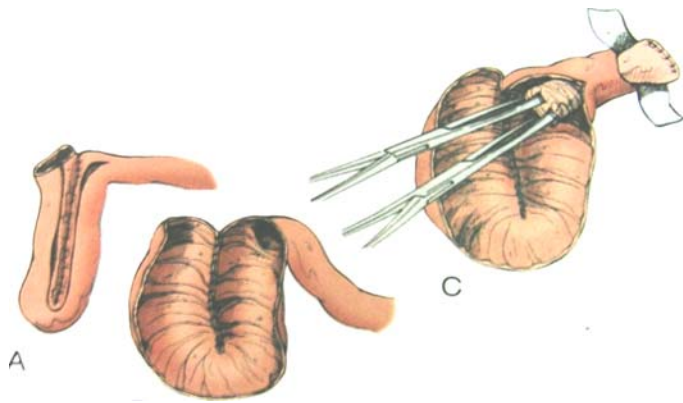
Wallace uretero intestinal anastomosis.



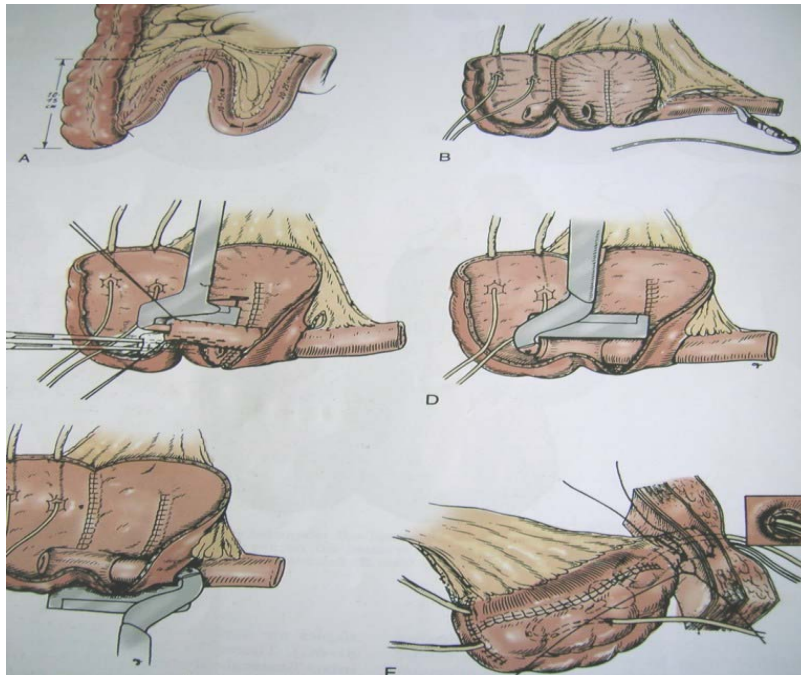
Bricker uretero intestinal anastomosis.



