GU Interventions

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History of GU Interventions

- Percutaneous nephrostomy - 1955
- Percutaneous stone removal - 1976
- Ureteral stent placement - late 70’s
- ESWL - 1982
- Percutaneous tumor ablation - late 90’s
GU Interventions

- Percutaneous nephrostomy (PCN)
- Percutaneous nephrolithotomy (PNL)
- Percutaneous ureteral interventions
- Percutaneous collection drainage
- Percutaneous biopsy
- Percutaneous tumor ablation
PCN - Indications

- Relief of obstruction
- Treat urinary leak/fistula
- Symptomatic stone disease
- Complex urinary tract infections
- Ureteral interventions
- Diagnostic and therapeutic endourologic interventions
PCN – Avascular Plane
PCN – Injection of Air
PCN – Adjacent Organs
PCN – Access

- **Lower calyceal group**
  - best suited for **simple drainage**
  - usually via a **posterolateral approach below the 12th rib**
PCN – Access

- Middle calyceal group
  - optimal access when ureteral manipulation is expected or targeted PCN
PCN – Access

- Upper calyceal group
  - usually reserved for complex manipulations (Staghorn calculus)
  - increased risk for bleeding and pleural transgression when above 11th rib
PCN - Procedure

- Prone position, IV sedation
- **Guidance** - ultrasound/fluoroscopy
- **Access** - use of 0.018-0.035 conversion system
PCN - Procedure

- Sample of urine for culture
- Do not **overdistend** a potentially infected system
- Delivery of 8-10F Cope loop catheter
PCN - Complications

- **Hematuria**

  - progressively decreases during the first 24 - 48 hrs

  - major bleeding reported in 1-2% of the cases
PCN - Complications

- **Hematuria management**
  - catheter upsizing
  - catheter clamping
  - tamponade balloon catheter (large tracts)
  - blood transfusions
  - renal arteriography/transcatheter embolization
PCN - Complications

- **Sepsis** - 1%
- Inadvertent adjacent organ injury
- **Catheter dislodgement/blockage**
Potential Pitfall: XGP
Xanthogranulomatous Pyelonephritis

- 5th - 7th decade, Female > Male
- Diffuse (90%), Segmental
- Plasma cells + lipid-laden macrophages (xanthoma cells)
- Anemia (70%), elevated LFT’s (25%), diabetes (10%)
- Enlarged, malfunctioning kidney with central obstructing calculus
- DDx: hydronephrosis, avascular tumor
Pediatric Nephrostomy

- **Micropuncture vs. modified two-step**
- **Modified favored in dilated systems (UPJ)**
- **Micropuncture favored for non-dilatation, distal obstruction, coagulopathy**

Koral K et al. JVIR 2003; 14:113-116
Stone Therapy

- Most calculi < 8mm will pass
- Open surgical techniques are seldom used
- ESWL remains the primary modality for stones below 2-3 cm
- ESWL limitations
ESWL - Limitations

- Large stones > 3 cm
- Stone in lower calyx
- Impacted, large ureteral stones
- Anatomic abnormalities preventing stone passage
- Staghorn calculi - produce large fragment burden, risk for sepsis
- Pregnant or pediatric patients
PNL – Tract Selection

Upper, mid or lower?
PNL - Results

- **Success** - 95%
- **May require more than one intervention or tracts**
- **Complications higher than PCN**, occur in 4-8%
- **Most common complications include perforation of the renal pelvis and bleeding**
Decompression In Stone Disease

- Obstruction, infection, renal deterioration, intractable pain
- **PCN vs. DJ**
- UCSD favors PCN
PCN vs. Ureteral Stent

- Prospective, randomized, stone hydro
- 40 patients: 20 PCN, 20 DJ
- Tech success: 100% PCN, 80% DJ
- Failure of DJ in prox stone, age > 60
- PCN shorter indwelling time (p= 0.043)
- Clinical course/QOL: Tendency in favor of PCN
- No mention of complications rates

Percutaneous Renal Access

Additional Indications

- Endourologic management of upper tract TCC including biopsy
- Chemolysis for stone therapy
- Management of fungal disease
- Endopyelotomy for UPJ obstruction
Percutaneous Ureteral Interventions

- Ureteral stent placement
- Ureteral stricture dilatation
- Ureteral occlusion
40 y/o woman with flank pain and hydrenephrosis
Ureteral Stent - Indications

- Similar to PCN - leak, obstruction, stone, fistula
- As a scaffold following balloon dilatation, endopyelotomy, or PNL
- Intra-operative ureteral identification in pelvic surgery
Ureteral Stent – Good or Bad?

- Finney and Hepperlen (1975)
- Urine flows through and around stents
- Ideal material not yet available
- Issues with infection and encrustation
Ureteral Stent - Types

- Double pigtail stents - internal drainage
- Nephroureteral stents - both internal and external drainage
Issues with “Double J”

- **Advantages:**
  - decreased rate of infection
  - better patient acceptance (maybe)

- **Disadvantages:**
  - difficulty in assessing for occlusion
  - require exchange every 3 - 6 months
Ureteral Stent - QOL

- 85 consecutive patients (73%)
- 78% bothersome urinary symptoms
- > 80% with pain affecting daily activities
- 32% sexual dysfunction
- 58% reduced work capacity

Ureteral Stent - Biomaterials

- **Polyurethane, silicone, Silitek, C-Flex, Percuflex and metal**
- **PU**: highly versatile and inexpensive, > urothelial ulceration and erosion
- **Silicone**: better tissue compatibility 2nd to its nontoxic and inert nature
Ureteral Stent - Biomaterials

