number of crystals in the kidney was smaller in Group 5 than in Group 4. Urinary calcium excretion was greater and urinary citrate excretion was smaller in Group 2 than in Group 1. Urinary pH was the same in both groups. The expression of CLC-K decreased in Group 2, compared with Group 1. The NaDC-1 was expressed distinctly in the apical membrane of proximal tubular cells in Group 2. The expressions of OPN and Bik were stronger in Group 2 than in Group 1. In Group 5, urinary pH and urinary citrate excretion increased, and OPN and Bik expressions decreased, compared with Group 4.

CONCLUSIONS: The reduced CLC-K expression in PKD appears to induce cyst formation and prevent calcium reabsorption, resulting in hypercalcemia. Cyst formation retards urinary flow and causes dilution of proximal tubules, which may contribute to decreased urinary citrate excretion and altering NaDC-1 activity. In addition to these changes, the increased OPN and Bik expressions may influence stone formation. Citrate is effective in the prevention of stone formation because it increases urinary pH and urinary citrate excretion and reduces OPN and Bik expressions in the kidneys.

1026 HIGH RESOLUTION VISUALIZATION OF INTERNAL STRUCTURE IN RENAL CALCULI BY HELICAL CT

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INTRODUCTION AND OBJECTIVES: Studies have shown that a significant number of stone patients undergo repeat SWL treatment to remove shock-wave-resistant stones. If the fragility of stones could be predicted at diagnosis, unnecessary shock wave treatment could be avoided. Helical CT has become the preferred method to localize stones, so we assessed whether CT could also give information about stone structure that might be useful for planning treatment.

METHODS: Urinary stones of known composition were imaged with a Marconi MX 8000 quad-slice scanner in vitro, at various slice widths, and images assessed using a range of window settings.

RESULTS: Visualization of stone structure was greatly enhanced by using bone windows and narrow slice width. Stones of similar mineral composition differed dramatically in their CT-visible structure, as shown below for three calcium oxalate monohydrate acid (COM-UA) stones. Stone on left shows close intercalation of COM and UA; middle stone shows complex layering; stone on right shows inner core of COM with UA cortex. Similar variation in structure was visible in other types of calculi.

CONCLUSIONS: Use of narrow slice width and bone windows greatly improves the visualization of kidney stone structure by helical CT. These results open up new possibilities for determining the relationship between stone structure and stone fragility in SWL.

1027 DYNAMICS OF LITHOTRIPTER SHOCK-WAVE-INDUCED BUBBLE OSCILLATION IN CONSTRAINED MEDIA AND MECHANISMS OF VESSEL RUPTURE DURING SWL

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INTRODUCTION AND OBJECTIVES: Hematuria following shock wave lithotripsy (SWL) is thought to be due to rupture of small blood vessels. Cavitation has been implicated as a potential mechanism for the hematuria injury. To more precisely understand the underlying mechanical process of small vessel injury, the dynamics of SWL-induced bubble oscillation in constrained media have been investigated.

METHODS: Silicone tubes (0.3–1.5 mm inner diameter), filled with circulating saline solution containing 0.2% Albunex contrast agent, were immersed in castor oil and placed in the acoustic field of a Dornier XL-1 lithotripter. Bubble dynamics induced inside the silicone tubes were characterized using high-speed video imaging and passive cavitation detection via a 20-MHz focused hydrophone.

RESULTS: Studies suggest that the symmetric bubble oscillation, typical for SWL-induced cavitation in water, is largely disrupted due to the constraint of the silicone tube on bubble expansion, leading to an asymmetric elongation of the bubble along the tube axis. The subsequent collapse of the bubbles inside the silicone tube (or blood vessels) is therefore significantly weakened, and thus the potential to cause tissue injury may be reduced. Additional experiments, performed with hollow cellulose fibers (internal diameter: 0.2 mm) suggest that the damage to small blood vessels may be caused by the rapid, large intra-luminal expansion of the cavitation bubbles. Suppression of large intra-luminal bubble expansion by inverting the lithotripter waveform was found to prevent the rupture.

CONCLUSIONS: Results from vessel phantom experiments suggest that the rupture of small blood vessels in SWL may be caused by the large, rapid expansion of intra-luminal bubbles induced by the lithotripter shock waves. With this important understanding of the mechanism of vascular injury in SWL, various strategies could be explored to selectively suppress the large intra-luminal bubble expansion to minimize tissue injury while maintaining adequate stone fragmentation. Such an improvement should greatly benefit the treatment of pediatric and elderly patients who are at higher risk for SWL-induced renal injury.