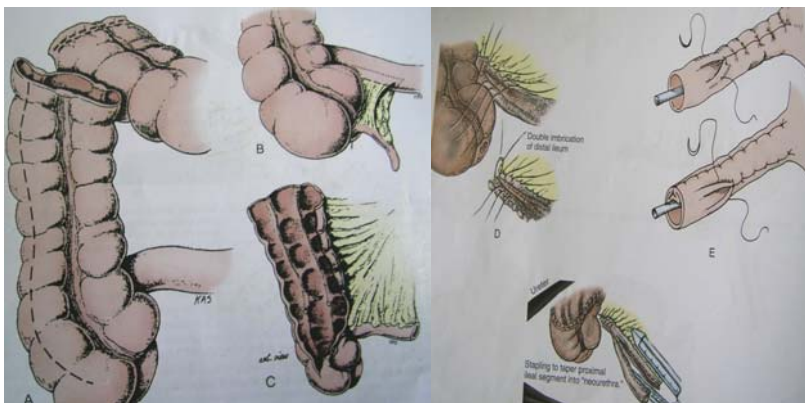
Rose bud or nipple stoma



Kock ileal reservoir

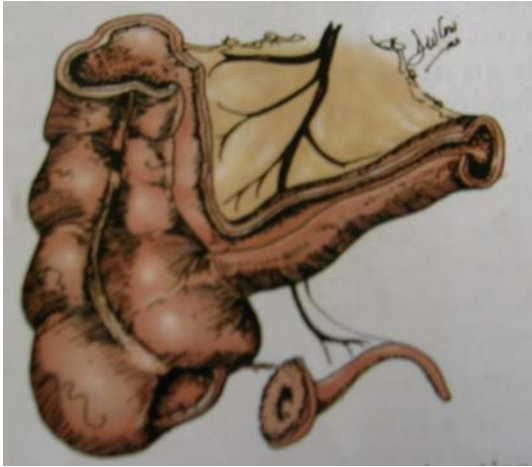


Mainz I pouch

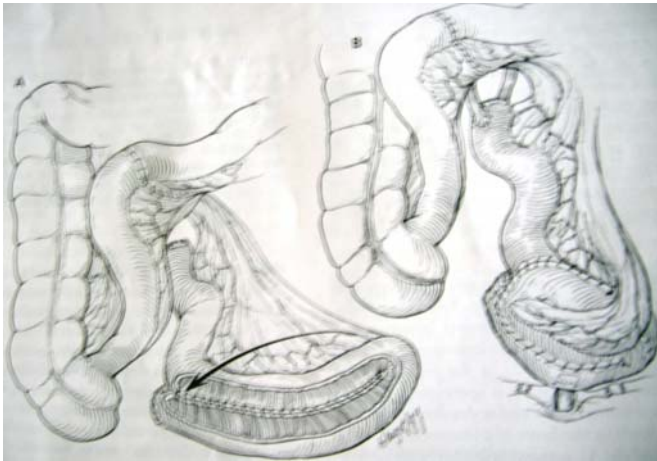


Indiana pouch

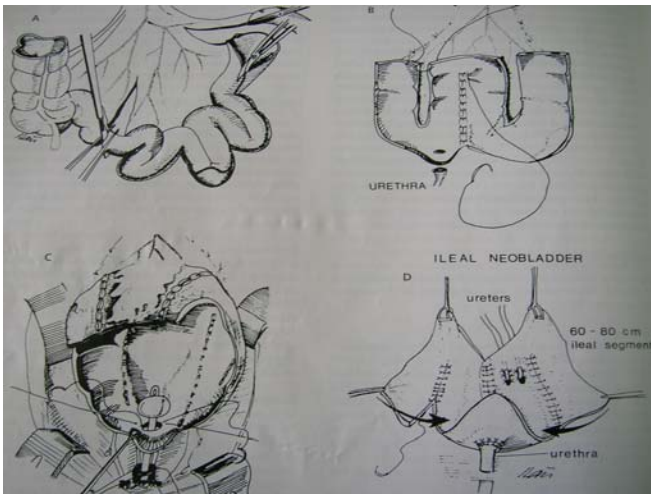




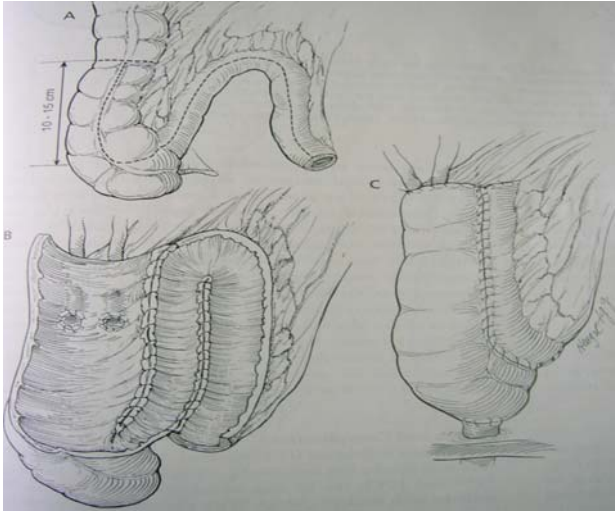
Mitrofanoff principle



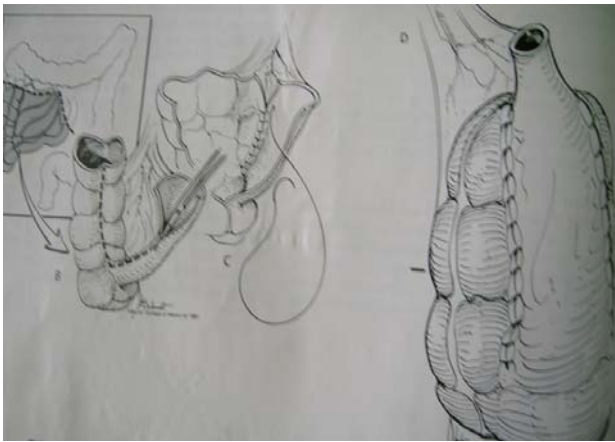
Studer Neobladder



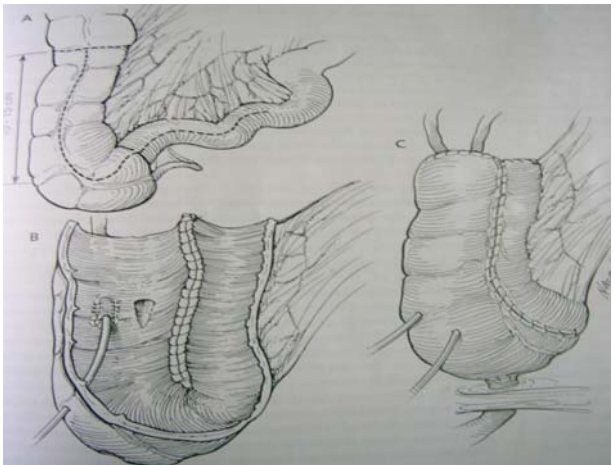
