Assessment of proliferation markers by AQUA

| Marker | AQUA range | Correlation coefficient | Clinical p-value |
|---|---|---|---|
| cdc2 | 165-2049 | 0.82 | 0.04 |
| cyclinD1 | 76-2099 | 0.93 | 0.66 |
| Ki67 | 10-40 | 0.83 | 0.26 |
| mcm2 | 51-150 | 0.71 | 0.26 |

**Conclusions:** On a pilot scale TMA of MCL cases, AQUA demonstrated reproducible continuous quantitation of potential biomarkers and identified an association between cdc2 expression level and patient outcome. Application of TMA/AQUA on a full scale likely has the statistical power and high throughput capabilities to identify prognostic biomarkers in MCL.

### 1770 Pre-Staining Slides with Hematoxylin for HER-2/neu FISH Testing

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**Background:** HER-2/neu testing for invasive breast carcinoma (IBC) is the standard of care. The two common methods of testing are immunohistochemistry (IHC) and fluorescent in situ hybridization (FISH). The advantage of IHC is that the pathologist can microscopically identify the neoplastic cells for interpretation. However, fluorescent in situ hybridization is performed on unstained slides so there may be a question whether the tumor cells are present. We evaluated a new technique of performing HER-2/neu FISH testing in IBC utilizing hematoxylin stained slides.

**Design:** We selected 23 cases of histologically confirmed IBC that had 2 or 3+ staining for HER-2/neu by IHC and no amplification by FISH. Sections were prepared which was then stained with hematoxylin (H) only to directly visualize the malignant cells to guide the evaluation. The result of FISH on the stained slides was compared to paired unstained slides not undergoing H staining. We also repeated FISH on two cases using previously hematoxylin-eosin (H&E) stained slides to evaluate the interference of background staining. Technical difficulties and interference of faint H staining were also studied.

**Results:** The fluorescence signal of FISH was not compromised by both H only and standard H&E staining. Comparison of the paired slides showed that the ratio of the amplified to non-amplified increased slightly in 60% (14/23) of the H stained cases, but did not become amplified which was the same result obtained with the traditional unstained slide procedure for FISH Her2/neu analysis. On the two H&E stained slides, one was amplified and one showed no amplification.

**Conclusions:** We believe this is a valuable new technique to perform FISH testing on H&E and H stained slides. This may be especially helpful when there is extensive necrosis, fibrosis, only a small amount of diagnostic IBC is present and/or when there is the possibility of not having diagnostic IBC in deeper unstained sections of the core needle biopsy submitted for HER-2/neu FISH testing.

### 1771 PAX-2 as a Renal and Müllerian Tumor Marker. A Comprehensive Study

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**Background:** PAX-2 is a transcription factor that is known to promote embryonic differentiation of central nervous system, kidney, and Müllerian organ. PAX-2 has been shown in renal neoplasms and Müllerian-type of neoplasms. However, the diagnostic utility of PAX-2 has not been comprehensively studied.

**Design:** Formalin-fixed, paraffin-embedded tissue samples for non-neoplastic tissue (443 cases), primary neoplasms (398), and metastatic neoplasms (91) were subjected to immunostain for PAX-2.

**Results:** PAX-2 was successfully detected as exclusive nuclear staining. For non-neoplastic tissue, PAX-2 was noted focally in glomerular visceral epithelial cells and in a subset of renal collecting ductal cells (89/89); diffusely in atrophic renal tubular epithelial cells (75/75); diffusely in normal endocervical, endometrial, and fallopian tubal cells (19/19), focally in regenerative bile duct epithelium (2/5); focally in lymphoid cell follicles (10/25). PAX-2 was not seen in the rest of tissue samples. For primary neoplasms, PAX-2 was expressed by 1/16 parathyroid adenomas, 1/1 endometrial polyp, 104/ 122 renal cell carcinomas (RCCs), 17/18 renal neoplasms other than RCC, and 9/50 Müllerian-type of neoplasms of ovary or endometrium. PAX-2 was not seen in other neoplasms including 20 transitional cell carcinomas. For metastatic neoplasm, PAX-2 was expressed by 71/95 metastatic RCCs, and 1/20 other metastatic tumors (metastatic endometrioid carcinoma).

**Conclusions:** Routinely processed tissue is eminently suitable for optimal PAX-2 immunostain. PAX-2 is a marker for Müllerian differentiation, but it is expressed in only a subset of Müllerian tumors. PAX-2 is a marker for renal differentiation and renal tubular atrophy. It is also a very sensitive and specific marker for both primary renal neoplasms and metastatic RCCs.

