Update on Urological Intervention

This brief presentation will focus on recent reports that provide updated information about or suggest improvements to the standard procedures with which we have significant previous experience, or introduce new procedures. In addition, recent information about interesting or severe complications will be discussed.

New information about the standard procedures

The standard procedures include percutaneous nephrostomy, ureteral dilation and stenting, percutaneous ureteral occlusion, renal biopsy, drainage of urinomas, hematomas and abcesses, stone removal and endopyelotomy. Standard percutaneous nephrostomy catheter placement for external drainage using ultrasound and fluoroscopy, should have a high rate of technical success, reported in two recent studies as 99% (Farrell) and 98.5% (Gupta), and a low complication rate of 5.6% (Gupta) to 6.5% (Farrell) overall with a 2.8% rate of bleeding requiring therapy (Farrell). However, we often place nephrostomy catheters into kidneys simply because they are obstructed without carefully evaluating the effect on the patient's life as a whole. This was pointed out in one recent study (Emmert) in which it was clear that technically successful nephrostomy drainage in patients with end-stage metastatic cervical carcinoma did not benefit the patients. One recent, fascinating study (Lang) investigated the effect of educating the technologists and nurses about non-pharmacologic methods of pain control and found a reduction in both pain medication usage and the level of procedural pain reported by the patients. Reports about stone removal continue to indicate that percutaneous debulking is frequently of value for large stones and in combination with ESWL for struvite stones (Wang). In a study of 60 staghorn calculi (Mattelaer), 34 required percutaneous procedures in addition to ESWL to achieve a 60% stone-free rate at a mean follow-up of 72.4 months. In another study (Saxby), percutaneous removal was clearly superior to ESWL for all stones > 2 cm. In one of the few prospective, randomized studies in the literature (Meretyk), PCNL plus ESWL (23 patients) was significantly superior to ESWL alone (27 patients) in the treatment of staghorn calculi. Percutaneous tract creation and stone removal have also been shown, using sensitive scintigraphic methods, to be safe and result in no significant loss of renal mass (Balbay). Using serum and urine chemical and enzyme markers, another study (Saxby) clearly showed that PCNL did less acute damage to the kidney than ESWL although almost all tests had returned to normal in their small study group by 2 weeks. It was even safe in children (Mor) resulting in a scar in only 1 of 25 children who were successfully treated with percutaneous techniques such that they achieved a maximal stone-free rate of 92%, often when other methods had failed. Treatment of ureteral stones often involves the placement of a ureteral stent. In one study (Deliveliotis), this was the only treatment given and, after the stent was removed after 2 weeks, resulted in 34 of 40 (85%) patients passing the stone (mean size 5.1 by 3.5 mm). Ureteral occlusion techniques have had mixed results except for ureteral clipping (Farrell) which is more invasive and requires more dedicated equipment than other percutaneous techniques, but is uniformly successful. In a report about the technically easier approach using intraureteral coils and gelfoam (Farrell), 100% technical and clinical success was also achieved without any major complications over a mean follow-up of 6.2 months. Reestablishing ureteral patency with dilation and stenting has had mixed reviews. This is

particularly true in the transplant population. In a recent study of urological problems in transplant patients (Fontaine), 59% of patients with a leak were able to be cured without surgery, and of those with an obstructive problem, 62% with an obstruction occurring within 3 months of transplantation were cured by percutaneous techniques compared to only 16% of the later developing stenoses. The best way to "treat" transplant urological problems would be to prevent them which was the subject of a recent report (Butterworth) which showed that creating the distal anastamosis with an extravesical technique over a stent markedly reduced postoperative urological complications compared to the standard Politano-Leadbetter technique. A similar experimental study in rats (Jablonski), showed that allografts that had stented ureteric anastamoses had a surprising decrease in allograft glomerulosclerosis compared to those with sewn anastamoses. Renal biopsy has traditionally been done by nephrologists after ultrasonographic "marking" of the kidney. This technique was compared in a non-randomized fashion to an ultrasound-guided "biopsy gun" technique (Nyman) and, not surprisingly, the guided technique was found to have fewer complications (0 of 213 compared to 8 of 235) and to yield superior samples.

