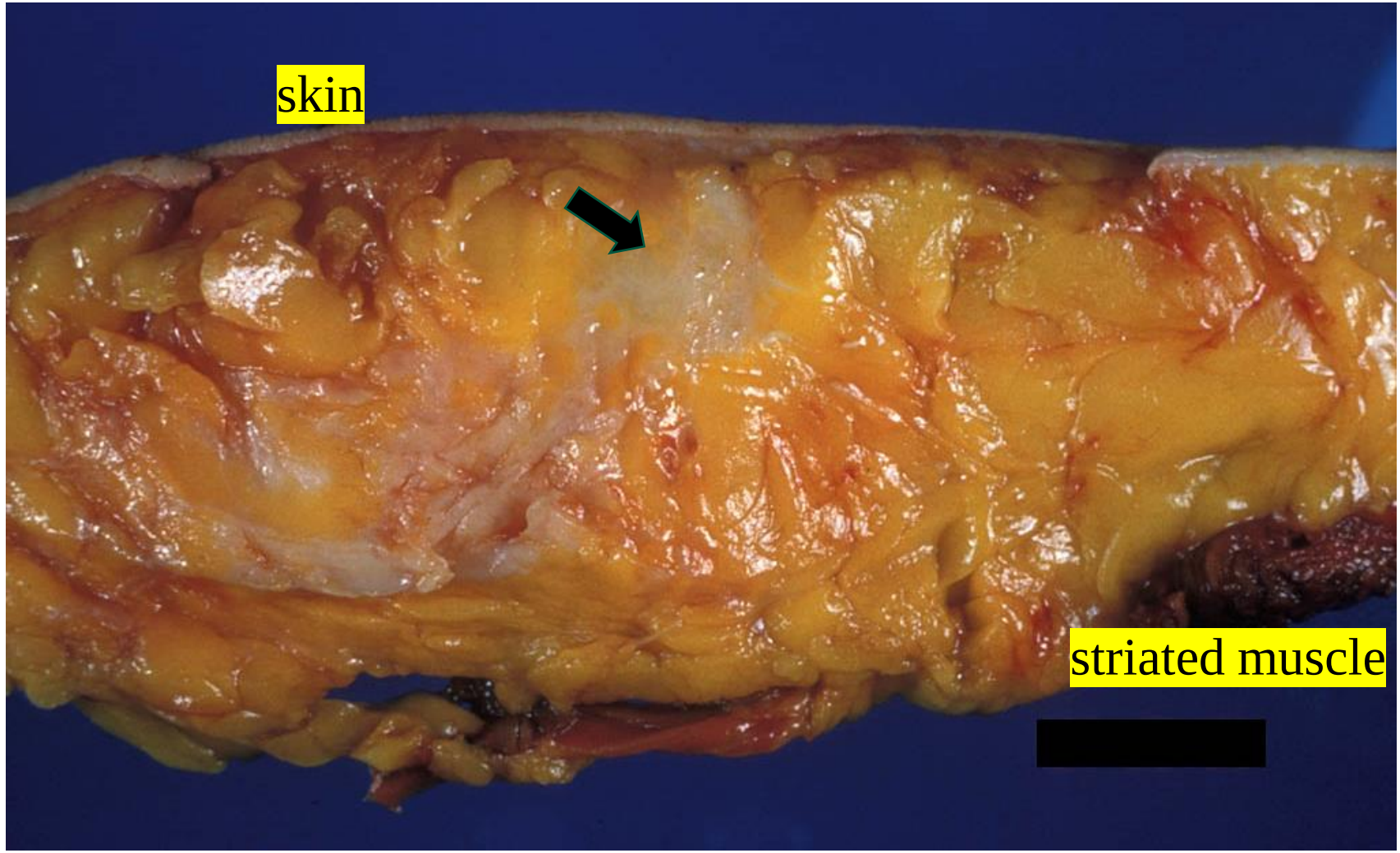
Fat cells and their peculiarities

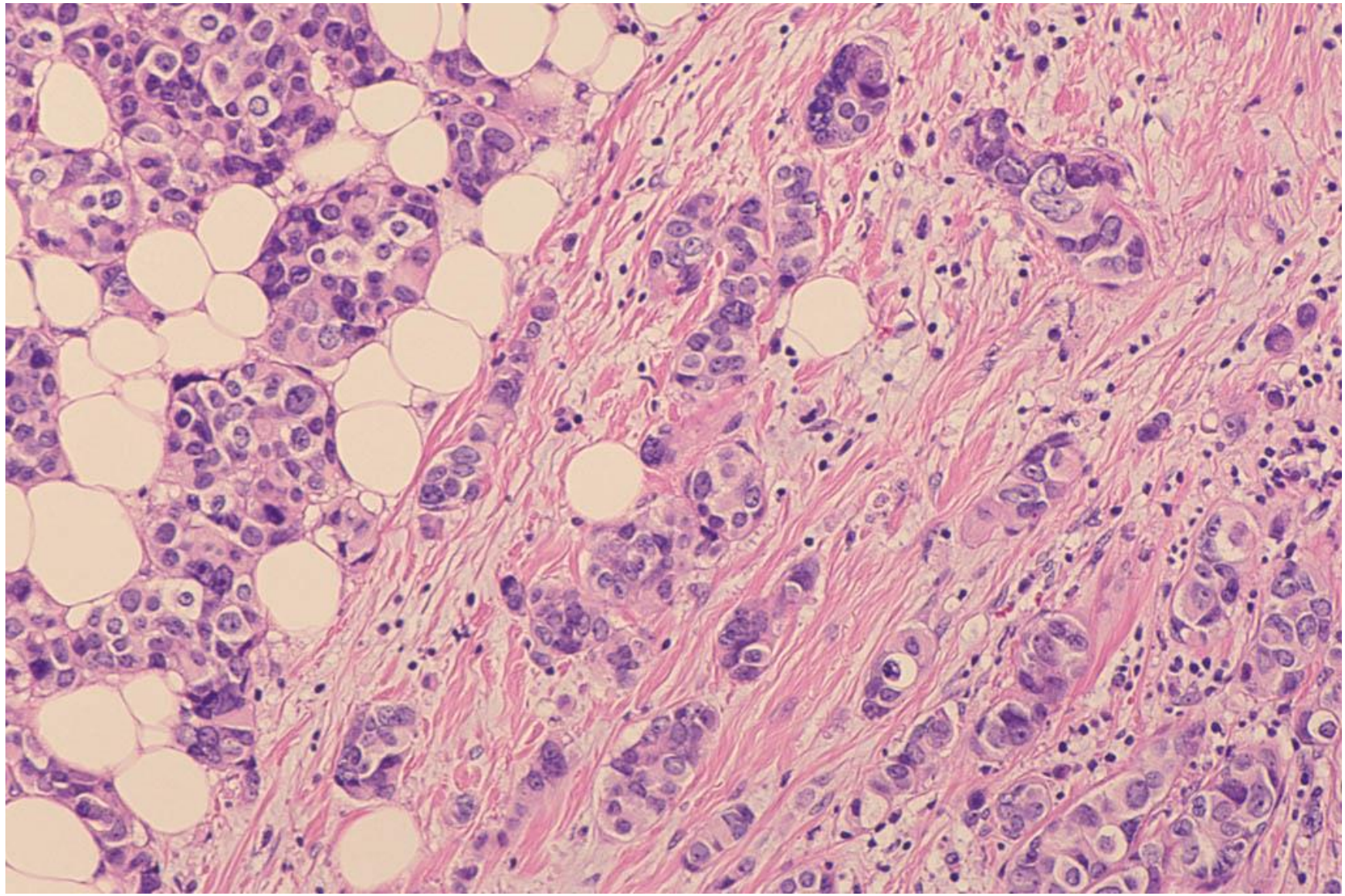
The fat tissue is divided into white and brown fat tissue. The white fat is actually colored yellow because of high content of lipid-soluble carotenoid. The white fat cells play a major role in obesity. Secondary changes of the fat cells include serous atrophy and membranous lipodystrophy-like change. Lipomatosis is seen in certain organs when the parenchymal cell atrophy occurs, including the bone marrow, thymus, lymph node, striated muscle, heart and pancreas. In contrast, fibrosis may be induced by parenchymal cell atrophy in the thyroid, urachus and vermiform appendix. Fibrosis is seen as a pathological process in the bone marrow, heart and pancreas. Benign tumors of the lipoma group often occur in the subcutaneous fat tissue, while malignant tumors (liposarcomas) are seen in the deep fat tissue, but never seen in the subcutaneous fat tissue.