### 1772 Three Dimensional Breast Pathology Imaging for Reducing Sampling Errors: A Case Study

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**Background:** Conventional pathological specimen evaluation may fail to accurately demonstrate tumour extent and closest margin in cases with multifocal or diffuse distribution of disease. These cases include multifocal in-situ ductal carcinoma [DCIS], locally advanced breast cancer [LABC] following neoadjuvant chemotherapy [NAC], or those in which tumor is impalpable (e.g., lobular carcinoma). Positive margins may be missed, the presence of multifocal disease may not be identified, or the tumor size or extent can be underestimated. Secondary treatments may be inadequate and disease can recur.

**Design:** We developed an efficient method for 3D, whole-specimen histology using whole-mount serial sections and digital imaging techniques. This approach does not require the usual gross sampling techniques, and total fixation and processing time for a mastectomy is a rapid 36 hours. We summarize the technique and present examples to illustrate its clinical utility. We apply the technique to: (1) lobular carcinoma, (2) LABC treated with NAC, 3) multifocal DCIS, and (4) a close or involved margin. To show its potential as a research tool we apply it to study the heterogeneity of biomarkers with established or potential prognostic significance; estrogen receptor and tumour stem cell markers. Digital imaging and display techniques render inspection of a vastly increased amount of histology data feasible.

**Results:** The specimen preparation and processing techniques yield diagnostic-quality whole-mount serial section images in a feasible timeframe. Comparison between simulated standard sampling technique and the 3D method for two DCIS cases resulted in multifocal disease and an involved margin being identified only with the 3D technique. The full extent of lobular carcinoma was appreciated only using the 3D technique. A more accurate assessment of pathological complete response to chemotherapy can be obtained by applying this technique. Biomarker distribution is readily visualized using whole-mount section images.

**Conclusions:** The 3D approach is highly amenable for cases which may require more extensive sampling (*e.g.* lobular carcinoma and DCIS, and LABC following NAC) by providing more accurate estimates of margins, or tumour burden when disease is multifocal or diffuse. This new technique allows more accurate tumor measurements and better information regarding the presence and distribution of prognostic and predictive markers.

### 1773 Application of COLD-PCR for Improved Detection of *KRAS* Mutations in Clinical Samples

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**Background:** *KRAS* mutations, found in 30% of all human tumors, are of prognostic value and can predict response to targeted therapies. Current *KRAS* mutation detection strategy consists of PCR and direct sequencing. To increase detection sensitivity, we evaluated Co-amplification-at-Lower Denaturation-temperature PCR (COLD-PCR) method which selectively amplifies minority mutant alleles, in various types of clinical samples.

**Design:** The sensitivity and specificity of *KRAS* mutation detection by pyrosequencing after COLD-PCR were compared with that using conventional PCR. Both PCR were performed simultaneously with identical set of primers that amplified a 98 bp region from genomic DNA covering codons 12 and 13 of *KRAS* gene. Based on melting temperature profile, the critical denaturation temperature for COLD-PCR was set to 80 °C versus 94 °C in conventional PCR. Both PCR reactions comprised of 50 cycles. Sensitivities were determined by serial dilution of a positive patient sample in to a negative control. Clinical specimens included bone marrows from 16 leukemia patients and manually microdissected formalin-fixed paraffin-embedded (FFPE) tissue of 28 solid tumors from colon, rectum, liver, lung and bladder.

**Results:** COLD-PCR increased the sensitivity of *KRAS* mutation detection compared to conventional PCR from 1:8 to 1:32 dilution. In subsequent studies with clinical specimens, COLD-PCR successfully detected mutations in all samples that were positive by conventional PCR, and enhanced the mutant to wild-type ratio by 2 to 3 folds. In a leukemia follow up bone marrow, COLD-PCR detected a mutation that was missed by conventional PCR. The enhancement of mutation detection by COLD-PCR inversely correlated with the tumor cell percentage in the samples. Higher enhancement was observed in FFPE samples than in bone marrow specimens. Implementation of the method was straightforward, requiring no additional cost for reagents and instruments. The method maintained high specificity and reproducibility.

