Urinary Diversion and Augmentation

4 main types of urinary diversion:
- Ureterosigmoidostomy
  - Mainz II
  - Mansoura rectal bladder
- Ileal conduit
- Cutaneous continent urinary diversion
  - Mainz I
  - Kock pouch
  - Indiana pouch
- Orthotopic urinary diversion
  - Studer pouch
  - Hautmann pouch

4 functional components of lower urinary tract:
- Non-refluxing
- Low pressure reservoir
- Continence mechanism
- Conduit to surface

Type	Reservoir	Conduit	Sphincter
Ileal conduit	-	ileum	-
Mainz ureterosigmoidostomy	sigmoid	anal canal	anal
Indiana continent pouch	caecum	ileum	iliocaecal valve
Ileal neobladder	ileum	urethra	rhabdosphincter

<u>Ileal conduit urinary diversion</u>
Originally described by Zaayer in 1911, popularised by Bricker in early 1950s
Reliable, easily performed procedure which has stood test of time
Typically 10-15 cm of ileum, 10-15cm from ileocaecal valve
Uretero-ileal anastomosis: largest data from Bricker (7% stricture, 4% leak); lowest stricture and leak rate with Wallace Y technique (3% stricture, 2% leak)
Contraindications:
- Short bowel syndrome
- Inflammatory bowel disease
- Pelvic irradiation

Complications
- Early
  - General (Infection, bleeding, DVT/PE)
  - Specific (related to anastomoses)
    - Urine leak
    - Bowel leak
    - Intestinal obstruction/prolonged ileus
    - Stomal necrosis
    - Stomal bleed
- Late
  - General (problems with scar, incisional hernia)
  - Specific
    - Stomal complications 20%

- Parastomal hernia
- Stomal stenosis
- Stomal retraction

Conduit complications

- Stenosis
- Volvulus
- Excessive length
- Stone formation

Upper tract dilatation* 30% (of which)

- Renal impairment 18%
- Dialysis dependence 7%
- Death from ESRF 6%

Pyelonephritis (commonest acute complication)

Renal deterioration**

Stone formation

Metabolic complications

- Previously thought to be over-reported
- Recent studies suggest 13-21% risk of metabolic complications
- Typically hyperchloraemic metabolic acidosis and low B12

Pyschological

- Lower reported QOL and sexual function vs. continent urinary diversion (Gerharz 1998)

***** Few studies performed analysing natural history and aetiology of renal unit deterioration. Important to differentiate patients with pre-diversion renal tract dilatation from those with normal units pre-surgery who subsequently develop dilatation. Good study by McNeal (1989) who compared urodynamics in patients with normal upper tracts and those with progressive dilatation after IC. High pressure high amplitude contractions predicted dilatation – half got better after revision of stoma ? due to stomal obstruction. Other causes of obstruction believed to be at uretero-ileal anastomosis, and the left ureter as it courses under the sigmoid mesentery.

** Renal deterioration usually a function of **infection, stones or obstruction**
Reflux of infected urine particularly damaging, leading to renal dilatation, recurrent pyelonephritis, stone formation and scarring. Good animal evidence to suggest that non-refluxing uretero-ileal anastomoses may prevent upper tract deterioration, but not reproduced in adults: experiments with colonic conduits containing non-refluxing ureters a/w similar upper tract effects.

<u>Ureterosigmoidostomy</u>
Oldest form of clinically applied urinary diversion
Early experience led to very high morbidity and mortality, particularly from obstruction and sepsis – improved somewhat by Leadbetter tunnelled anti-reflux anastomosis in early 1950's
However, very high intrarectal pressures (up to 200 cm water – Coffey 1911) led to persistent pyelonephritis and incontinence, and thus superseded by ileal conduit urinary diversion

Recent resurgence in interest stimulated by a number of modifications, designed to reduced intraluminal pressure (examples include Mansoura and Mainz II). A number of proponents believe this to be the diversion of choice in patients requiring a urethrectomy, particularly in developing countries as access to external appliances extremely limited.

