These presentations are to help you identify basic histopathological features. They do not contain the additional factual information that you need to learn about these topics, or all the images from resource sessions.

This presentation contains images of basic histopathological features of glomerulonephritis, selected tubulointerstitial diseases, including acute pyelonephritis, and renal infarction. Before viewing this presentation you are advised to review relevant histology, relevant sections of a pathology textbook, relevant lecture notes and relevant sections of a histopathology atlas.

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Glomerulonephritis/glomerulopathy

- Immune mediated
- Antibody and antigen deposition in or around glomerular capillary basement membranes and/or in mesangium
  - Circulating antibody reacts with endogenous or exogenous antigen already within the glomerulus
  - Deposition of circulating antigen/antibody complexes
- Mediate damage via a variety of mechanisms e.g. complement activation, cytokine release, inflammatory cell infiltration
- No organisms
- Inflammatory cells are not seen in all types. These types are often referred to as glomerulopathy or nephropathy rather than glomerulonephritis
Glomerulonephritis/glomerulopathy

- Many different types/patterns showing different light and electron microscopic (EM) changes and immunofluorescence (IF) features. These 3 modalities are used in the assessment of tissue from renal biopsies to make a diagnosis.
  - Light microscopy: variable depending on disease
    - Proliferation of cells within the glomerulus: endothelial, epithelial and/or mesangial
    - Infiltration by inflammatory cells
    - Deposition of additional mesangial matrix
    - Necrosis
    - Parts or all of glomerulus involved
    - Crescents
    - Other
  - Immunofluorescence: variable types and patterns of immunoglobulin and complement deposition
  - Electron microscopy: variable location and pattern of electron dense immune deposits
- Variable clinical presentation, age groups affected, outcome etc
Normal glomerulus

Hypercellular glomerulus with infiltrate of neutrophils and proliferation of endothelial and mesangial cells in post infective GN
Thickened glomerular capillary walls (yellow arrows) in membranous nephropathy

Normal glomerular capillary walls (red arrows)
A: Mesangial hypercellularity and increased mesangial matrix in IgA nephropathy
B: Immunofluorescence microscopy demonstrating glomerular mesangial staining for IgA.
(Images from Robbins Pathologic Basis of Disease 6th edition. Saunders)
Severe acute immune mediated glomerular injury leads to global or segmental fibrinoid necrosis (red star) of glomeruli and subsequent crescent formation (black star). Crescents represent accumulations of epithelial cells and macrophages and extracellular material in the urinary space and result from severe damage to the capillary wall. The major causes of crescentic GN are immune complex mediated (e.g. Henoch Schonlein purpura, SLE, postinfectious, other), anti-GBM antibody mediated, and pauci-immune which is usually antineutrophil cytoplasmic antibody (ANCA) mediated (e.g. in Wegener's granulomatosis, microscopic polyangitis).
Collapsed glomerular tuft (black star) with glomerular crescent (red star) resulting from proliferation of epithelial cells and infiltration of macrophages into Bowman’s space. Crescent formation is a manifestation of severe acute glomerular injury. There are many causes. Residual Bowman’s capsule is indicated by black lines.
Chronically injured glomeruli from any cause (e.g. chronic ischaemia, immunological damage) become fibrosed and frequently atrophied. The cells of the glomerular tuft die (becoming acellular) and it atrophies (black star) and scar tissue fills the remainder of Bowman’s space (red star). The entire nephron subsequently atrophies, as will the kidney ultimately. Yellow star: normal glomerulus.
Special histochemical stains in addition to H&E, are used in the light microscopic assessment of renal biopsies. This silver stain shows up basement membranes nicely.
Immunofluorescence: A: Granular deposits of IgG in capillary loops in membranous nephropathy
B: Linear deposits of IgG in capillary loops in anti-glomerular basement membrane glomerulonephritis
C: Mesanial deposits of IgA in IgA nephropathy.
Images from Rubin's Pathology, Lippincott Williams and Wilkins 5th ed.
The glomerular capillary basement membrane can differ in thickness in different diseases.
A: Normal capillary basement membranes
B: Thickened in diabetes mellitus
C: Thin in thin basement membrane disease
EM: Different glomerulonephritic diseases show immune deposits seen as electron dense areas in varying locations within the glomerulus.
A: Subepithelial in membranous nephropathy.
B: Subendothelial (here in a class III lupus nephritis)
EM: Different glomerulonephritic diseases show immune deposits seen as electron dense areas in varying locations within the glomerulus. Mesangial immune deposits (yellow stars) in IgA nephropathy.
Renal amyloidosis is a cause of nephrotic syndrome and chronic renal failure. Amyloid is a pathologic extracellular protein that can develop in a variety of diseases. There are multiple biochemically distinct forms, which vary depending on the underlying disease. Renal amyloid is usually due to the deposition of serum amyloid associated protein (SAA) produced by the liver in various chronic inflammatory disease states (e.g. TB, rheumatoid arthritis), or due to the deposition of immunoglobulin light chains in multiple myeloma. Amyloid deposits, seen as amorphous eosinophilic material on light microscopy, occur in connective tissues, basement membranes and vessel walls. The glomerulus here shows amyloid in glomerular capillary basement membranes and mesangium. 'Congo red' is a special stain typically used to confirm the presence of amyloid. Image (H&E) from Rubin's Pathology, Lippincott Williams and Wilkins 5th ed.
Tubulointerstitial diseases of the kidney include acute pyelonephritis, urate nephropathy, nephrocalcinosis, cast nephropathy in multiple myeloma and drug and toxin induced disease. In drug induced disease there is a predominantly mononuclear (lymphocytes, plasma cells, macrophages) inflammatory cell infiltrate, often with many eosinophils (black arrows) and variable tubular injury. From Robbins Pathologic Basis of Disease 6th ed. Saunders.
Numerous neutrophils (e.g. red arrows) in tubules and interstitium in acute pyelonephritis (medium-high power). Note the cuboidal renal tubular epithelium (yellow arrows) and that the neutrophil filled tubules look different to glomeruli. Acute pyelonephritis results from bacterial infection, generally having ascended from the bladder. It thus primarily affects the tubules and interstitial tissue rather than the glomeruli.
In cases of acute inflammation where neutrophils are abundant, generally associated with certain types (pyogenic) of bacterial infection, necrosis may develop. The numerous neutrophils release tissue damaging lysosomal enzymes and oxygen derived free radicals as they die leading to liquefactive necrosis. Bacterial toxins contribute to necrosis. When confined within a solid organ, an abscess may form. The image demonstrates a microabscess in the kidney. Colonies of bacteria are present centrally (yellow star). These are surrounded by necrotic debris and neutrophils (red stars). Abscess formation in the kidney may complicate acute pyelonephritis and infective endocarditis.
Recent renal infarct, coagulative necrosis. Note how the tissue architecture is maintained but nuclei have undergone karyolysis and disappeared.