**Conclusions:** Our study showed that COLD-PCR increased the *KRAS* mutation detection sensitivity from 6% to 1.5% in comparison to conventional PCR methods. This method is especially beneficial for clinical applications in solid tumors due to more prominent enhancement of mutation detection in FFPE samples. COLD-PCR may not only reduce repeat testing due to equivocal results in specimens that have low percentage of tumor cells in high non-neoplastic background but also find utility in monitoring therapy response.

## Ultrastructural

### 1774 Dense Deposit Disease Mimicking Acute Post-Infectious Glomerulonephritis

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**Background:** Dense deposit disease (DDD) has been recently reviewed (Mod Pathol 2007:20:606-16) with the conclusion that DDD is a distinct entity separate from membranoproliferative disease. DDD demonstrates 5 patterns: 1) membranoproliferative; 2) mesangial proliferative; 3) crescentic; 4) acute proliferative/exudative; 5) unclassified. Crescentic and acute proliferative/exudative patterns occurred between 3 and 18 years of age. While other DDD patterns had a wide age range (3-67yrs) with 90% occurring in those ≤30 years of age. DDD disease may mimic acute post-infectious glomerulonephritis (AGN) on light, immunofluorescence (IF) and electron microscopy (EM).

**Design:** DDD (crescentic and acute proliferative/exudative patterns) mimicking AGN on initial presentation were identified in 6 patients at 2 pediatric hospitals (3M:3F, age range 4-12 yrs; AGN symptoms: hematuria, proteinuria, elevated Cr). Following medical

management for AGN, the patients had relapses or persistent renal symptoms leading to repeat renal biopsies (1 to 4 years after initial diagnosis).
**Results:** Initial biopsies demonstrated either an acute proliferative/exudative pattern (3/6 with endocapillary proliferation with neutrophils) or a crescentic pattern (3/6 with >50% of glomeruli with crescents). PAS and trichrome staining revealed hump-like membranous deposits. IF showed C3-positive globular to granular membranous deposits. EM demonstrated subepithelial hump-like deposits and infrequent subepithelial deposits with no mesangial interposition. Repeat biopsies demonstrated thickened capillary loops with PAS-positive membranous "ribbons". IF showed globular to granluar C3-positive membranous deposits, and discontinuous linear C3-positive membranous deposits. EM revealed subepithelial hump-like deposits, and intramembranous electron dense transformation of the lamina densa (intramembranous dense deposits).
**Conclusions:** In the pediatric age group, DDD may present as crescentic and acute proliferative/exudative patterns with subepithelial hump-like deposits detected by special stains, IF and EM. These DDD patterns may be confused with AGN due to the lack of ribbons of intramembranous dense deposits. Persistent or recurrent renal disease in these patients requires repeat renal biopsy to ascertain whether there is well-established acute proliferative/exudative or crescentic DDD that initially mimicked AGN.

### 1775 Cellular Congenital Mesoblastic Nephroma: Clinical-Diagnostic Imaging-Pathologic Features

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**Background:** Congenital mesoblastic nephroma (CMN) is the most common renal neoplasm of infancy. 2 CMN forms exists - classic (low cellularity, resembling myofibroma) and cellular (high cellularity, resembling congenital infantile fibrosarcoma). Cellular CMN is locally aggressive and invasive, and associated with metastatic disease. Cellular CMN shares similar histopathologic features and the tumor-defining translocation [t(12;15), ETV6-NTRK3] with congenital infantile fibrosarcoma.
**Design:** Pathology archives were searched over a 10 year period for cellular CMNs (n=8, age range 6d to 6 mos, 5M:3F). Clinical presentation was large palpable abdominal mass with hypertention (6/8), hypercalcemia (2/8), hematuria (2/8), and *in utero* polyhyrdramnios (1/8). Tissue was available for microscopic, ultrastructural, cytogenetic and RT-PCR translocation studies.
**Results:** Diagnostic imaging showed large renal masses (5.5 to 14.6cm). Tumors crossed the midline and encased major vessels in 2 cases. There was paravertebral, retroperitoneal and intraspinal tumor extension in 1 case. Tumors were Stage 1 or 2 in 5 cases. Tumor weights ranged from 137 to 1,552 gms. Tumors had a fleshy character with some areas of cystic degeneration and hemorrohage. Tumors were highly cellular spindle cell proliferations with minimal supporting stroma. Mitotic rate was brisk. Tumors lacked encapsulation and infiltrated the adjacent normal kidney. 4 tumors infiltrated the renal capsule with extension into perirenal adipose tissue (3/4). Electron microscopy showed spindle cells with infrequent collagen. In the stroma, there was dense granular, amorphous material previously characterized for congenital infantile fibrosarcoma. Cytogenetics and RT-PCR identifed the t(12;15) tranlsocation. Metastastic disease occurred in 2 patients (liver, lung, peritoneum). Chemotherapy was required in 4 patients due to inability to perform a primary resection at diagnosis or due to metastatic disesae. At a mean follow-up peroid of 3.6 years, 1 patient died of disease and 7 are free of disease.
**Conclusions:** Cellular CMN is distinctive aggressive, invasive neoplasm with metastatic potential. This tumor shares histopathologic, ultrastructural and molecular features with congenital infantile fibrosarcoma. Renaming cellular CMN as Congenital Infantile Renal Fibrosarcoma should be considered in order to provide appropriate workup, therapy and followup for infants with this aggressive primary renal tumor.

