International Academy of Pathology
Malaysian Division

FINAL REPORT

QUALITY ASSURANCE PROGRAM
GENERAL DIAGNOSTIC HISTOPATHOLOGY
CYCLE 01/2020

NOTES FROM THE COORDINATOR

1. For this cycle 01/2020, a total of 23 institutions responded online by the closing date of 15 July 2020.

2. Excerpts of previously circulated information about this quality assurance program are reproduced here:
    - **IAP-MD QAP provides a platform via the evaluation reports to compare and identify diagnostic insufficiency based on the outcomes of submitted diagnoses and targeted diagnoses.**
    - **In the evaluation reports of each cycle, the targeted diagnosis for each case is provided, followed by a tabulated list of diagnoses submitted by participating laboratories and followed by discussion and possible differential diagnoses on the case.**
    - **Evaluation of performance of each laboratory is conducted by participating laboratory by comparing own submitted diagnoses with the diagnoses provided in the evaluation reports. Evaluation of performance shall be the responsibility of each participating laboratory.**

3. Any queries regarding this final report for cycle 01/2020 could be directed to Dr. Ch'ng Ewe Seng, e-mail: iapmdqap@gmail.com.

4. The coordinator would like to acknowledge the contributions from Prof. Dr. Nor Hayati Othman, Dato Dr. Norain Karim, Dr. Hakimah Mahsin, Datin Dr. Nik Raihan Nik Mustapha, Dr. Wan Syahira Ellani, Dr. Adam Malik, Dr. Suhaila Abdullah, Dr Hairulhasliza Harun, Dr. Chew Bee See, Dr. Yusri Yusuf and Dr. Nurul Akmar Misron.

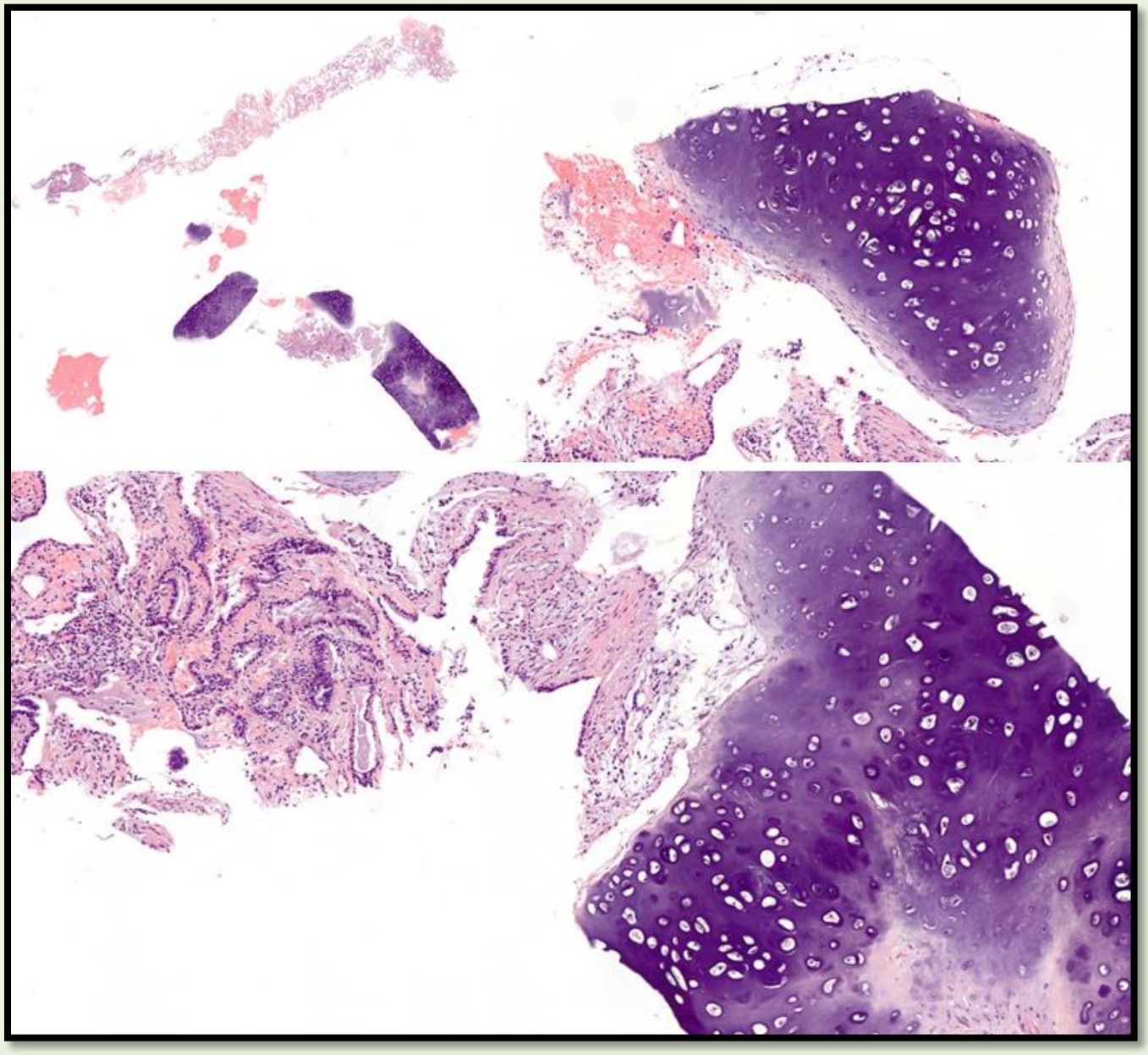
Prepared by,

Ch'ng Ewe Seng, MD, MPath, FIAC
Coordinator for IAP-MD QAP

Case 1

Case 1: A 56-year-old female presented with an incidental X-ray finding of a right lung mass. One representative section.

Targeted Diagnosis: **Pulmonary hamartoma**



Case 1

Submitted Diagnoses by Participating Institutions	Number	
Pulmonary hamartoma / Pulmonary chondroid hamartoma	22	Acceptable
Benign cartilagenous tumour. Differential diagnoses include chondroma and pulmonary hamartoma.	1	Acceptable

Educational notes:

1. There are fragments of benign chondroid tissue and adjacent glandular structures lined by respiratory epithelium. Unremarkable lung tissue fragment is noted. These features are consistent with pulmonary hamartoma.
2. Pulmonary hamartomas are benign, slow growing neoplasms mostly located at peripheral, presenting as asymptomatic, solitary, well-circumscribed nodule with "popcorn calcification" on imaging studies. Endobronchial lesions account to 10% of cases and may produce symptoms of bronchial obstruction.
3. Pulmonary hamartomas show predominantly chondroid or chondromyxoid tissue mixed with varying amounts of mesenchymal components in addition to entrapped respiratory epithelium. They differ from pulmonary chondromas by presence of two or more mesenchymal components. In addition, pulmonary chondromas form cartilaginous nodules bordered by a thin fibrous capsule without entrapped respiratory epithelium.