Suggested improvements to the old standards

Most of these suggested improvements involve changes in technique or equipment. Some variations in technique are minor such as performing nephrostomy catheter placement as an outpatient procedure (Gray) but could have a significant impact on cost and practice patterns if the results generally are as successful as this study which reported 100% technical success in this carefully selected group of 48 patients (out of 589 patients in that time interval), and that 42 of the patients were able to manage the post-procedure course completely as outpatients. The 6 who were admitted had no major complications. Another relatively minor change has been the change from cystoscopic to fluoroscopically guided techniques for double-J stent removal or replacement. We (Nazarian) and others (Wetton) have used this technique for years, successfully both in men and women and in native and transplant ureters, utilizing the Amplatz snare to engage the lower end of the stent in the bladder. The technical success rate should be close to 100% with the only truly "difficult" cases being male renal transplant patients in whom the stent must be brought down only into the prostatic urethra for recanalization with a wire, to avoid loss of access to the ureter. A recent report which favors the use of a rigid forceps under fluoroscopic control to grasp the stent (Breen), seems unnecessarily risky in terms of the possibility of perforation. Sometimes, the change in technique represents a rather dramatic departure from the standard and almost a new procedure. This is the case for a report of a series of percutaneous nephrostomy catheter placements (Barbaric) done under combined CT (puncture) and fluoroscopic (placement) guidance in the supine oblique position. The technical success rate was 97% (144/147) and there were no major complications which represents an improvement over even the most recent standard technique reports. Some variations in equipment like a report about the Korth Endostent (Korth), don't result in an overall improvement but demonstrate changes in the pattern of the results. Use of the Korth endostent resulted in a decrease in post-procedure fever and, somewhat remarkably, demonstrated better results with secondary (especially anastamotic) stenoses which have been troublesome with the standard techniques. A possible method to decrease post-procedural pain after endosurgery, and to reduce the length of hospital stay

and costs (Candela) involves the removal of all tubes after endourological procedures and closing the wound with sutures. Remarkably, echo and clinical follow-up in the first 15 patients demonstrated no increase in the incidence of urinomas or infection, a result which certainly needs verification. The question of the “optimal” stent size continues to be debated in the literature. In a recent pig study (Anidjar), experimental endopyelotomies were stented with 12 Fr vs 7 Fr stents and showed no difference in the restenosis rate (1 of 5 in each group) and greater histological reaction to the 12 Fr stent. Although these results favor the use of a “smaller” stent for this problem, the question of what the appropriate stent size is to treat malignant stenoses where there is little or no chance for the ureter to develop flow “around” the stent, awaits a good randomized study. The question of how much the flow “around” the stent contributes to overall stent function, is a significant one and probably differs based on stent size, length of time that the stent has been in place, and the underlying pathology. In a recent, very interesting clinical study (Patel), 11 of 15 stented ureters were demonstrated with color flow Doppler to have flow around the stent compared to 8 with flow through the stent. Peristaltic, “ureteric jet” producing flow as is seen with normal ureters, was seen only weakly in 4 of 15. The use of even small stents to treat ureteral calculi has recently been called into question by a study in dogs (Lennon) in which 4 Fr stents caused ureteral dilatation, diminished peristalsis and impaired stone passage compared to a percutaneous nephrostomy tube or no tube at all. In a non-randomized study of patients with small (< 2 cm), solitary renal calculi (Low), stent placement also showed no benefit in terms of symptoms or stone clearance. Similarly, a study of ureterotomy of artificial strictures in dog ureters (Gardner) showed only a small benefit of stenting in the resultant stricture rate (2 of 10 stented animals developed strictures compared to 3 of 5 unstented). Reduction of the problem of chronic infection and colonization of ureteral stents was discussed in an in-vitro study (Cormio) that evaluated antibacterial coatings which had no effect, and antibiotic soaking which had a pronounced effect on bacterial adherence to the stent. In an in-vivo study by the same group (Cormio), intermittent bacterial adhesion to stents did not appear to result in significant clinical problems whereas formation of a biofilm which was not dependent on the type of stent but more on the virulence of the organism, resulted in infection. These results as well as the findings in a review of infectious complications of double-J stents (Eschwege), suggest that prophylactic antibiotics may be warranted for short periods in all patients post-stent placement, and in infection prone patients for as long as the stent is in place. We feel that bactiuria after percutaneous drainage is an underappreciated problem. Occasional studies have monitored nephrostomy patients closely and they usually find that asymptomatic bactiuria is common, as in one study of infants (Van Glabeke) in which bactiuria occurred in 2 of 9 cases. Bleeding is a common but certainly undesirable problem after endourological procedures. One newly developed drainage catheter (Goldfischer), which uses a combination of the Malecot end and a large shaft, was successful in decreasing bleeding problems. An interesting study of bleeding during percutaneous stone removal (Davidoff), showed that tract dilation with a balloon decreased the bleeding during the case compared to dilating with fascial dilators. Our experience strongly supports this study and has also shown us that dilating with a balloon is also technically much easier and faster.