Hautmann ileal neobladder



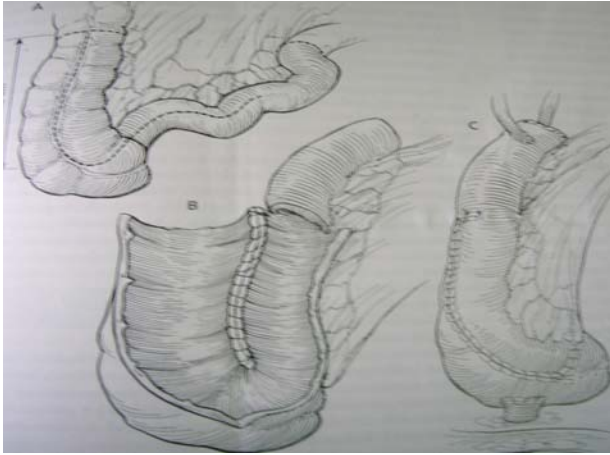
Mainz I ileocolic neobladder



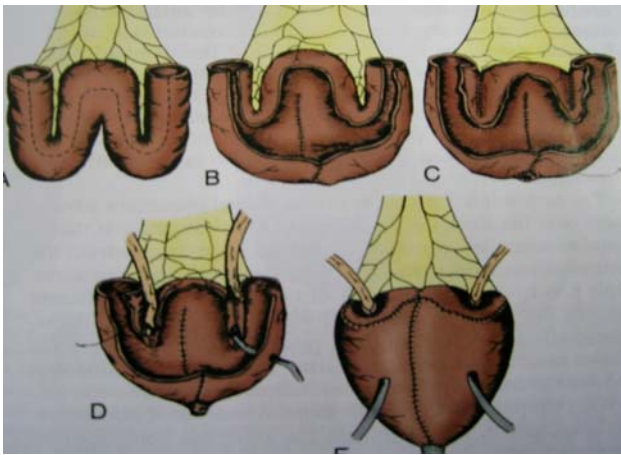
Le Bag ileo colonic neobladder



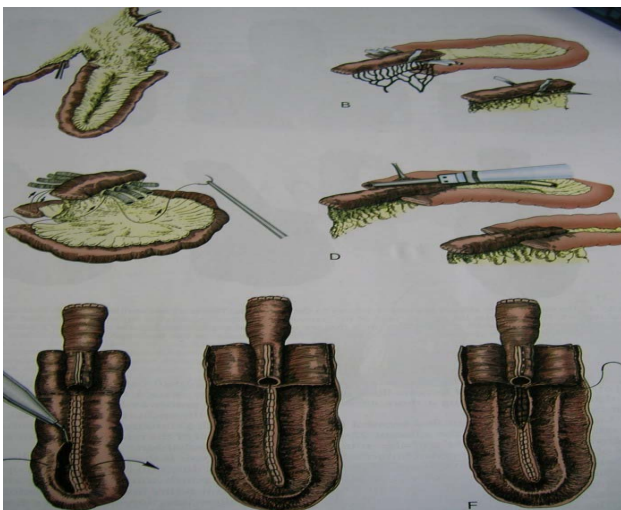
UCLA type I neobladder



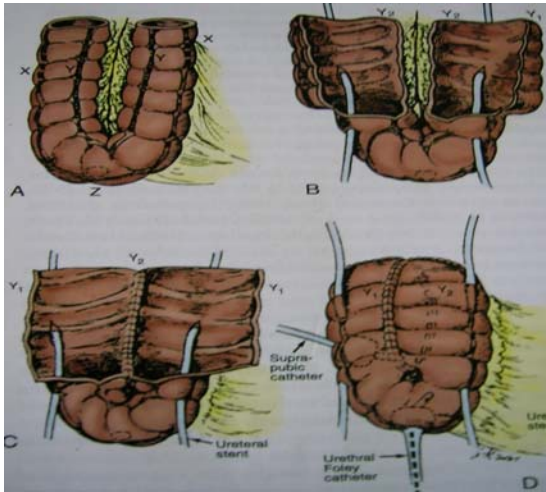
UCLA type II neobladder



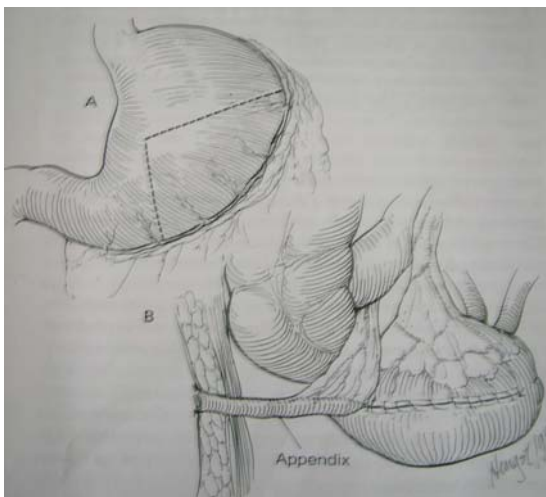
Serous lined extramural tunnel neobladder