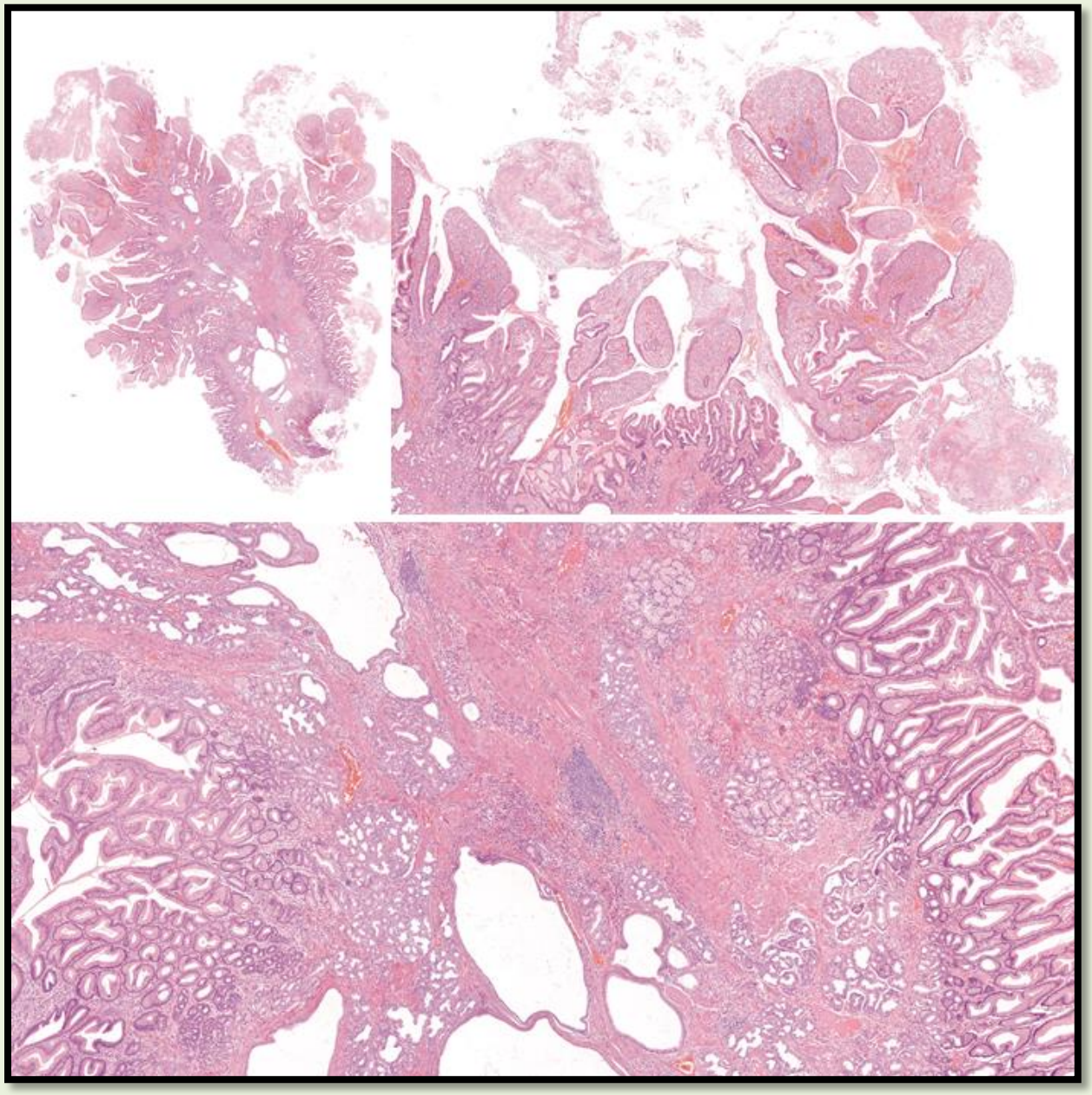
Reference:

1. Travis, William D., et al. "WHO classification of Tumours of the Lung, Pleura." Thymus and Heart 4 (2015).

Case 2

Case 2: A 59-year-old male presented with altered bowel habit for 3 months associated with tenesmus. OGDS showed a gastric lesion. One representative section.

Targeted Diagnosis: **Gastric hyperplastic polyp**



Case 2

Submitted Diagnoses by Participating Institutions	Number	
Hyperplastic polyp/ Gastritis cystica polyposa/profunda	5	Acceptable
Hyperplastic Polyp / Hamartomatous Polyp (PJS). Correlation is mandated.	1	Acceptable
Inflammatory hyperplastic polyp / hamartomatous polyp	1	Acceptable
Peutz Jeghers polyp/ Hamartomatous polyp	13	
Hamartomatous polyp and Amoebiasis	1	
Gastric adenoma/ Foveolar type gastric adenoma, low grade.	2	

Educational notes:

1. This gastric polyp is composed of antral-type gastric mucosa with broad papillae covered by hyperplastic foveolar epithelium associated with expanded, granulation tissue-type lamina propria. The core of the polyp shows fraying of long sweeping irregular bundles of smooth muscles, entrapping the pyloric glands in lobules. Some of glands are irregularly distended. No dysplastic change is observed in the lining epithelium. These features are consistent with a hyperplastic polyp.
2. The overall features of this polyp are that of a hyperplastic polyp; nonetheless, some entrapped pyloric glands in the core may suggest a hyperplastic polyp bordering on gastritis cystica polyposa. Gastritis cystica polyposa is a morphologic variant of hyperplastic polyps whereby misplaced foveolar and/or glandular epithelium are entrapped in disorganized smooth muscle bundles extending **downward** from the muscularis mucosae.
3. Fraying pattern of irregular smooth muscle bundles in this polyp raises the possibility of Peutz-Jeghers polyps of the stomach. In Peutz-Jeghers polyps, the smooth muscle bundles extend from the muscularis mucosae into the lamina propria of papillary projections and **upward** to the surface of the polyp. The pits and glands are grouped by arborizing septations of smooth muscle.
4. Nonetheless, histological distinction between gastric Peutz-Jeghers polyps and gastric hyperplastic polyps is unreliable in contrast to the well-established histological features of Peutz-Jeghers polyps from the small bowel and colon. Caution should be exercised to establish Peutz-Jeghers syndrome from gastric polyps.