- Encrustation due to rx of magnesium ammonium phosphate to urease + bacteria (Abber JC, Kahn RI. J Urol 1983; 130: 763)
- Coatings: Hydrogel
Ureteral Stent – What’s New?
Coatings

- **Goals:** facilitate delivery, reduce encrustation
- **Materials:**
  - Polyvinylpyrrolidone
  - Phosphorylcholine
  - Heparin
  - Oxalate degrading enzymes
  - Silver nitrate and ofloxacin
Multiple Double J’s

- Failed single stent
- Extrinsic compression
- Malignancy

Ureteral Stent - Placement

- A middle calyceal approach is preferred
- 6-8F, 22-26cm
- Smaller stents for stones, larger for malignancy and following dilatation
- Careful assessment of intraluminal location both in the ureter and bladder
Ureteral Stent - Complications

- Urinary symptoms: pain, dysuria, hematuria, incontinence, bladder irritability
- Encrustation
- Infection
- Migration, fragmentation
Ureteral Stricture Dilatation

- Balloon dilatation has modest results (50%)
- Most effective in short, recent onset and proximal strictures
- Malignant, irradiated, ischemic, inflammatory and anastomotic strictures respond less favorably
Percutaneous Collection Drainage

- Renal and peri-renal abscess
- Urinoma
- Lymphocele
Renal/Peri-renal Abscess

- **Predisposing factors:**
  - Diabetes
  - Urinary calculi
  - Obstruction
  - Debilitated

- Mortality as high as **50%**

- Drain left in place until output decreases to 5-10ml in 24hrs
Urinoma

- **Etiologies:**
  - iatrogenic
  - tumoral
  - traumatic
  - inflammatory
  - obstructive
  - renal tx

- Management usually includes percutaneous drainage plus PCN and ureteral stent placement
Lymphocele

- Common as a complication following lymph node dissection and renal transplantation
- May be symptomatic when infected or by extrinsic compression to adjacent structures
- Simple drainage yields unsatisfactory results
Lymphocele

- Sclerosing agents: ethanol, iodopovidone and tetracycline
- Mixed results
- Rule-out communication to bowel or urinary tract
- Half of cavity volume instilled with sclerosant with dwell time of 30-60 minutes
- Complication: 1) cavity superinfection 2) communication injury
Percutaneous Renal/Adrenal Biopsy

- **Mets, lymphoma, limited kidneys**
- **RCC** – core for genetics, expectant management for low grade tumors, Cryo
- Transhepatic route for adrenal
Renal Tumor Ablation

- Parenchymal sparing surgery (*Herring J Urol 2001*)
- Small, incidentally discovered renal tumors
- Radiofrequency ablation, cryoablation, interstitial laser and high intensity ultrasound have been used
- Percutaneous or laparoscopic technique
Renal Cryo

Nonsurgical candidates
- solitary kd
- mets
- multiple RCC’s

Small < 3cm
Peripheral
- anterior: lap
- posterior: perc
Preprocedural CT
2.4 Endocare cryoprobes – placed probes at a superior and inferior locations
Two Freeze-thaw cycles
Patient Selection

Nephron sparing surgery:
Partial nephrectomy recommended for all T1 tumors < 7 cm (as long as margins can be removed and expected morbidity is acceptable)

Cryoablation
• Not surgical candidate
• Likely to develop numerous tumors (VHL/elderly)
• Ideal Tumor: small (< 4 cm), partially exophytic, posterior  
  – Central and Larger tumors: higher rate of tx failure and hemorrhage
• Relative contraindications: younger patient age, large tumors, hilar/centrally located tumors, and cystic neoplasms
Technique

• Probes should be positioned 1 cm from the tumor margin and 1–2 cm from each other
• The use of multiple probes creates a synergistic effect that results in the formation of even more ice
• Two 10 minute freezes (argon) cycle separated by a 8 minute passive thawing (helium) cycle
• Can perform open, lap, or perc
  – Lap: anterior location, larger cryoprobes, surgical hemostasis
  – Perc: posterior location, CT/US with accurate depiction of ablative zone, less invasive, better M&M
How does it work?

- **Synergistic effect**
  - Intracellular and extracellular ice crystals are directly cytotoxic and lead to cell dehydration and rupture.
  - When thawed, there is microvascular occlusion with cell hypoxia resulting in indirect ischemic injury.

- **Cell death is time and temperature dependent**,
Imaging Follow-up

• Lack of enhancement and decrease in size are reliable indicators of successful cryoablation
  – CT 3/6/12 months, yearly afterwards
  – Benign peripheral contrast enhancement may persist for several months
  – Nodular, irregular or crescent shaped enhancement is suggestive of residual tumor
  – Residual viable tumor is typically T2 hyperintense and enhances.
  – Doubtful cases – targeted biopsy
Complications

- Hemorrhage
- Urine leak
- UTI
- Pain
- Transient elevation of creatinine
- Incomplete treatment
Midterm follow-up study evaluating safety/efficacy of cryoablation

- Prospective nonrandomized – 95 patients (nonsurgical candidates)
- Mean followup: **28 months** (range 6-63 months)
- Mean tumor size: 26 mm (range 10-68 mm)
- 91 treated with CT guidance, 29 with MRI guidance
- **Technical success rate 94%** (two tumors required second cryoablation due to recurrence/residual tumor)
- **Complication rate 7.3%**
  - Bleeding
- Survival: **After 12 months – 96.7% and disease free rate 96.4%**
- Renal function was unchanged even in those with only 1 kidney
- Limitations of study: short follow-up, assessment of tumor ablation based on radiology without pathologic correlation
Cryoablation vs RFA

- Cryo
  - Less painful
  - Monitoring ablative zone
  - Bleeding

- RFA
  - Less bleeding
  - Ureteral injury
  - Higher recurrence, especially central