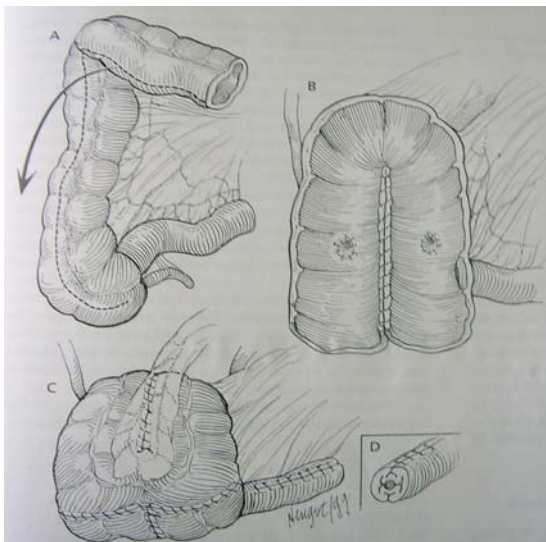
T pouch ileal neobladder-Stein



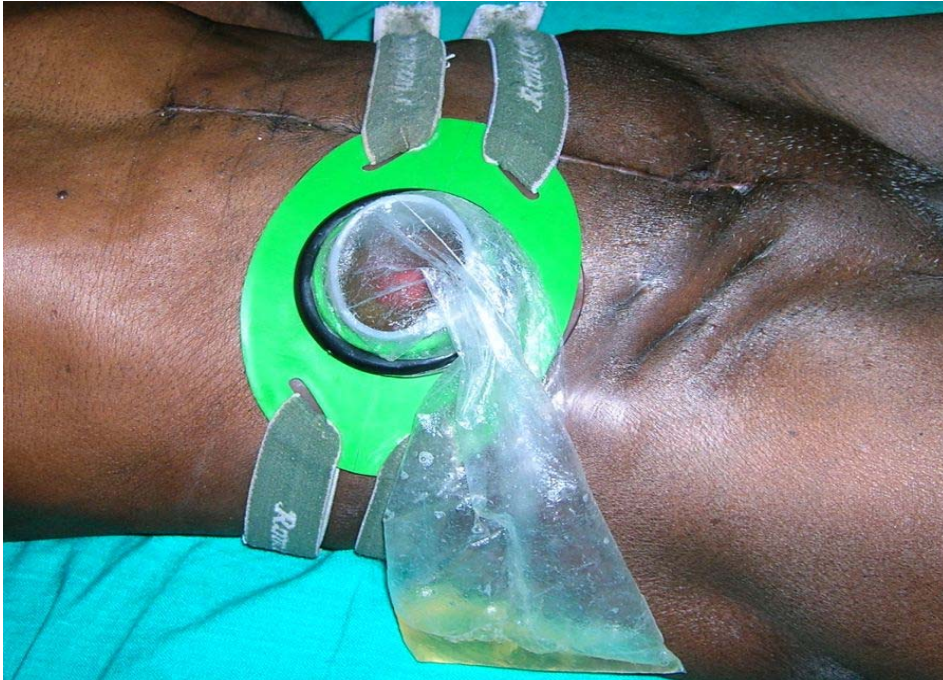
Sigmoid neobladder – Reddy



Gastric pouch



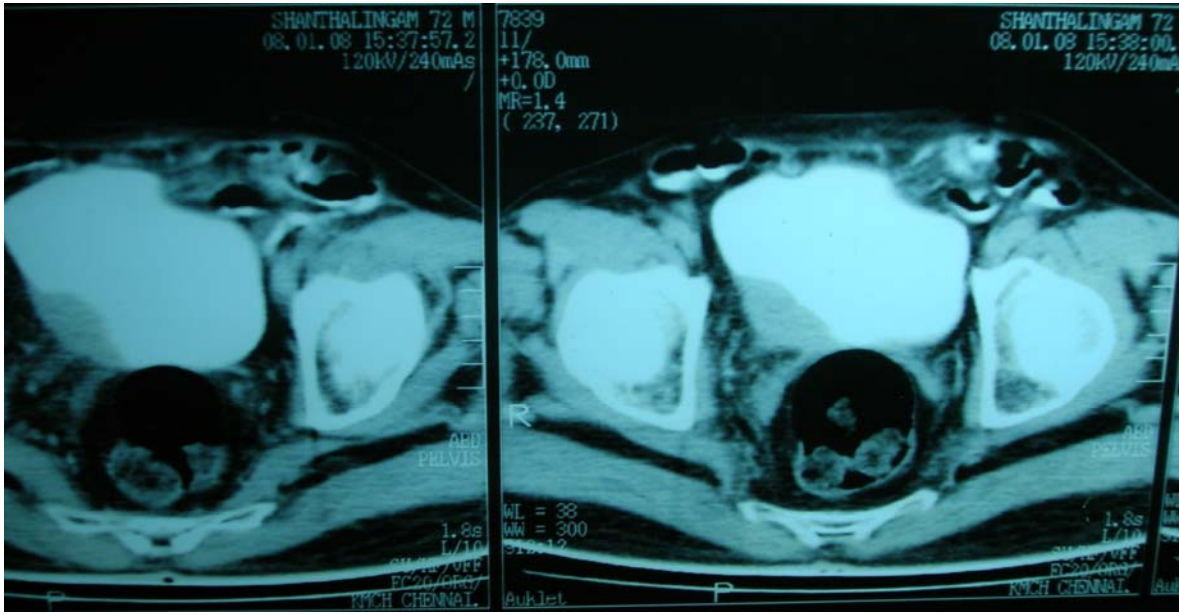
Florida pouch



RADICAL CYSTECTOMY WITH ILEAL CONDUIT



ILEAL CONDUIT WITH ROSE BUD STOMA