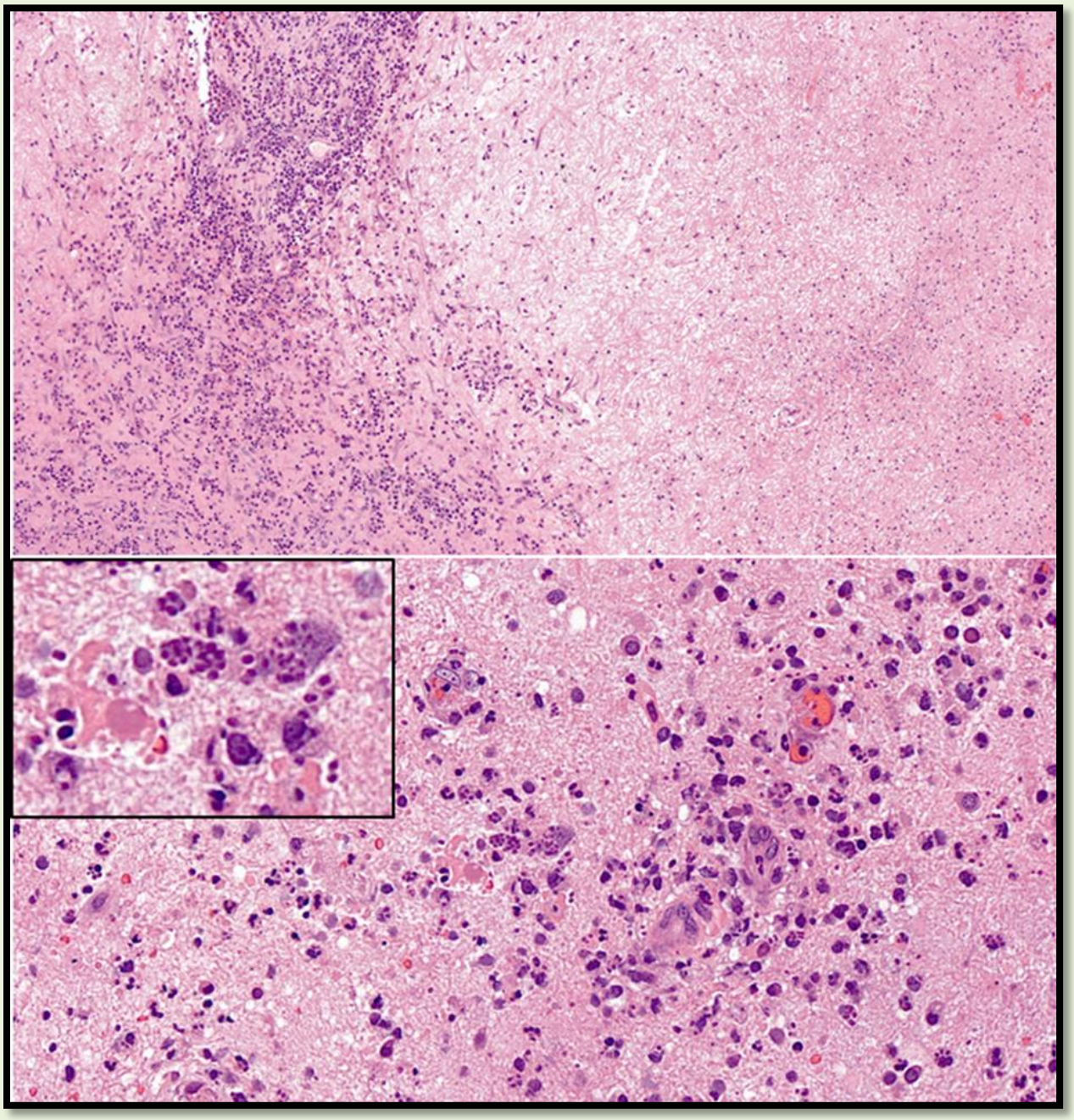
Reference

1. Odze, Robert D., and John R. Goldblum. Odze and Goldblum Surgical Pathology of the GI Tract, Liver, Biliary Tract and Pancreas. Elsevier Health Sciences, 2014.
2. Lam-Himlin, Dora, et al. "Morphologic characterization of syndromic gastric polyps." The American journal of surgical pathology 34.11 (2010): 1656-1662.

Case 3

Case 3: A 33-year-old male with underlying retroviral disease presented with altered behavior. Biopsy of the brain lesion. One representative section.

Targeted Diagnosis: **Cerebral toxoplasmosis**



Case 3

Submitted Diagnoses by Participating Institutions	Number	
Cerebral toxoplasmosis/ CNS Toxoplasmosis. To correlate with serology or microbiological study/ Cerebal toxoplasmosis. PAS, Ziehl-Neelsen stain to rule out other infections.	16	Acceptable
Toxoplasmosis and cryptococcal infection	1	
Fungal organism morphologically suggestive of Histoplasmosis	3	
HIV encephalitis with possible opportunistic infection (crytococcosis)	1	
Cryptococcosis	1	
Herpes simplex encephalitis	1	

Educational notes:

1. The brain tissue fragments show necrotizing cerebritis with large areas of necrosis containing eosinophilic cellular debris. There are foci of mixed acute and chronic inflammatory infiltrates and perivascular inflammatory infiltrates. Extracellular microorganisms and rare pseudocysts are observed, morphologically consistent with free tachyzoites and bradyzoites of *Toxoplasma gondii*.
2. Most common differential diagnoses for intracranial lesions of AIDS patients are primary central nervous system lymphoma, progressive multifocal leukoencephalopathy, cerebral toxoplasmosis and HIV encephalitis. In this brain tissue biopsy, microorganisms with the size less than a lymphocyte are identified. *Histoplasma capsulatum* and *Toxoplasma gondii* are the main differentials. Morphologically, the former is distinguished from the latter by presence of fungal cell wall in the form of halo in H&E stain. This could be highlighted by GMS and PAS special stains. *Toxoplasma gondii* may be difficult to be recognized due to resemblance to cellular debris. Immunohistochemistry against *Toxoplasma gondii* is helpful.

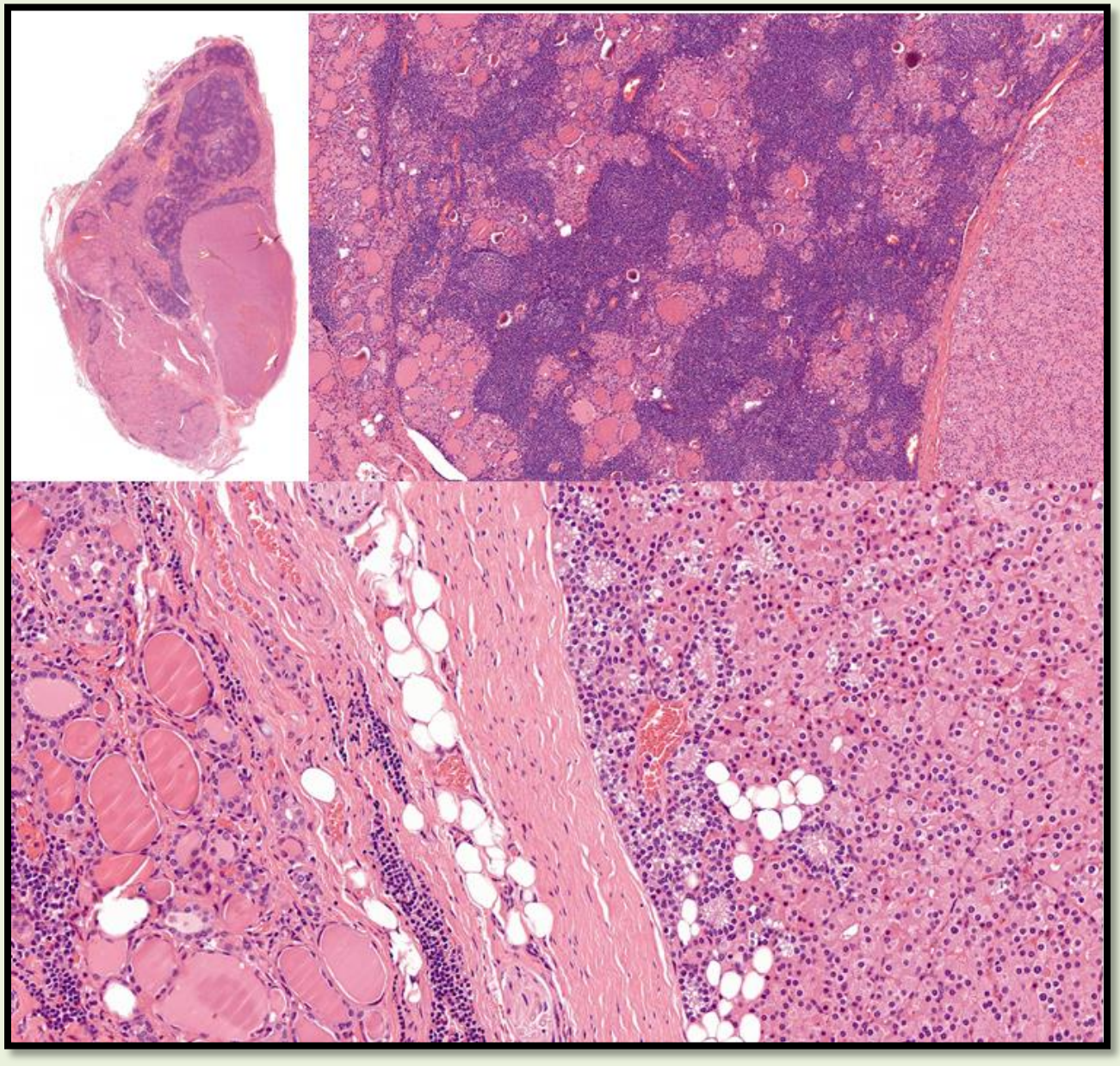
Reference

1. Lee, Ashley M., et al. "Safety and diagnostic value of brain biopsy in HIV patients: a case series and meta-analysis of 1209 patients." Journal of Neurology, Neurosurgery & Psychiatry 87.7 (2016): 722-733.
2. Kradin, Richard L. Diagnostic Pathology of Infectious Disease. Elsevier Health Sciences, 2017.

Case 4

Case 4: A 76-year-old female presented with a left thyroid nodule. One representative section.