New procedures

Some of these new procedures represent an application of known endourological techniques to other problems such as using the incision and stenting techniques of endopyelotomy to treat stenoses of the infundibulae, or to create a communication between the collecting system and urinary cysts. Others are extensions of techniques from other areas of surgery to the endourological field such as a recent study which used laparoscopic suturing techniques through the endoscope (Oshinsky) to successfully primarily close endopyelotomy incisions in 7 of 8 cases. Some procedures, like the recently reported treatment of ureteral stenoses with the Acucise balloon, required the development of a new piece of equipment. The "cutting balloon" was used successfully to treat a transplant reimplantation ureteroneocystostomy stenosis (Koutani), 9 of 9 transplant ureter stenoses (Bosma) when none of 4 cases treated with standard balloon technique were successful, and 15 patients with native ureteral stenoses (Cohen) who achieved a complete success after only one treatment (usually as an outpatient) in 11 of 15 (73%) with only 2 complications. Of the 4 failures, 2 had post-operative stenoses longer than 2 cm which likely represented areas of ureteral ischemia which is usually resistant to any type of percutaneous therapy. A new type of occlusion device has been described which could potentially provide the easiest way yet to occlude ureters percutaneously (Marr). It is a simple variation of a double body Z-stent that has been constrained at the stent junction to form an "hour-glass" shape, with one stent coated with silicone. Of 9 pigs into which the device was placed, 7 developed immediate complete occlusion with high-grade obstruction in the other 2. Unfortunately, there was no long-term follow-up which can be important since this device, like many other ureteral "plug" techniques, induced a large amount of urothelial reaction which raises the suspicion about the possibility of longer term "tunneling" around the obstruction. Another new technique is the use of a small "trocar" catheter to perform bedside percutaneous nephrostomy catheter placement in infants under ultrasound guidance(Morelli) to allow for renal irrigation in addition to systemic therapy to treat renal candidiasis. We have noticed a significant incidence of fungal infection in patients with chronic double-J stents and gynecological malignancy. The optimal treatment for this problem does not yet appear clear and we are initiating a study to compare systemic therapy to systemic plus irrigation therapy. One completely new approach to percutaneous entry into the kidney (Cadeddu) involves the use of biplane fluoroscopy and a "robot arm" to perform the puncture. The prototype system achieved an impressive 6 of 12 (50%) first stick puncture into the target calyx in an in-vivo pig model. In another report using new guidance techniques (Nolte-Ernsting, personal communication), MR guidance has also been shown to be capable of directing entry into pig calyces with high accuracy even in the non-obstructed system. This gives the interventionalist a tool for puncturing the collecting system of patients who can not tolerate normal iodinated contrast agents and who are too obese to be easily imaged with ultrasound. Other "new procedures" are concerned with the research and development of new materials to overcome inadequacies or complications associated with the standard procedures such as ureteral stent placement. The use of stents to provide internal drainage has been extended to cases where the continuity between renal pelvis and bladder has been totally lost and is not surgically correctable. The stent in some cases that we and others (Postoak) have done, has been placed after "sharp puncture" through the obstruction with a fluoroscopic or visual (endoscopic) target placed on the other side of the obstruction, or in one recent report (Cockburn), placed through a subcutaneous route. The role of such "heroic" stents vis-à-vis the simpler alternative of chronic external