C CARCINOMA BLADDER – MUSCLE INVASIVE



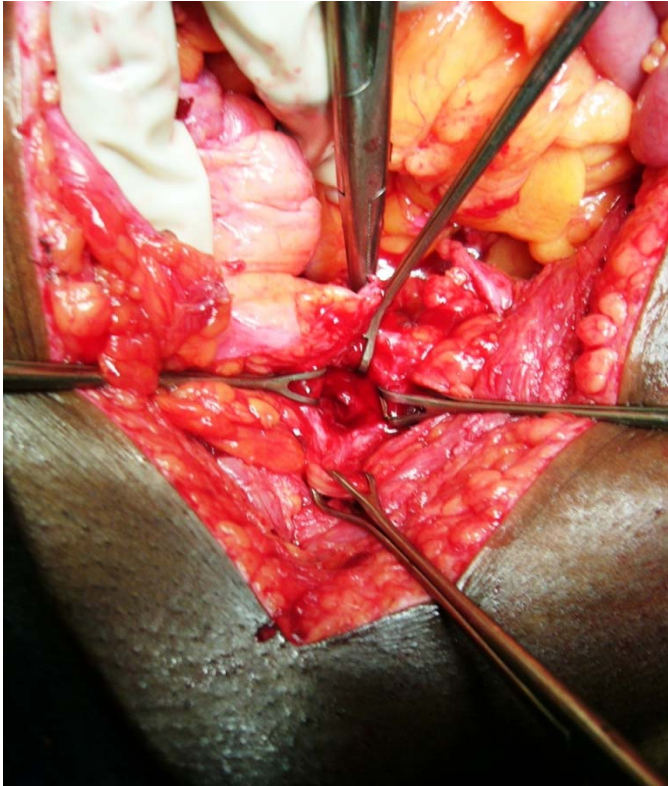
POST OPERATIVE PERIOD - RADICAL CYSTECTOMY WITH ILEAL CONDUIT , same patient shown in CT.



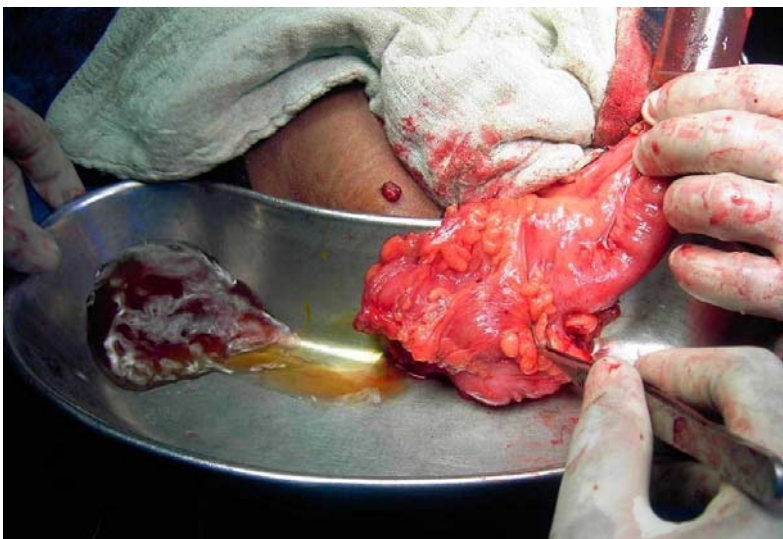
A male patient with THIMBLE BLADDER – GU TB