Targeted Diagnosis: **Parathyroid oncocytic adenoma and Hashimoto thyroiditis**



Case 4

Submitted Diagnoses by Participating Institutions	Number	
Parathyroid (oncocytic/ oxyphil) adenoma and lymphocytic thyroiditis/ Hashimoto thyroiditis	17	Acceptable
Intrathyroid parathyroid adenoma	1	Acceptable
Parathyroid adenoma/hyperplasia and lymphocytic thyroiditis	2	Acceptable
Parathyroid adenoma with severe Hashimoto's thyroiditis. Suggest IHC to exclude thyroid lesion such as follicular adenoma, medullary carcinoma or poorly differentiated thyroid carcinoma	1	Acceptable
Follicular adenoma	1	
Hurtle cell adenoma and lymphocytic thyroiditis	1	

Educational notes:

1. There is a well-circumscribed, encapsulated parathyroid adenoma almost exclusively composed of oncocytic cells. At the periphery, a thin rim of chief cells and stromal fat are noted. The background thyroid tissue displays prominent lymphocytic infiltrates with germinal center formation in the stroma accompanied by oncocytic change of the thyroid follicular cells.
2. Recognition of the thin rim of chief cells and stromal fat identifies the parathyroid origin of the nodule. As this nodule is almost exclusively composed of oncocytic cells, a neoplastic process, i.e. adenoma, is substantiated. In contrast, chief cells predominate in parathyroid hyperplasia. Nonetheless, distinction between parathyroid chief cell adenoma and parathyroid chief cell hyperplasia requires close clinico-pathological correlation.
3. The background thyroid tissue shows prominent lymphocytic infiltrates with germinal centers. In addition, parenchymal damage with oncocytic change is evident, consistent with Hashimoto thyroiditis. This contrasts with lymphocytic thyroiditis whereby the parenchymal damage is limited.

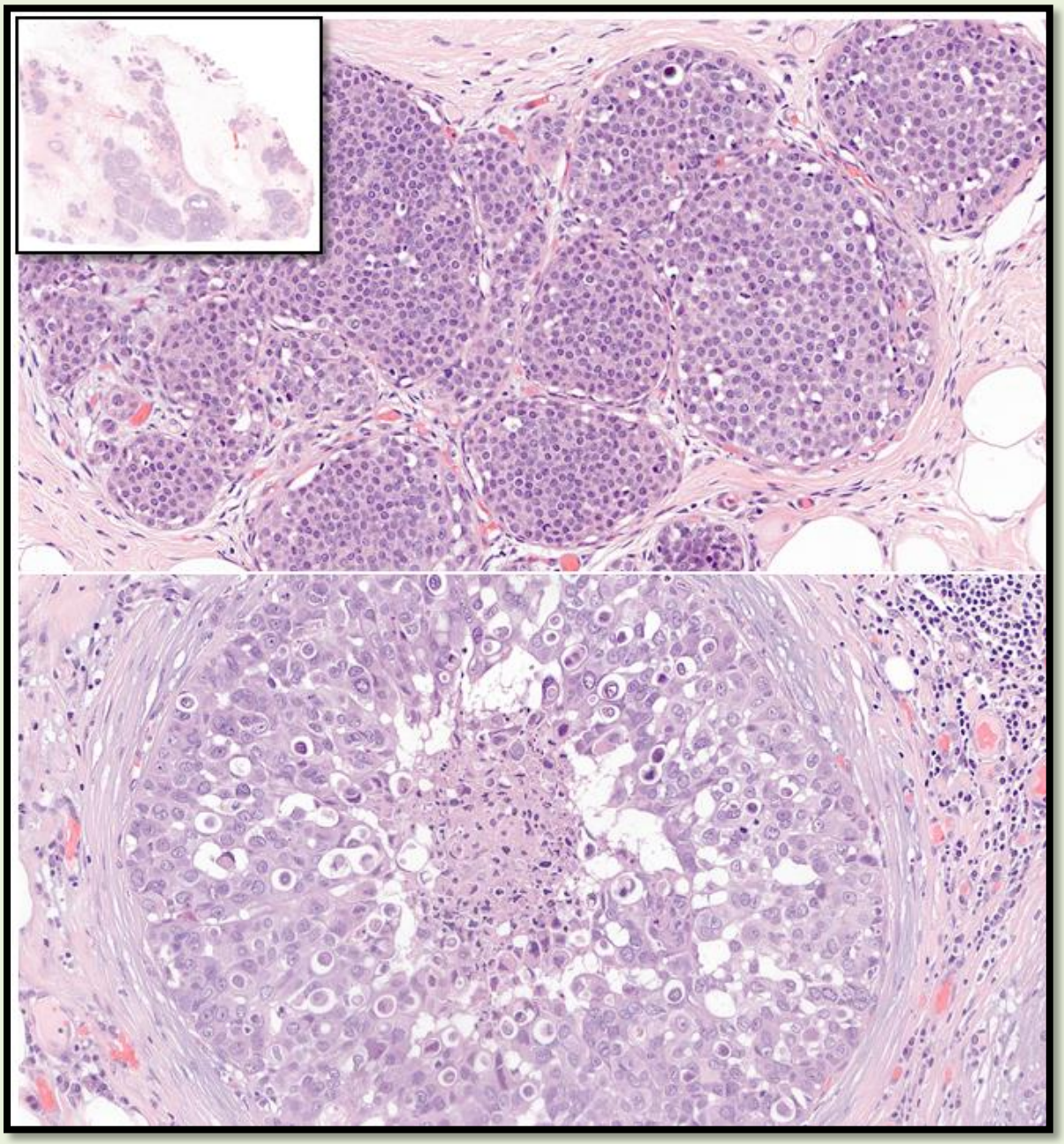
Reference

1. Goldblum, John R., et al. Rosai and Ackerman's Surgical Pathology. Elsevier Health Sciences, 2017.

Case 5

Case 5: A 60-year-old lady presented with right breast microcalcifications. Wide local excision. One representative section.

Targeted Diagnosis: **High grade ductal carcinoma in situ and lobular carcinoma in situ**



Case 5

Submitted Diagnoses by Participating Institutions	Number	
Ductal carcinoma in situ high grade, with LCIS/ High grade ductal carcinoma in-situ with lobular cancerization/ lobular carcinoma in-situ	6	Acceptable
High grade DCIS with possible microinvasion and concomitant LCIS	1	Acceptable
High-grade DCIS with microinvasion and LCIS	2	Acceptable
High grade DCIS with lobular cancerization. Comment: E-cadherin to exclude lobular neoplasia and p63 to exclude invasion.	1	Acceptable
High grade in-situ carcinoma favoring LCIS. E-Cadherin to differentiate DCIS/LCIS. P63 and SMMHC to exclude microinvasion.	1	Acceptable
High grade DCIS/ High grade DCIS with lobular cancerization	3	
High grade DCIS with lobular cancerization; suspicious of microinvasion/ High grade DCIS with area suspicious of microinvasion (to do p63)	4	
High grade DCIS with microinvasion/ Extensive High nuclear grade DCIS with comedonecrosis + microinvasive carcinoma/ High grade DCIS with microinvasion. Comment: For confirmation with p63	3	
Pleomorphic LCIS/ Lobular carcinoma in situ in the background atypical lobular hyperplasia.	2	

Educational notes:

1. This wide local excision shows extensive high-grade ductal carcinoma in situ (DCIS). There are distended ducts filled by high grade neoplastic cells arranged predominantly in comedo pattern. Contour of the ducts remains smooth without microinvasion. In addition, lobular carcinoma in situ (LCIS) is observed, comprised of acini distended by a monomorphic population of neoplastic cells with small round nuclei. E-cadherin immunostaining is negative in LCIS whereas it is retained in DCIS. p63 immunostaining shows preserved myoepithelial cells in the involved ducts.
2. There is extensive high-grade DCIS in this specimen. In such situation, a diligent search for microinvasion (microinvasive carcinoma) is warranted. Deeper sections and immunohistochemistry for myoepithelial cell markers might be helpful for suspicious foci. Nonetheless, microinvasive carcinoma should only be diagnosed when the invasion is definite and is less than 1mm for each invasive focus.
3. This specimen shows concomitant LCIS. In contrast to lobular cancerization of DCIS, the involved acini in LCIS are expanded in a uniform manner by a monomorphic population of cells. Loss of membranous E-cadherin confirms LCIS. A caveat to be considered is aberrant expression of fragmented membranous and/or cytoplasmic staining of E-cadherin in a small proportion of LCIS, which does not necessarily support the diagnosis of DCIS.