### 1776 Xp11.2 Translocation Renal Carcinomas in a Pediatric Population

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**Background:** Xp11.2 translocation renal cell carcinomas (RCC) demonstrate TFE3 (Xp11.2) fusion with several different partners (ASPL, 17q25; PRCC, 1q21; PSF, 1p34; NonO, inv(X)p11.2;q12); CLTC, 17q23). These tumors tend to occur in children and young adults. Xp11.2 tumors account for up to 75% of all RCCs in pediatrics. TFE3 immunostaining is available to distinguish these tumors from conventional RCCs, in addition to cytogenetic/molecular studies. Electron microscopy (EM) may be helpful in identifying a subset of Xp11.2 tumors with an ASPL fusion partner, which have crystalline rhombiod strucutures identical to those in alveolar soft part sarcoma.
**Design:** 6 TFE3-positive RCCs had tissue available for routine, immunocytochemistry (ICC)and EM study (3M:3F, age range 4 to16yrs). ICC for pancytokeratin, EMA, vimentin, RCC, CD10, TFE3 and HMB45 was performed. EM was performed on glutaraldehyde-fixed tissue in 3 cases and on paraffin-recovered tissue in 3 cases. Cytogenetic analysis was available in 4 cases.
**Results:** Tumor size ranged from 1 to 13cm. Tumor was confined to the kidney in 2 cases. Renal vein was involved in 3 cases. Metastatic disease was present in 4 cases (lymph nodes, lung, liver, retroperitoneum). Tumors tended to have pseudopapillary architecture comprised of clear cells with voluminous cytoplasm and thick, plant-like cell borders. Fuhrman nuclear grade 3 was typical. Occasional deeply eosinophilic cytoplasm was seen. Extracellular eosinophilic basement membrane-like material was seen infrequently. ICC demonstrated: nuclear TFE3 (6/6), RCC (6/6), CD10 (5/6), vimentin (0/6), pancytokeratin (0/6), EMA (0/6) and HMB-45 (0/6). EM showed abundant glycogen, intercellular desmosome-like junctions, lipid inclusions and basement membranes. Infrequent rhomboid crystalline structures were found in 2 cases. Cytogenetics was performed in 4 cases and detected Xp11.2 translocations (ASPL-TFE3 [2/4]; PSF-TFE3 [1/4]; PRCC-TFE3 [1-4]).
**Conclusions:** Xp11.2 RCCs are unique renal neoplasms that primarily occur in the pediatric population. At initial diagnosis, these tumors tend to present at advanced stages with locoregional and distant metastatic disease. Complete resection of the primary renal mass and metastases with adjuvant therapy when indicated provide a favorable overall survival rate (92% 5-yr survival AJCP 2006;126:349-64). Immunocytochemical, electron microscopic and cytogenetic/molecular diagnostic techniques utilized in concert allow for an accurate diagnosis and appropriate therapy.

### 1777 The Utility of Ultrastructural Immunolabeling (Immunogold Electron Microscopy) in the Classification of Systemic Amyloidosis