Another patient with Genito Urinary TB with Thimble bladder

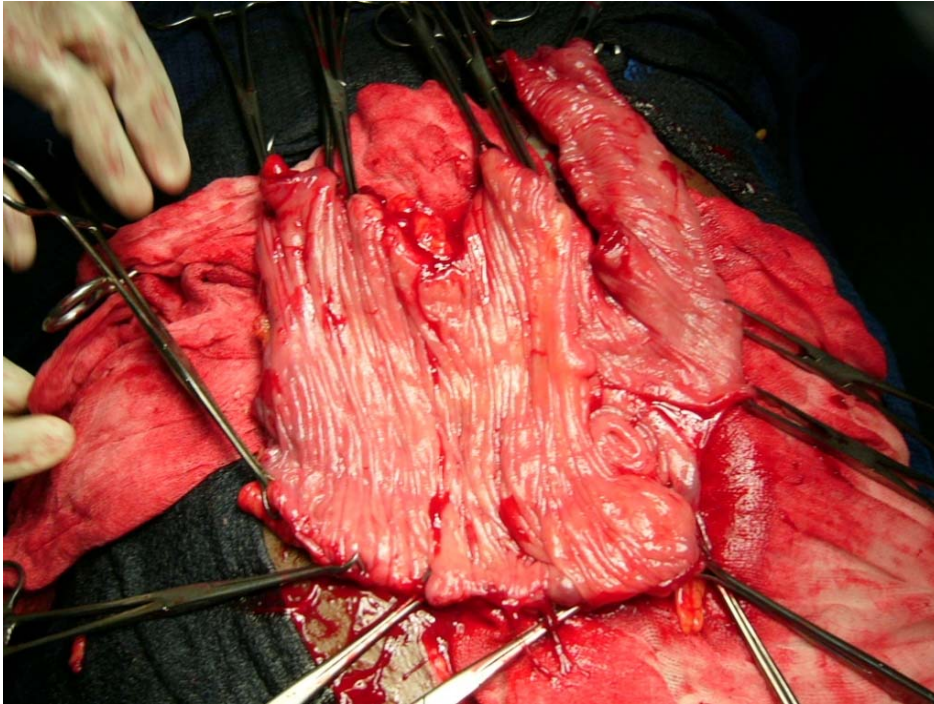


THIMBLE BLADDER opened.