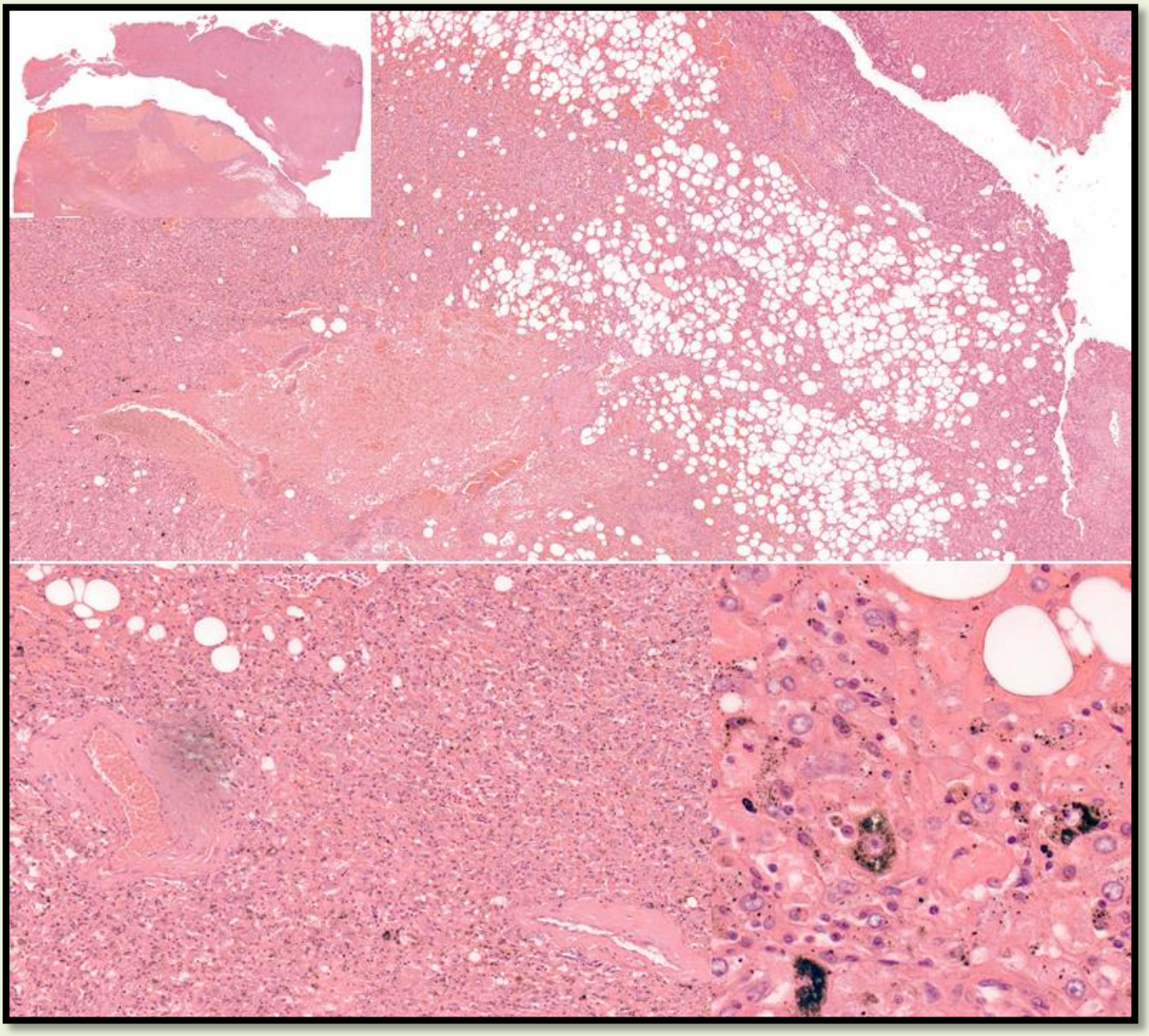
Reference

1. Lakhani, S.R., et al. " WHO classification of tumours of the breast" (2019)

Case 6

Case 6: A 41-year-old male presented with epigastric pain. Intraoperatively, a ruptured "hemangioma" was noted at segment VIII of the liver. One representative section.

Targeted Diagnosis: **Angiomyolipoma**



Case 6

Submitted Diagnoses by Participating Institutions	Number	
Angiomyolipoma	17	Acceptable
Spontaneous liver rupture due to peliosis hepatis/ peliosis hepatis	2	
Hepatic adenoma/ Hepatocellular adenoma	2	
Features are in favour of Epithelioid Haemangioendothelioma/ HCC with veno-occlusion pattern of liver changes. Suggest to do CD31 and reticulin stain to rule out EHE / HCC.	1	
Ruptured hepatoma. Need CD34 and Glypican 3 TRO HCC	1	

Educational notes:

1. This non-capsulated liver tumor contains large hemorrhagic areas. The tumor is composed predominantly of epithelioid cells with abundant eosinophilic cytoplasm and round nuclei with occasional nucleoli. Scattered tumor cells contain fine black cytoplasmic pigments. A minor component of adipocytes is integral to this tumor. These histological features suggest epithelioid angiomyolipoma.
2. The classic angiomyolipoma is a triphasic tumor composed of smooth muscle, fat and muscular arteries in variable proportions. Nonetheless, a cell population may predominate. Particularly, in smooth muscle-predominant tumors, the smooth muscle cells may be spindled, epithelioid, clear, oncocytic or pleomorphic.
3. This angiomyolipoma shows predominantly epithelioid morphology of the myoid cells, which mimics hepatocellular adenoma or hepatocellular carcinoma. Presence of fine black cytoplasmic pigments in tumor cells and intratumoral adipocytes prompts consideration for angiomyolipoma. Immunohistochemistry could be of great help as angiomyolipomas are consistently reactive towards HMB-45 and anti-smooth muscle antibodies. In addition, generous sampling is recommended to aid in recognition of the variable proportions of triphasic components of angiomyolipoma.

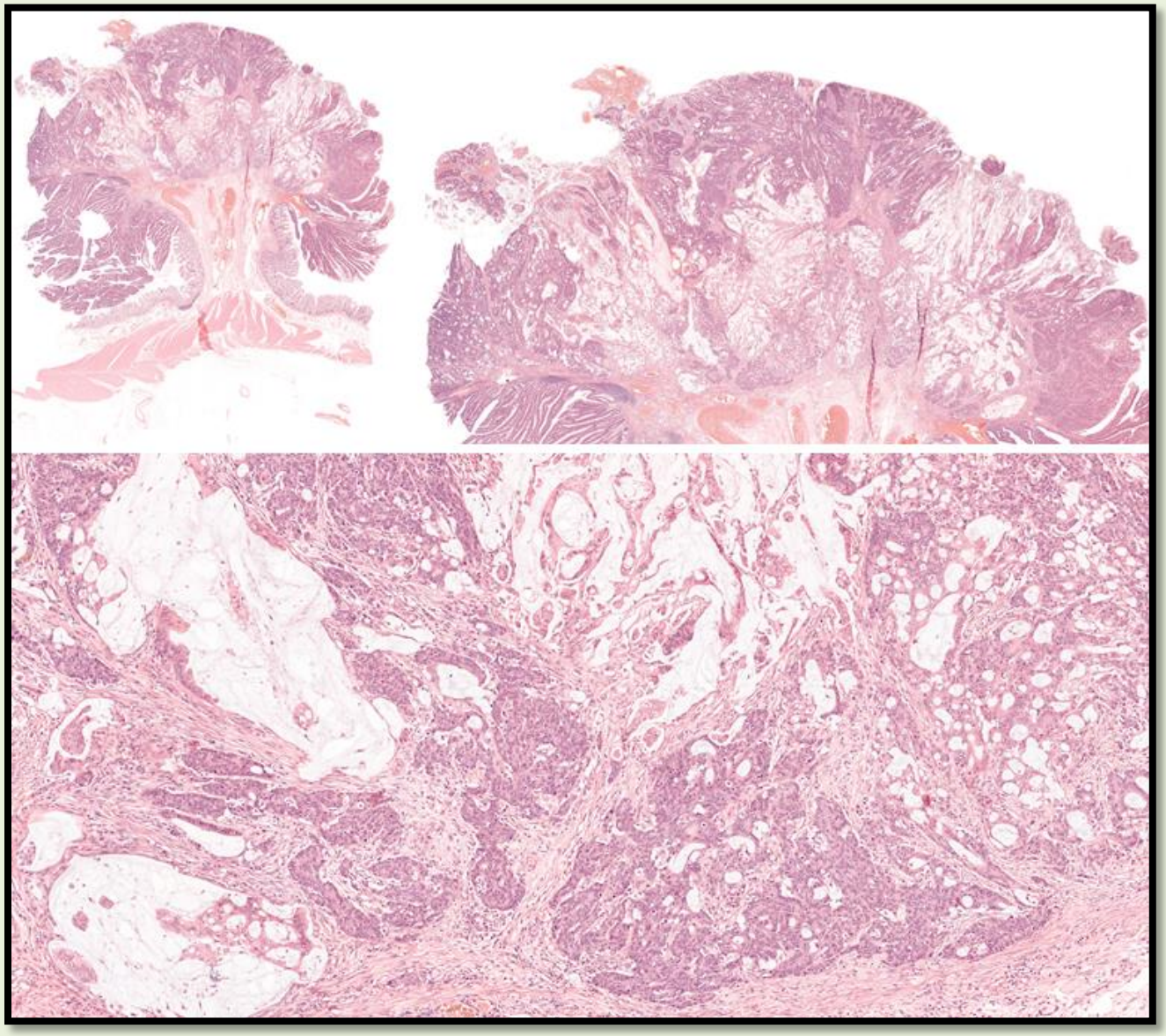
Reference:

1. Mounajjed, Taofic, Vishal S. Chandan, and Michael S. Torbenson, eds. Surgical pathology of liver tumors. Springer, 2015.

Case 7

Case 7: Colonic polyp was resected from a 60-year-old male. One representative section.

Targeted Diagnosis: **Mucinous adenocarcinoma arising in villous adenoma with high grade dysplasia, Haggitt level 1, pT1**



Case 7

Submitted Diagnoses by Participating Institutions	Number	
Mucinous adenocarcinoma arising from villous or tubulovillous adenoma, Haggitt 1/ Adenocarcinoma arising from an adenoma (Haggitt level 1)	12	Acceptable
Adenocarcinoma in polyp, Haggitt 1/ Malignant polyp, Haggitt level 1	3	Acceptable
Malignant polyp, Haggitt 2	1	Acceptable
Adenocarcinoma arising from villous or tubulovillous adenoma/ Villous adenoma with adenocarcinoma invading the stroma.	4	Acceptable
Moderately differentiated adenocarcinoma with mucinous features arising in pedunculated tubulovillous adenoma (pT2). Adequately excised	1	
Intramucosal adenocarcinoma arising in a villous adenoma/ Intramucosal adenocarcinoma	2	

Educational notes:

1. This is a locally excised pedunculated polyp. The polyp is a villous adenoma with high grade dysplasia containing an invasive mucinous adenocarcinoma in the head of the polyp. This invasive adenocarcinoma destroys the muscularis mucosae and invades into the submucosa. It remains confined to the head of the polyp flanked by adenomatous epithelium (Haggit level 1, pT1). This moderately differentiated adenocarcinoma shows infiltrative irregular cribriform glands with abundant extracellular mucin (>50%). This tumor has low tumor budding. No lymphovascular is noted. Resection margin is free from tumor involvement.
2. This adenocarcinoma has invaded beyond the muscularis mucosae; it is more advanced than intramucosal carcinoma, which, by definition, has invasion confined within the muscularis mucosae. Intramucosal carcinoma is staged as pTis and has virtually no risk of metastasis despite intramucosal invasion in colon.
3. It is crucial to evaluate malignant polyps for histological factors associated with lymph node metastasis in order to guide the need for complementary surgery. These histological factors include (1) the depth of invasion beyond the muscularis mucosae, (2) the width of tumor invasion (3) Haggitt level of invasion for polypoid tumors or Kikuchi level for sessile tumors (4) lymphovascular invasion (5) tumor budding at tumor front, (6) histological differentiation and (7) resection margin status (positive or close margin <1mm).
4. This invasive adenocarcinoma has pools of extracellular mucin >50% of the lesion containing malignant epithelia, thus it is designated as mucinous adenocarcinoma. Mucinous adenocarcinoma has similar prognosis to that of adenocarcinoma, NOS but responds poorer to systemic treatment in the metastatic setting.

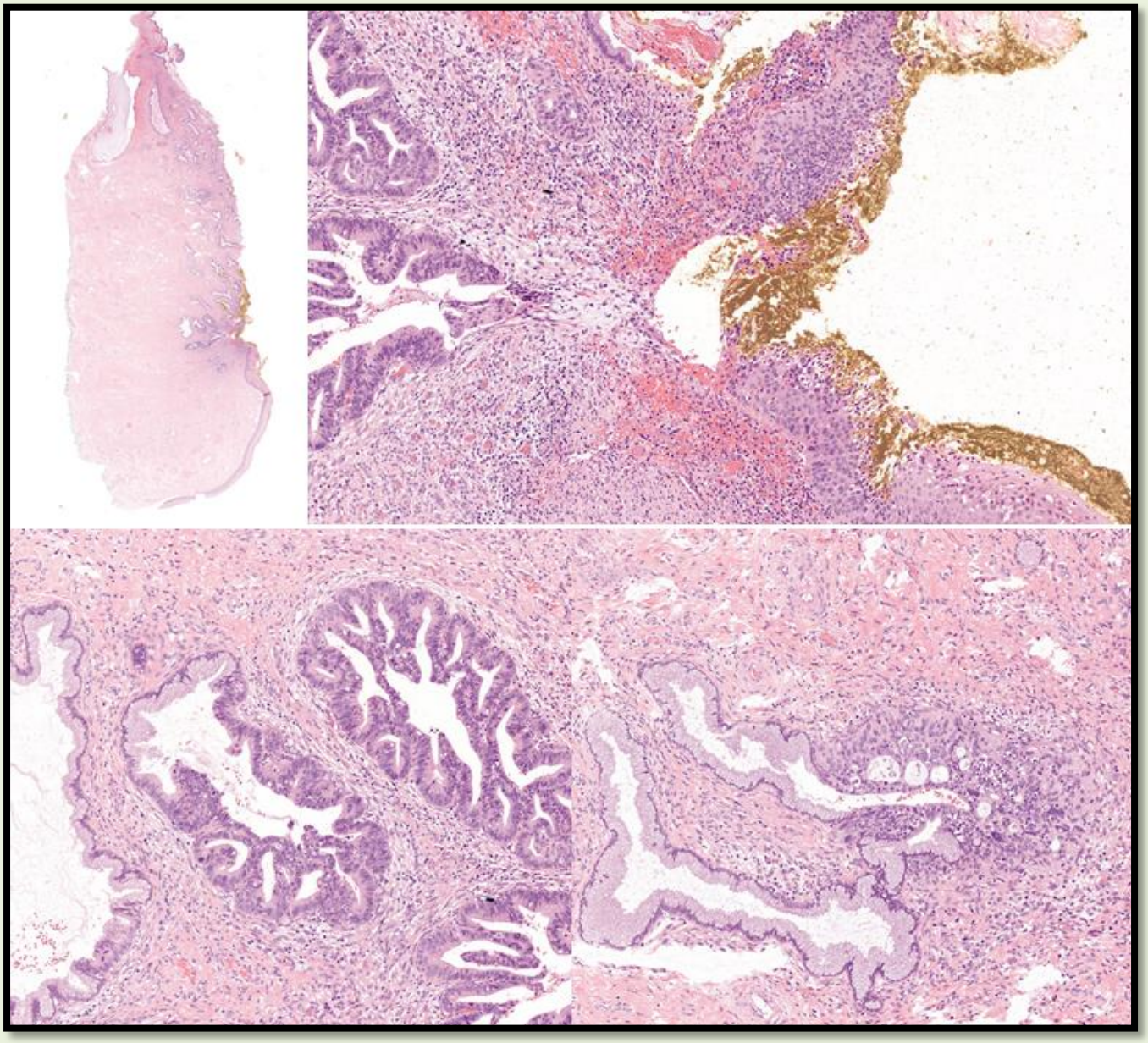
Reference

1. Hagen, Catherine E., and Ayesha Farooq. "Histologic Evaluation of Malignant Polyps and Low-Stage Colorectal Carcinoma." Archives of Pathology & Laboratory Medicine 143.12 (2019): 1450-1454.
2. Nagtegaal, I. D., et al. "WHO Classification of Tumors of the Digestive System." (2019).