- Mansoura rectal bladder
  - Sigmoid intussusception to prevent reflux of urine into colon
  - Ileal augmentation of sigmoid to reduce intraluminal pressure
  - Ureters anastomosed to form a Kock nipple
- Mainz II
  - Sigmoid opened longitudinally and closed transversely
  - Tunnelled ureterosigmoid anastomosis
  - Modified Mainz, incorporating ileal chimney

Contraindications

- Poorly functioning anal sphincter (neuropathy, prolapse etc)
  - Exclude with manometry or porridge test
- Pelvic radiotherapy
- Severe sigmoid diverticulosis

Complications

- Early
  - General
  - Specific ~5%
    - Urine leak
    - Bowel leak
    - Intestinal obstruction/prolonged ileus
- Late (Relatively scare long-term data for modified procedures)
  - General
  - Specific
    - Hyperchloraemic acidosis
      - ~50% of patients
      - Uncorrected may lead to bone demineralisation and osteomalacia – difficult to spot on normal x-ray
      - Usual presentation with acute metabolic acidosis due to intercurrent illness (severe thirst, N+V, salty taste in mouth, fatigue, rectal urge and diarrhoea) – treat with rectal catheter, sodium bicarbonate and IV hydration
      - **Nocturnal emptying mandatory to avoid severe acidosis**
      - Prophylaxis with 100-150 mmol/day sodium bicarbonate
    - Ureterosigmoid cancers
      - ~1500 x increased risk cf. general population
      - Affects one third of long-term survivors > 20 yrs post-surgery
      - 90% anastomotic
      - 95% adenomatous

Faeces and urine admixture crucial for liberation of carcinogenic initiating chemicals (?N-nitroso compounds).
Long lag-time – 18 yrs for benign tumour; 23 yrs for malignant tumour

Renal deterioration
Limited long-term data
Similar results to IC urinary diversion

Incontinence – very low
Daytime >99%
Night-time 97%

<u>Cutaneous continent urinary diversions</u>

Multiple differing procedures reported

Many reliant on clean intermittent self catheterisation, popularised by Lapides (1972). All require a low pressure reservoir and continence mechanism

Long-term results impaired by difficulties maintaining long-term continence mechanisms and conduit patency

Subsequently superseded by orthotopic bladder substitution techniques, utilising rhabdosphincter and urethra.

Thus, the use of a cutaneous continent urinary diversion tends to be reserved as a option for patients after urethrectomy.

Tissues that may be used in the construction of continent urinary diversions

Reservoir	Conduit	Control mechanism
Bladder	Urethra	Urethral sphincters
Stomach	Appendix	Mitrofanoff
Ileum	Ileum (tubed)	Kock
Cecum	Ileum (natural)	Ileocecal valve
Colon	Ureter	Anal sphincter
Rectum	Skin tube	Artificial sphincter

Examples:

Kock pouch
Ileal reservoir
Intussuscepted ileal nipples - x1 to ureters, x 1 to skin to form catheterisable conduit

Mainz I
Caecum and ascending colon detubularised and closed
Tunnelled ureters into wall of reservoir
IC valve intususseppted into pouch
Catheterisable ileal conduit

Indiana
Detubularised caecum
IC valve forms continence mechanism
Ileal catheterisable conduit

Contraindications to retentive diversion

Renal impairment
- eGFR < 60ml/min
- Urine pH <5.8 after ammonium chloride loading test
- Osmolality < 600mosm/kg in response to water deprivation

Hepatic impairment

Bowel dysfunction
- Short bowel syndrome (<1.5m)
- Inflammatory bowel syndrome
- Previous pelvic radiotherapy

Long-term chemotherapy*/disease modifying drugs (e.g. methotrexate)

Psychiatric disorder

Unable or unwilling to perform CISC

Possibly age > 65 years (higher nocturnal eneuresis with orthotopics)

* All patients undergoing short-term chemotherapy require pouch catheterisation beforehand to prevent toxicity