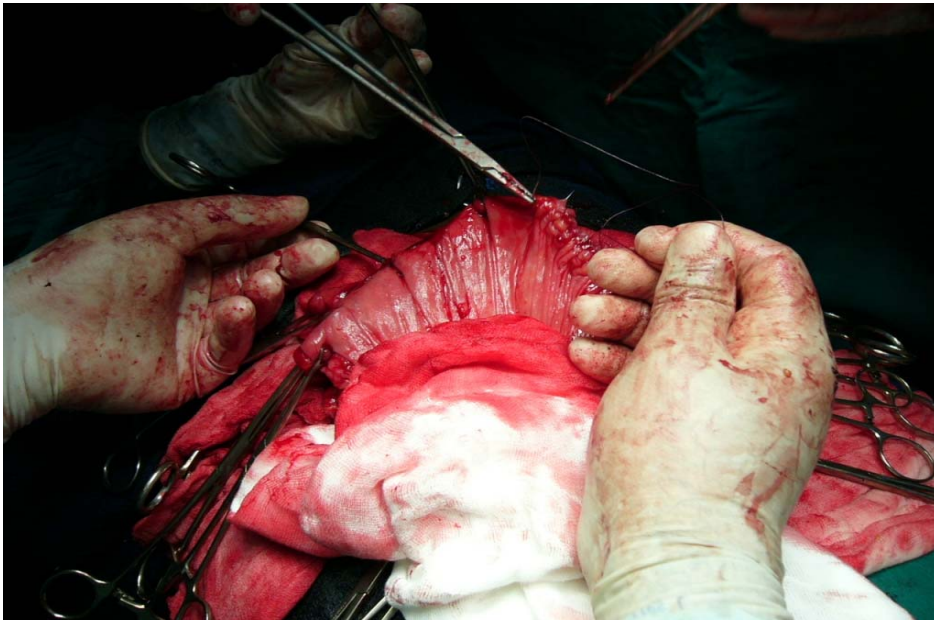


ILEO CAECAL SEGMENT – isolated

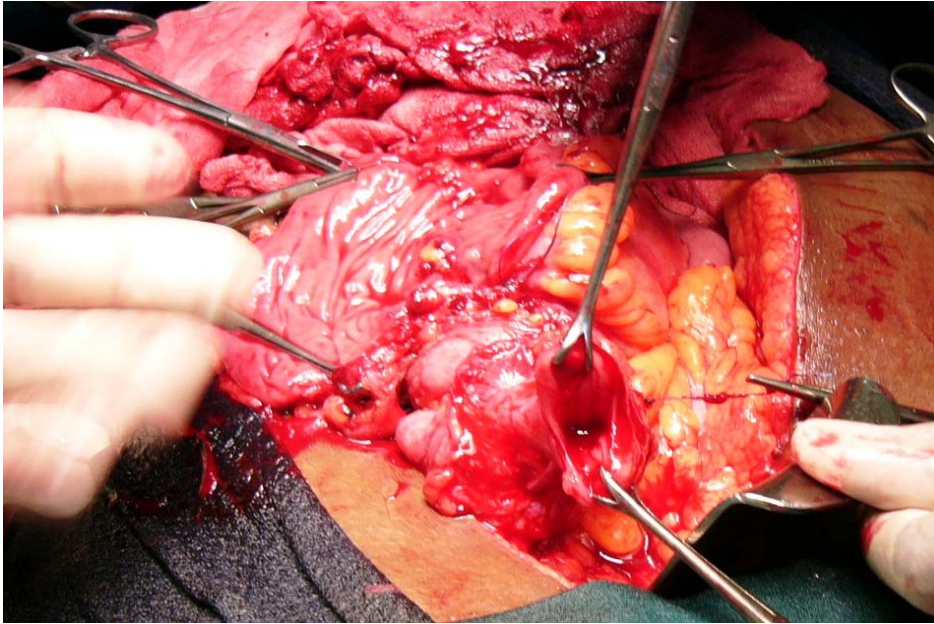




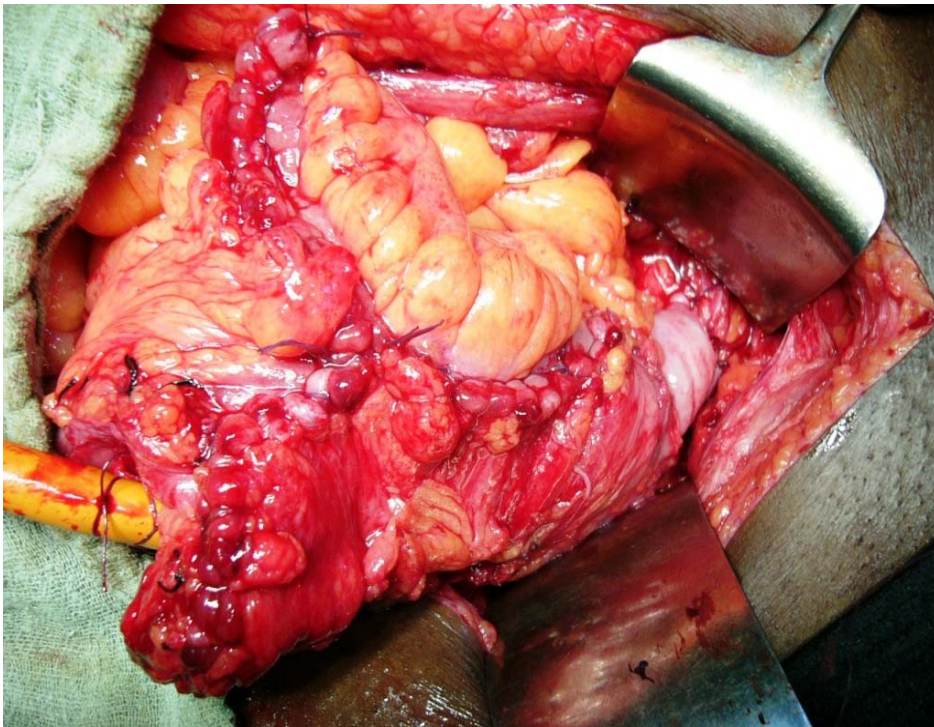
Detubularised Ileo caecal region



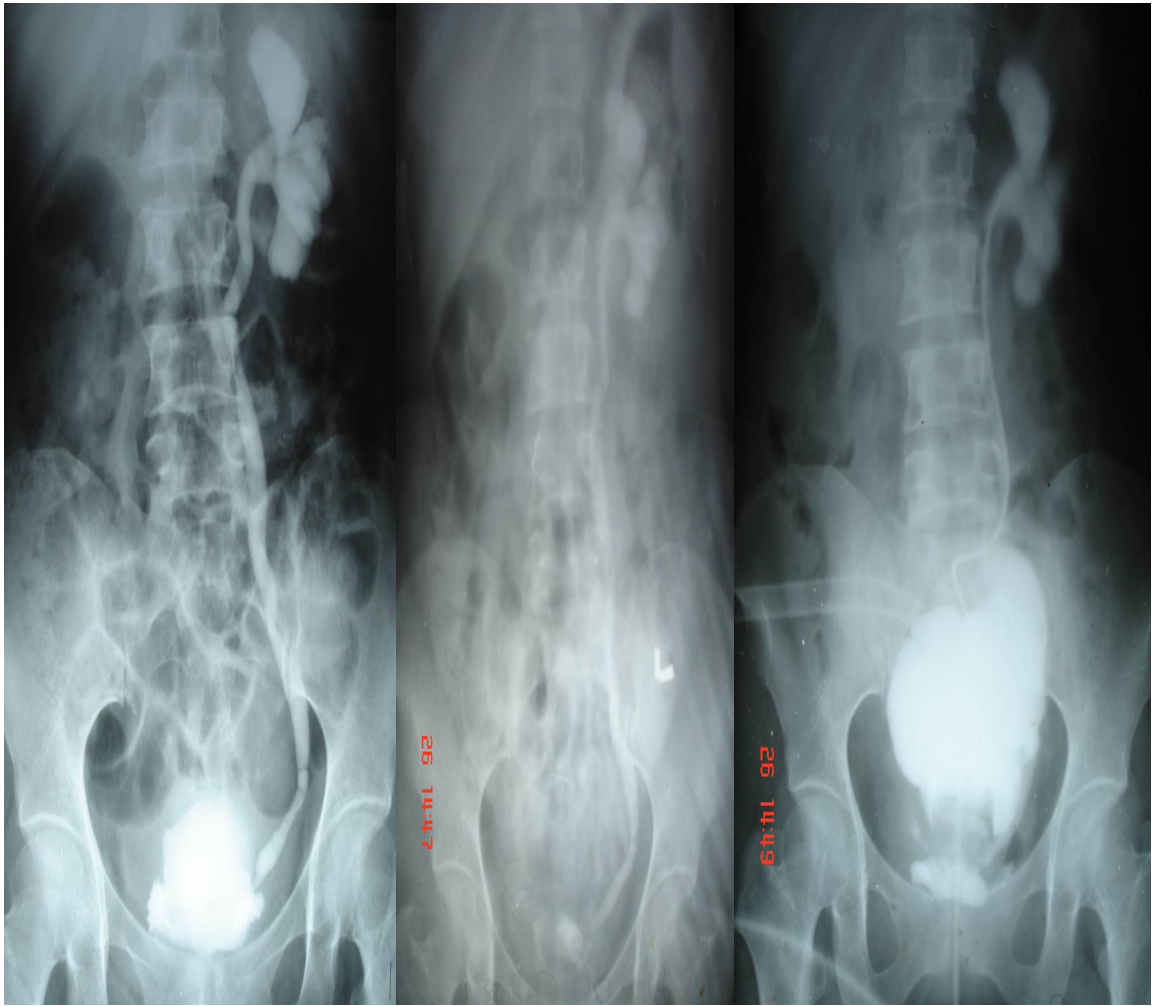
Posterior plate is formed



Augmentation of bladder in progress



Augmentation cystoplasty completed.



BEFORE AUGMENTATION CYSTOPLASTY

AFTER AUGMENTATION CYSTOPLASTY



exstrophy bladder with bone defect



pouch calculus




U CYTO	USG	XRAY	IVU	CT KUB	LFT	S. ELECT	PERFORM	CARDIAC
	SM BL		THIMBLE		N	N		
			THIMBLE		NORMAL	N		
POSITIVE	GR LAT W			LAT W GR	N	N	>90%	
	P CALC	CAL POUCH			N	MET ACID		
			THIMBLE		N	N		
POSITIVE	GR R LAT				N	N	>90%	
POSITIVE				DOME	BORDERL	N		
			THIMBLE		N	CR 1.8		
POSITIVE				TRIG LT L	N	N	>80%	
			THIMBLE		N	cr1.8mg%		
			THIMBLE		N	MET ACID		
					N			
POSITIVE				RT LAT	N		>80%	
				LEFT LAT	N	N	>90%	
	GR RT LAT							
POSITIVE							>90%	
POSITIVE							>90%	
			THIMBLE					
			LOW UR ST				KARNOFS	
TES : Na	135to145							
K+	3.5 TO 5							

CL	105TO108	mEq/L						
HCO3	23TO25							