Case 8

Case 8: Cervical cone biopsy was performed on a 40-year-old female. One representative section.

Targeted Diagnosis: **High grade squamous intraepithelial lesion (HSIL) and adenocarcinoma in situ (AIS)**



Case 8

Submitted Diagnoses by Participating Institutions	Number	
High grade squamous intraepithelial lesion (HSIL) or Cervical Intraepithelial Neoplasia 3 (CIN3) and adenocarcinoma in situ (AIS)	6	Acceptable
High grade intraepithelial lesion with glandular involvement and AIS	7	Acceptable
High grade intraepithelial lesion with glandular involvement and possible invasion and AIS	4	Acceptable
Adenocarcinoma in situ with Cervical Intraepithelial Neoplasm	1	Acceptable
High grade intraepithelial lesion and AIS with microinvasion	2	Acceptable
HSIL with glandular involvement with microinvasion and coexisting adenocarcinoma-in-situ	1	Acceptable
Adenocarcinoma in situ	2	

Educational notes:

1. Section from the cervix shows co-existing high grade squamous intraepithelial lesion (HSIL) and adenocarcinoma in situ (AIS). The HSIL component shows full thickness dysplasia involving a few glands. The endocervical glands also show AIS with atypical epithelium displaying pseudostratified enlarged hyperchromatic nuclei. No microinvasion is observed.
2. Both HSIL and AIS are human papillomavirus (HPV)-associated precancerous lesions of the uterine cervix although the latter is considerably less prevalent as compared to the former. Between 24% to 75% of AIS cases are detected with co-existing HSIL or invasive squamous cell carcinoma.
3. To determine presence of invasion in suspicious foci of HSIL, criteria for invasion are applied, such as stromal desmoplasia, irregular or scalloped margins, clearing of chromatin and prominent nucleoli of invasive cells, and/or abundant, paradoxically mature eosinophilic cytoplasm.
4. As AIS is confined to the pre-existing normal endocervical epithelium, the normal lobular architecture is maintained. AIS may show 'endometrioid' features and rarely neuroendocrine and Paneth cells are present. Of note, intestinal differentiation in endocervical glands almost always indicates a premalignant or malignant lesion.

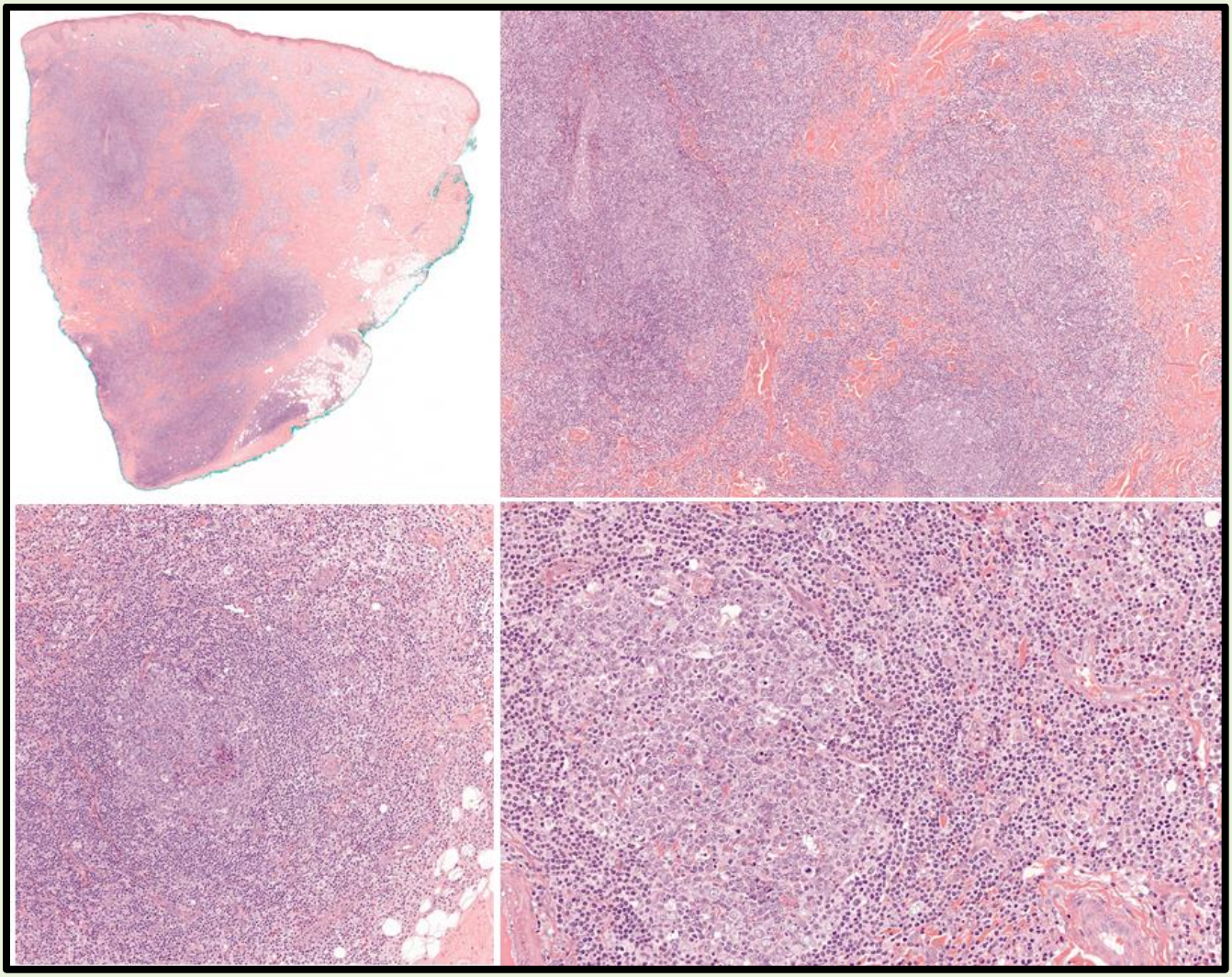
Reference

1. L. Mutter, Jaime Prat. Pathology of the female reproductive tract. 3rd ed. Philadelphia: Elsevier (2014).
2. Carcangiu, M. L., et al. WHO classification of tumours of female reproductive organs. International Agency for Research on Cancer, 2014.

Case 9

Case 9: A 72-year-old male presented with a non-tender nodule over right clavicular region for a few months. One representative section.

Targeted Diagnosis: **Nodular pseudolymphoma**



Case 9

Submitted Diagnoses by Participating Institutions	Number	
Angiolymphoid hyperplasia with eosinophilia/ Epithelioid haemangioma	18	Acceptable
Kimura disease (angiolymphoid hyperplasia with eosinophilia)/ Kimura disease.	3	
Kimura Disease. Differential could be Angiolymphoid Hyperplasia with Eosinophilia. Suggest IHC to exclude T cell Lymphoma	1	
Langerhans cell histiocytosis	1	

Educational notes:

1. The skin tissue shows nodular lymphocytic infiltrates in the dermis associated with lymphoid follicles. The lymphoid follicles show reactive follicular hyperplasia with presence of tingible body histiocytes. There are eosinophils and histiocytes admixed with the lymphocytic infiltrates. Vascular proliferation is not prominent. These features are consistent with nodular pseudolymphoma.
2. Histological features of dense dermal lymphocytic infiltrates with lymphoid follicles prompt consideration for nodular B cell pseudolymphoma, indolent primary cutaneous marginal zone lymphoma (PCMZL) and primary cutaneous follicle center lymphoma (PCFCL). A caveat to take note of is that both nodular B cell pseudolymphoma and PCMZL show reactive germinal centers. Another caveat is that neoplastic germinal centers in PCFCL show negative BCL-2 expression. Immunoglobulin light chains restriction for kappa or lambda would be helpful to separate nodular B cell pseudolymphoma from the latter.
3. Differential diagnosis such as angiolymphoid hyperplasia with eosinophilia (ALHE) and Kimura disease is considered given the abundant eosinophils present in the lymphocytic infiltrates. ALHE is now more considered an angioproliferative process in the dermis rather than a pseudolymphoma. In ALHE, reactive germinal centers may occur but histologically, capillary vessels with prominent endothelia and cytoplasmic vacuole shall be the prominent feature. In contrast, Kimura disease is a distinctive entity involving deep-seated structures such as subcutis and muscle without overlying skin lesion. Eosinophils in Kimura disease display eosinophilic folliculolysis, eosinophilic microabscesses.