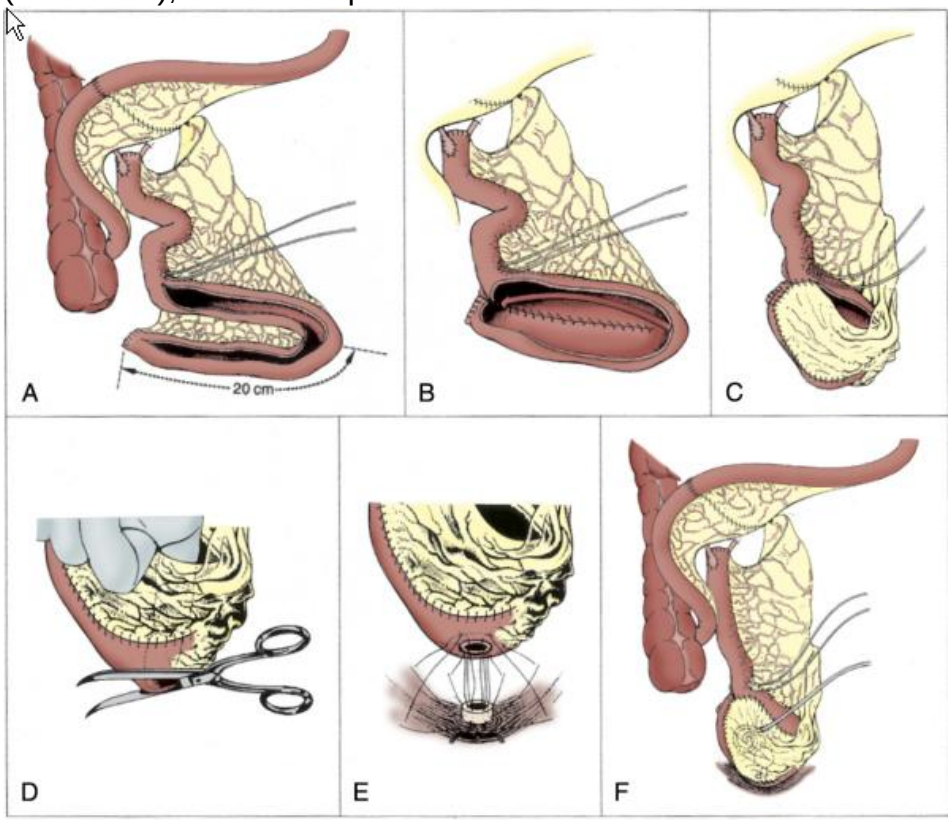
Complications of retention diversion
- Infection
- Stone formation
  - Particularly bad when staples are present in reservoir
- Upper tract dilatation
  - Equivalent to ileal conduit
  - As cutaneous continent diversions cannot leak anti-reflux mechanism mandatory to avoid upper tract dilatation. Less important with Studer pouch/chimney
- Renal impairment
- Reservoir rupture
  - Severe complication
  - Occurs in ~1% of cases (kids >>adults)
  - Sudden onset of abdominal pain, peritonitis and reduced catheterisation volume (Treat with IVI, IVAbx and catheter, with recourse to laparotomy if fails to settle).
- Metabolic abnormalities
  - Typically hyperchloreamic metabolic acidosis
- Malignancy
  - True risk of malignancy in patients with bowel mucosa exposed to urine (without faeces) is unknown
  - No malignant neoplasms in ileal conduits (adenomas occasionally)
  - A small number of pouch neoplasias have been identified, a majority in patients with diversion for TB bladder. Interestingly most occurred around anastomosis, suggesting urothelium may be susceptible rather than enteric mucosa.
  - High levels of nitrosamines identified in cystoplasties, particularly in those with positive urine cultures: ?bowel mucosa permissive for persistent infection, leading to bacterial conversion of urine, with subsequent initiation of cancer in urothelium.

Orthotopic bladder substitution

Currently favoured bladder substitution method in those with retained functioning urethra and sphincter

Originally pioneered by Camey and DeLuc in 1979

Many different reported technique, including Camey II, Hautmann W, Studer (see below), and orthotopic forms of Mainz and Kock.



All obviates need for bag, neo-sphincter mechanism or catheterisable conduit

Vast majority of patients dry, without requirement for ISC – usually empty bladder to completion by valsalva and relaxation of pelvic floor

However well known that neobladders expand (up to seven fold) with time and requirement for ISC may develop in up to 30% after 5 yrs

Similar complications to continent urinary diversions above

Quality of life and urinary diversion

Early studies showed no difference between IC and continent diversion for a number of parameters

More recently widely believed that continent diversion is superior to IC in terms of sexual relationships self esteem and social interaction.

However, no randomised controlled trial

Two carefully performed reviews both concluded that there is insufficient evidence that one diversion better than another(Porter; Gerharz; both J Urol 2005) - emphasises requirement for careful patient counselling and selection prior to diversion