1028 SUPPRESSION OF LARGE INTRALUMINAL BUBBLE EXPANSION DURING SWL

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INTRODUCTION AND OBJECTIVES: To reduce the potential of vascular injury, without compromising fragmentation capability, we have devised a method to suppress intra-luminal bubble expansion via intraluminal supersonic jets.

METHODS: A thin shell ellipsoidal reflector insert was designed and fabricated to fit snugly into the original reflector of a Dornier HM-3 lithotripter. The inner surface of the reflector insert shares the same first focus with the original HM-3 reflector, but with its second focus located 3.5 mm below that of the HM-3 reflector. With this modified reflector, the original lithotripter shock wave is partitioned into a leading lithotripter pulse and an ensuing second compressive wave of 10 MPa peak pressure and 2 μs pulse duration, separated from each other by about 4 μs.

RESULTS: The superelevation of the two waves leads to a selective truncation of the trailing tensile component of the lithotripter shock wave, and consequently, a reduction in bubble expansion. Using stone and vessel phantoms, it has been demonstrated in vitro that this modified reflector can significantly reduce the propensity for vessel rupture, while maintaining adequate stone comminution compared to the original HM-3 lithotripter. Biochemically, a reduction in conjugated dienes measured in microdialysates has been observed when comparing levels obtained with the modification versus the standard HM3. Moreover, histological staining demonstrates a significant decrease in the volume of injury with the addition of the modified reflector for SWL on female swine at 24 kV for 2000 shocks (13% vs. 1.2%).

CONCLUSIONS: This improvement could significantly benefit the lithotripsy treatment for stone patients, especially for pediatric and elderly patients who are at significantly higher risk for shock wave lithotripsy-induced chronic injury.

1029 CAVITATION DAMAGE TO KIDNEY STONES IN SWL INVOLVES THE ACTION OF BUBBLE CLUSTERS: NEW OBSERVATIONS USING ULTRA-HIGH SPEED IMAGING IN VITRO

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INTRODUCTION AND OBJECTIVES: There is strong evidence to support the idea that cavitation plays a role in stone breakdown in SWL. In order to better understand how cavitation bubbles interact with stones we recorded ultra-high speed movies of the bubble activity induced by single shock waves fired by an electrohydraulic lithotripter.

METHODS: An Imacon 408 ultra-high speed imaging system (Hiland) capable of capturing 7 sequential frames at 10 ns to 1.2 μs frame intervals was used to record bubble activity at the surface of hydrated artificial (gypsum or Portland cement) and natural (COM) kidney stones in vitro. Single pulses (20 kV) were delivered using a research lithotripter patterned after the Dornier HM3.

RESULTS: The individual cavitation bubbles that formed at the surface of stones did not remain independent, but combined with one another to form “bubble clusters”. Such clusters formed consistently at the proximal face, distal end, and along the sides of the stone. The proximal cluster enveloped the end of the stone and then collapsed to a small volume, creating a crater (cavitation erosion). Bubble clusters elsewhere on the stones were much smaller and caused less erosion. Cracks in stones acted as nucleation points for cluster formation and collapse, and bubble cluster activity appeared to widen existing cracks.

CONCLUSIONS: These observations give new perspective to the role that cavitation plays in stone fragmentation. Hundreds of individual cavitation bubbles may form at the surface of a stone, but these do not cycle independently of one another. Instead, cavitation bubbles coalesce or aggregate together to form a cluster. Bubble cluster dynamics sweep bubbles away from some areas of the stone and the cluster collapses violently to a small focus. The impact of bubble cluster
collapse against a stone may be far greater than the action of a single bubble. Further, these high-speed camera images suggest that the growth of cracks in stones may be enhanced by bubble clusters. It seems reasonable to suggest that conditions that influence bubble clusters may affect stone comminution in SWL.

CONCLUSIONS: Micropapillary bladder cancer does not appear to be as responsive to BCG or neoadjuvant chemotherapy as conventional TCC. Nodal metastasis and a limited response following systemic therapy portend an especially poor prognosis for patients with this aggressive bladder carcinoma variant.