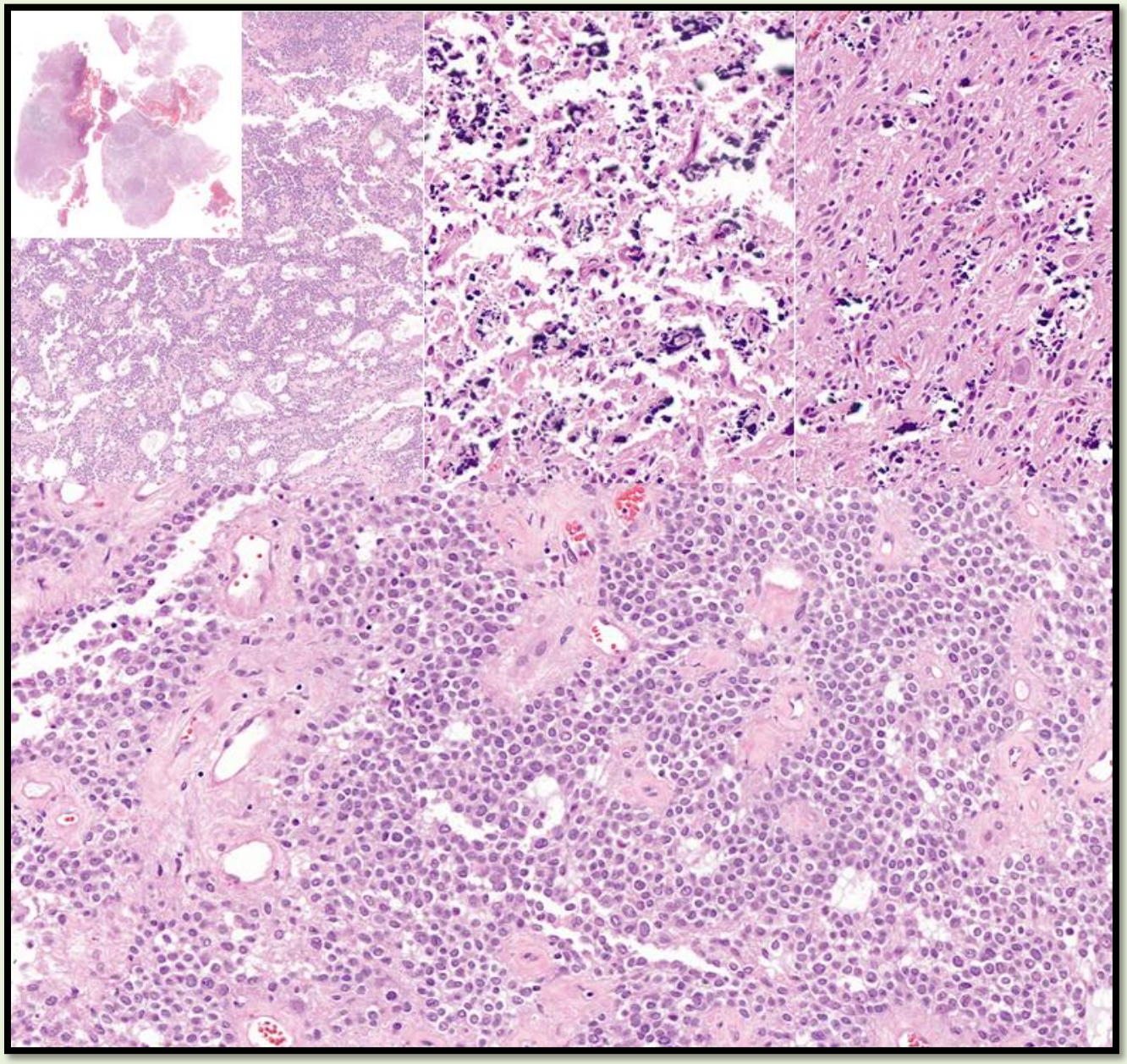
Reference

1. Mitteldorf, Christina, and Werner Kempf. "Cutaneous pseudolymphoma—A review on the spectrum and a proposal for a new classification." Journal of Cutaneous Pathology 47.1 (2020): 76-97
2. Abuel-Haija, Mohammad, and Matthew T. Hurford. "Kimura disease." Archives of pathology & laboratory medicine 131.4 (2007): 650-651.

Case 10

Case 10: A mass at the right lateral ventricle was noted in the brain CT scan of a 28-year-old female. One representative section

Targeted Diagnosis: **Central neurocytoma (WHO grade II)**



Case 10

Submitted Diagnoses by Participating Institutions	Number	
Central neurocytoma	5	Acceptable
Low grade glioma (WHO grade II), Differential diagnosis: Central neurocytoma, Ependymoma, Oligodendroglioma	1	Acceptable
Atypical central neurocytoma	2	Acceptable
Ependymoma	13	
Anaplastic ependymoma	1	
Oligodendroglioma	1	

Educational notes:

1. This brain tumor is composed of a monomorphic population of cells displaying round or oval nuclei. The nuclei have finely speckled chromatin. The tumor shows focal oligodendroglioma-like honeycomb areas and prominent perivascular pseudorosettes around the rich capillaries. Calcifications are observed in one fragment. Focal ganglionic differentiation is seen. No microvascular proliferation with multilayered endothelia, brisk mitosis or tumor necrosis is observed.
2. The oligodendroglioma-like areas raise the possibility of oligodendroglioma. However, oligodendroglioma does not show finely speckled chromatin of the nuclei. In addition, oligodendroglioma is a diffusely infiltrative glioma located in the cortex and white matter in contrast to the intraventricular location of central neurocytoma.
3. The tumor cells crowd around the capillaries forming prominent perivascular pseudorossettes. The perivascular pseudorossettes raise the possibility of ependymomas. Perivascular pseudorossettes of ependymomas contain coarse glial processes in contrast to the delicate neuropil of neurocytoma. Immunohistochemistry would be helpful as neurocytomas show neuronal immunophenotype with strong and diffuse positivity against synaptophysin but focal staining for GFAP, reflecting limited glial differentiation. This immunophenotype contrasts that of ependymomas, i.e. negative for synaptophysin and more diffuse GFAP staining especially the coarse glial processes in perivascular pseudorossettes.
4. Central neurocytomas with anaplastic histological features (i.e. brisk mitotic activity, microvascular proliferation, and necrosis) or elevated Ki-67 index >2% are called atypical central neurocytomas. Atypical central neurocytomas are not assigned a different WHO grade due to uncertainties in prognosis.

Reference

1. Perry, Arie, and Daniel J. Brat. Practical Surgical Neuropathology: A Diagnostic Approach E-Book: A Volume in the Pattern Recognition Series. Elsevier Health Sciences, 2017.
2. David N. Louis, Hiroko Ohgaki, Otmar D. Wiestler,Webster K. Cavenee (Eds): WHO Classification of Tumours of the Central Nervous System (Revised 4th edition). IARC; Lyon 2016.

©E.S. Ch'ng, International Academy of Pathology, Malaysian Division Secretariat, Department of Pathology, School of Medical Sciences, Universiti Sains Malaysia Health Campus, 16150 Kubang Kerian, Kelantan, Malaysia, August 2020.