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**Background:** Current management for patients with systemic amyloidosis relies on precise amyloid subtyping. Available modalities for amyloid subtyping include routine immunohistochemistry (IHC), immunofluorescence, immunoblotting, mass spectrometry, and amino acid sequencing. IHC is often hampered by non-specific background staining, due in large part to amyloid "stickiness", often rendering an inconclusive result. Ultrastructural immunolabeling or immunogold electron microscopy (EM) has shown promise as an alternate modality. This study presents the utility of immunogold EM in a series of patients in whom IHC was inconclusive.
**Design:** A total of 26 patients had immunogold EM, of which 11 had IHC performed at our institution. Samples submitted for immunogold EM include heart (6), liver (1), colon (2), and abdominal fat (17). The tissues were fixed in 4% paraformaldehyde and embedded in lowicryl. The sections were incubated overnight with polyclonal rabbit anti-human kappa light chain, anti-human lambda light chain, anti-human transthyretin, and monoclonal rabbit anti-human serum amyloid A. The sections were then incubated for one hour with goat anti-rabbit antibody conjugated to a 20 nm gold particle. The sections were stained with uranyl acetate and lead citrate and examined using a transmission electron microscope.
**Results:** Amyloid subtyping by immunogold EM was successful in 25 of 26 patients. By immunogold EM, 4 patients had serum amyloid A (AA) amyloidosis, 9 patients had immunoglobulin light chain (AL) lambda amyloidosis, 2 patients had AL kappa amyloidosis, and 10 patients had hereditary transthyretin (TTR) amyloidosis. For 1 patient amyloid subtyping was inconclusive. Eleven of the 26 patients also had amyloid subtyping by IHC. By IHC, 2 patients were diagnosed as AA, 2 as AL lambda, and for 7 amyloid subtyping was inconclusive. Subsequent evaluation by immunogold EM yielded definitive results in all 7 patients with 1 patient diagnosed as AA, 1 as AL lambda, 1 as AL kappa, and 4 as TTR.
**Conclusions:** Immunogold EM is an effective tool for subtyping amyloid, with a positive identification rate of 96%. This contrasts with IHC which has a rate of 36% in our case series. In addition, immunogold EM can be performed readily on minimally invasive fat pad aspirates. Prior notification for patients with clinically suspicious systemic amyloidosis is required to assure proper specimen fixation and embedding.

### 1778 Combination Analysis of Electron Microscopy and Cytology in Tumor Diagnosis

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**Background:** At present, cytological diagnoses of tumors combined with ancillary techniques can be as precise as those of surgical pathology. The cytopathologists are challenged to make a definitive diagnosis on the basis of the cytological samples with increasing frequency. In our cytology practice, electron microscopy (EM) is routinely employed for difficult cases of tumors. We here present 6 such cases.
**Design:** The fine-needle aspiration cytology (FNAC) and body fluid cytology (BFC) samples were examined by routine cytology, immunocytochemistry (ICC) and EM. ICC was performed on cell block or cell-transferred cytology specimens. EM samples were prepared from cell blocks or imprint-cytology specimens obtained from cut surface of the fresh tumor tissue.
**Results: Case 1: Amelanotic melanoma.** FNAC showed a large pleomorphic cell tumor. HMB-45 was focally positive by ICC. By EM, premelanosomes were identified. **Case 2: Primary adrenal cortical carcinoma.** FNAC showed a granulomatous lesion with some large atypical cells suggesting the primary diagnosis of inflammatory pseudotumor of the liver. EM confirmed that the large atypical cells had the characteristics of adrenal cortical epithelial cells. **Case 3: Peritoneal malignant mesothelioma (MM).** Peritoneal BFC was Class IV~V (MM, susp). By ICC and EM examinations, the diagnosis of epithelioid MM was definitive. **Case 4: Metastatic adenocarcinoma of the colon.** Pleural BFC was Class V (adenocarcinoma of unknown primary; lung? or colon?). ICC showed CK20(+) / CK7(-) and Villin(+). EM indicated the tumor with features of colon origin. **Case 5: Pheochromocytoma.** EM from imprint-cytology specimens demonstrated numerous epinephrine producing granules in the tumor cells. **Case. 6: Uterine leiomyosarcoma.** Routine endometrial cytology revealed a pleomorphic tumor suspicious of sarcoma. EM from imprint-cytology specimens demonstrated the features of smooth muscle differentiation.
**Conclusions:** The combination analysis of EM and cytology in tumor diagnosis is often powerful to help solve diagnostic dilemmas of challenging cases.

### 1779 Unique Ultrastructural Features in Pheochromocytoma from Patients with Mutations in the Succinate Dehydrogenase B and D Genes

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**Background:** Pheochromocytomas (pheos) are rare tumors that arise either from the chromaffin cells of the adrenal medulla, or extra-adrenal paraganglionic tissue. They often produce and secrete catecholamines. Although pheos have been classified according to the site of origin, familial history and mutations, a comprehensive ultrastructural comparison has not been carried out before. Traditionally, pheos have

been diagnosed with electron microscopy by the presence of secretory granules in tumor cells. It is of high interest from clinical and research perspectives to find out whether ultrastructural features correlate with familial *versus* sporadic pheos, or with widely known mutations of the succinate dehydrogenase B and D (SDHB/D) genes.