1032
THE MANAGEMENT OF URETHRAL TRANSITIONAL CELL CARCINOMA AFTER RADICAL CYSTECTOMY FOR INVASIVE DISEASE
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INTRODUCTION AND OBJECTIVE: Previous papers have identified risk factors for urethral recurrence following radical surgery for transitional cell carcinoma (TCC). However, reports on the clinical presentation, management, and outcome of these patients are lacking. We report on our experience with the diagnosis, management, and outcome of urethral TCC after radical cystectomy for bladder cancer.
METHODS: A database of 1054 patients who underwent radical cystectomy and urinary diversion for TCC from 1987-97 was retrospectively reviewed. Patients were identified who had urethral TCC after surgery.
RESULTS: Urethral TCC was diagnosed in 48 men at median 18.5 (range 2-116) months after cystectomy. 2048 (42%) of patients were diagnosed within one year. Symptomatic recurrence occurred in 25 of 43 (58%) evaluable patients; 22 of whom had bloody urethral discharge while 7 had pain or a palpable mass. 13 patients (30%) were asymptomatic with an abnormal cytology. The remaining 5 patients underwent prophylactic urethrectomy based on the cystectomy pathology. Of the 34 patients with cytology results at the time of recurrence only two had a negative cytology. 42 patients underwent urethrectomy; 37 total and 5 ideal with perineal urethrostomy (two were later converted to total urethrectomy). Three patients were treated with intra-urethral instillations of 5-FU for superficial disease or carcinoma in situ: One patient remained disease free (with 7 years of follow up), while two progressed to invasive disease and required a urethrectomy. Three patients were treated with systemic chemotherapy alone. Only one remained disease free at last follow-up. Overall, with a mean follow up of 23.1 (range 2-275) months since diagnosis, 36/49 (75%) patients had died, 28 from metastatic TCC. Only 11 (23%) remained disease free. Of the 39 patients with disease confined to the urethra at the time of diagnosis 20 (51%) ultimately died of TCC. Conversely, all five patients with definite evidence of disease recurrence outside of the urethra at the time of diagnosis ultimately died of TCC.
CONCLUSIONS: Urethral recurrence remains a potential problem years after radical cystectomy for TCC. Most patients present with symptoms. However, severe urethral cytology alone does not achieve significant proportion. Treatment remains urethrectomy; unfortunately, only 23% of patients with urethral recurrence remain disease free. Identification of prognostic indices, earlier detection, and aggressive therapy are needed to improve outcomes in these patients.

1033
CYSTECTOMY WITH PROSTATE SPARING IN BLADDER CANCER, 100 PATIENTS, 10 YEARS EXPERIENCE
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INTRODUCTION AND OBJECTIVES: To minimize the risk of incontinence and impotence after prostate-sparing for bladder cancer, the authors have selected patients who could be candidate to a prostate sparing.
METHODS: Since 1992, 100 patients, mean age 64 (48-82) with bladder tumors (PTA1:23, PTA2:41, PTA3:36) underwent a cystectomy with prostate sparing according to the following selection criteria: normal digital rectal examination, normal PSA, normal transrectal ultrasound of the prostate. Surgery consists on: 1) a transurethral resection of the prostate (TURP)with analysis of frozen section of the prostate urethra and transitional prostate 2) under the same anesthesia, a Cystectomy with a reconstruction by a Y U bladder sutured to the prostatic capsule, after confirmation of absence of prostate cancer on the frozen section analyzed from surgical capsule samples.
RESULTS: Peri-operative death: 1 patient, cancer death: 21 pts (21%), non related cancer death: 6 pts (6%).Mean follow-up 33 months (2 to 111 months). Global actuarial survival: PTA1NO: 21/22 pts (96%), PTA2NO: 3/41 pts (8%), PTA3NO: 1724 pts (71%), N+: 4/13 pts (31%), Actuarial survival negative of disease (NED): PTA1NO: 22/23 pts (96%), PTA2NO: 33/41 pts (82%), PTA3NO: 142/24 pts (58%). Patients all stage N+: 4/13 pts (31%). Local recurrence : PTA1NO: 1/22 (4.5%), PTA2NO: 2/24 (8.3%), PTA3NO: 2/22 (9.1%), N+: 0/13 (0%). Prostate cancer: 3 pts (two errors of indication and 1 cancer after 3 years of follow up under hormonal monotherapy). Day continence: 17/23 pts (79%) are fully continent (too pad), night continence: average wake up 1.2 (0-4). Potency: 61 patients with a previous sexual life are evaluable: 5 (8.1%) became impotent, 6 (10%) less potent, 50 (82%) have the same sexual life as pre-out of a retrograde ejaculation secondary to the TURP.

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