drainage needs to be carefully explored on a case by case basis. Some investigators have claimed that such tunneled stents can eventually be removed and that the “neoureters” will function normally. This has never been true in our experience and a recent study in dogs (Kuzaka) also shows that resected segments of ureter that reestablish continuity after 3 months of stenting have normal urothelium but only fibrous elements in the wall which result in stenoses, even immediately after stent removal. The problem of stent dysfunction in patients without other urinary problems, was found to most commonly be due to encrustation which has prompted investigators to evaluate new materials for stents which would prevent encrustation by being biodegradable. One report (Schlick) mentions 2 new plastics which can be “dissolved” by increasing the urinary pH. Various materials have been tested to see which are less likely to become encrusted (Tunney, Cormio), with silicone being clearly superior for the most common forms, struvite and hydoxyapatite encrustation. There is no question that stents induce histological changes in ureters although the clinical implication of those changes is unclear. In an effort to determine if stent material also affects this problem, a study was done (Cormio) which evaluated different stents in a pig model and showed that hydrogel-coated stents had the least epithelial destruction, but silicone stents induced the least inflammatory changes. The use of metal stents in the ureter must be considered a “new” procedure since the role of metal stents in the treatment of ureteral stenosis or obstruction remains unclear particularly the question about how long they will stay patent. Our experimental results in animals (Hunter) suggest that metal stents, covered or uncovered, lead rapidly to ureteral occlusion which has also been our clinical experience. Similar problems were noted in a recent well documented study which found that 6 of 7 patients with a metal stent in a area of malignant ureteral obstruction developed an intrastent obstruction that was usually due to hyperplastic urothelial overgrowth rather than malignancy (Hekimoglu). However, some reports have appeared recently of long term success especially in malignant disease (Diaz-Lucas, Pauer, Barbalias), using self-expanding and also in one series (Barbalias) balloon-expanded stents, but even then, the need for additional procedures to maintain patency approaches 50% (Pauer) and any additional procedures require starting essentially from the beginning with a new cystoscopy or percutaneous puncture. The technique which did not work in the Hekimoglu study but has been reported to be successful in a study of metal stents in the treatment of ureteral stenosis due to prostate carcinoma (Lopez-Martinez), is to place a double-J stent through the metal stent for, in this case, 2 months, to maintain patency during the time that the stent induced edema is maximal. How this treats the more slowly progressive problem of hyperplastic overgrowth is unclear, and in this as well as the other studies which claim success, survival rates are low and most follow-up appears to be clinical only.

Complications

In a review article (Watson), the adverse effects of double “J” stents on the urinary tract were explored including both histological changes in the ureter and the changes that occur in renal function due to the fact that stents only incompletely relieve obstruction. We have noticed that a disturbing percentage of our patients with chronic double-J stents seem to develop renal dysfunction in the stented kidney. We are in the process of evaluating this problem but have postulated that it involves both chronic recurrent low-grade infections and problems with reflux. Renograms on patients with patent 10 Fr double-J stents, which

are our standard, do not seem to indicate that partial obstruction is as important as suggested by the study by Watson. The problem of stent-induced reflux has recently been addressed by a recent ingenious development of an anti-reflux stent (Friedrich) with a soft Wiruthan membrane valve at the bladder end. They have inserted 340 of these stents into children primarily at the time of surgical repair of a reflux or obstructive problem. The stent can also be inserted endoscopically. It has worked well to both allow restoration of normal renal function and prevent reflux. Further tests of a similar stent design seem warranted in adults. The material malfunction problem of stent fracture was found in two other reports (Gorman, Samson) to be due to fracture at the sideholes. The Gorman study suggested that the problem was not due to material degradation after prolonged periods of in-vivo use or in-vitro immersion in physiologic solutions, whereas the Zisman study found marked material changes in pieces of catheters that had fragmented. Either way, these studies suggest that creation of larger sideholes, as we routinely do for most double "J" stents, must be done with caution both as regards hole placement (away from existing holes) and hole size. The most severe complications in the urinary tract occur during endourological procedures. When life-threatening bleeding occurs after percutaneous nephrolithotomy, which occurred in 0.3% of 3080 cases in one series (Sacha), treatment should proceed directly to angiography since most of these cases involve a direct communication between the collecting system and a branch renal artery or a pseudoaneurysm either of which can often be treated with embolization. Whatever catheter or balloon has been placed in the tract to tamponade the bleeding will often need to be briefly "removed" over a wire to allow the pathology to be detected on the angiogram. When we have had such problems, the patient is prepared and consented for both the interventional procedure and possible nephrectomy. If a drainage catheter is in the tract, the patient is placed prone and the drainage catheter replaced with a balloon catheter, especially a long one such as the 10 mm diameter, 10 cm long Medi-Tech tract creation balloon, so that the entire tract can be tamponaded reliably and quickly. The patient is then placed supine and the angiogram done with the balloon inflated. If a vessel cut-off or wall irregularity is noted in the vicinity of the balloon, that vessel is embolized. If no abnormality is identified, the balloon is momentarily deflated for the next angiogram which invariably demonstrates the point of extravasation or vessel abnormality which is then embolized.

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