**Design:** We performed a retrospective EM analysis on adrenal and extra-adrenal tumors from 23 patients. Evaluated ultrastructural features encompassed morphology and numbers of mitochondria and secretory granules, cell processes and intracytoplasmic inclusions (lipid and glycogen). The tumors occurred in the following clinical settings, which were unkown to us at the time of the ultrastructural evaluation: Group 1: sporadic (n=5); Group 2: familial with SDHB (n=8) and SDHD (n=4) mutations; Group 3: in association with VHL (n=4), or MEN (n=2) syndromes.

**Results:** Pheos occurring in patients with SDHB/D gene mutations exhibited consistently higher numbers of mitochondria when compared to sporadic, as well as VHL- and MEN-associated pheos. Mitochondrial abnormalities were also more commonly encountered in pheos from patients with mutations. In addition, fewer numbers of secretory granules were observed in pheos from patients with SDHB mutation.

**Conclusions:** The observed unique ultrastructural characteristics in pheos from patients with SDHB/D mutations, i.e. numerous mitochondria and/or sparse secretory granules, distinguish them from pheos occurring in other clinical settings. Therefore, they may be of diagnostic and/or prognostic significance, since tumors with SDHB are known for their high malignant potential.

### 1780 The Significance of Podocyte Foot Process Effacement (FPE) in Primary IGA Nephropathy: Clinicopathologic Study of 161 Cases

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**Background:** IGA nephropathy (IGAN) is the most common glomerular disease worldwide. Patients may present with hematuria and non-nephrotic (NNRP) or uncommonly nephrotic range proteinuria (NRP). To our knowledge, correlation of podocyte FPE with subclasses of IGAN and proteinuria (PT) has not been studied.

**Design:** Retrospectively, 161 cases of primary IGAN with light, immunofluorescence and electron microscopy (EM) were reviewed and classified according to HAAS classification. EM was available in 110/161 (67%) cases. FPE was evaluated as mild:<30%, moderate:30-70%, severe:>70% and correlated with class and the level of PT.

**Results:** 101 were males and 60 were females with M: F ratio of 1.71: 1. In 72 cases, race was known as follows: White: 63(88%); black: 6(8%); Hispanic: 2(3%); Asian:1(1%). Clinical history was available in 94 cases: PT 39 cases (42%), PT+hematuria 33 cases(35%), hematuria 15 cases(16%), and renal failure in 7 cases(7%). In 88 cases with FPE, PT was nephrotic in 21 and non-nephrotic in 29 cases. The distribution of cases in different HAAS class in relation to the EM findings, FPE and PT are shown in Table 1.

Table 1. The distribution of cases.

| HAAS class | # of cases =161 | EM + deposits n=88/110 | FPE n=88/110 | proteinuria-NRP=21, NNRP=29 cases |
|---|---|---|---|---|
| I | 44 | 25/27 | mild-10/27 Mod-3/27 sev-7/27 n=20/27 (74%) | NRP-3(1mod,2sev FPE; NNRP-9(5mild,4sev FPE) |
| II | 59 | 40/43 | mild-14/43 mod-4/43 sev-17/43 n=35/43 (81%) | NRP-9(5mild,4sev FPE); NNRP-12(6mild,2mod,4sev FPE) |
| III | 34 | 23/23 | mild-9/23 mod-3/23 sev-8/23 n=20/23 (87%) | NRP-5(1mild,4sev FPE); NNRP-6(2mild,2mod,2sev FPE) |
| IV | 6 | 5/5 | mild-1/5 mod-0/5 sev-2/5 n=3/5 (60%) | NRP-1(1sev FPE); NNRP-0 |
| V | 18 | 12/12 | mild-3/12 mod-1/12 sev-6/12 n=10/12 (83%) | NRP-3(3sevFPE); NNRP-2(1mild,1sev FPE) |

Mod:moderate, sev:severe.

**Conclusions:** FPE is common in IGAN. No correlation between FPE and NRP or NNRP group, or IGAN subclass is present. Whether FPE is simply a reflection of other pathologic mechanisms and its significance in the pathophysiology of IGAN requires further investigation.