Ref.-1: Sakers A, et al. Adipose-tissue plasticity in health and disease. Cell 2022; 185(3): 419-446. doi: 10.1016/j.cell.2021.12.016

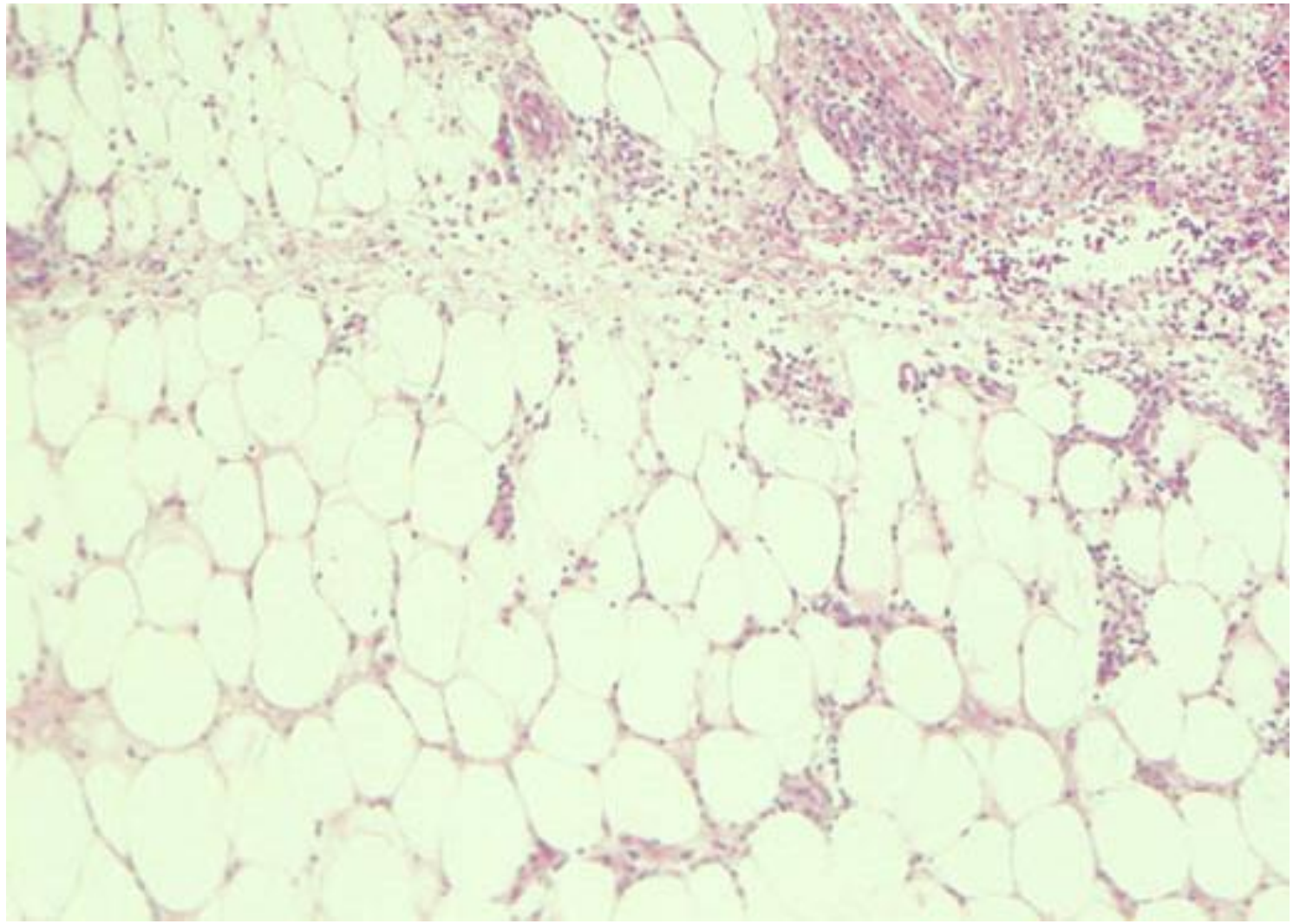
Ref.-2: Akcalar S, et al. Imaging findings of lipomatosis: a comprehensive review. Jpn J Radiol 2013; 31: 1-8. doi: 10.1007/s11604-012-0144-x



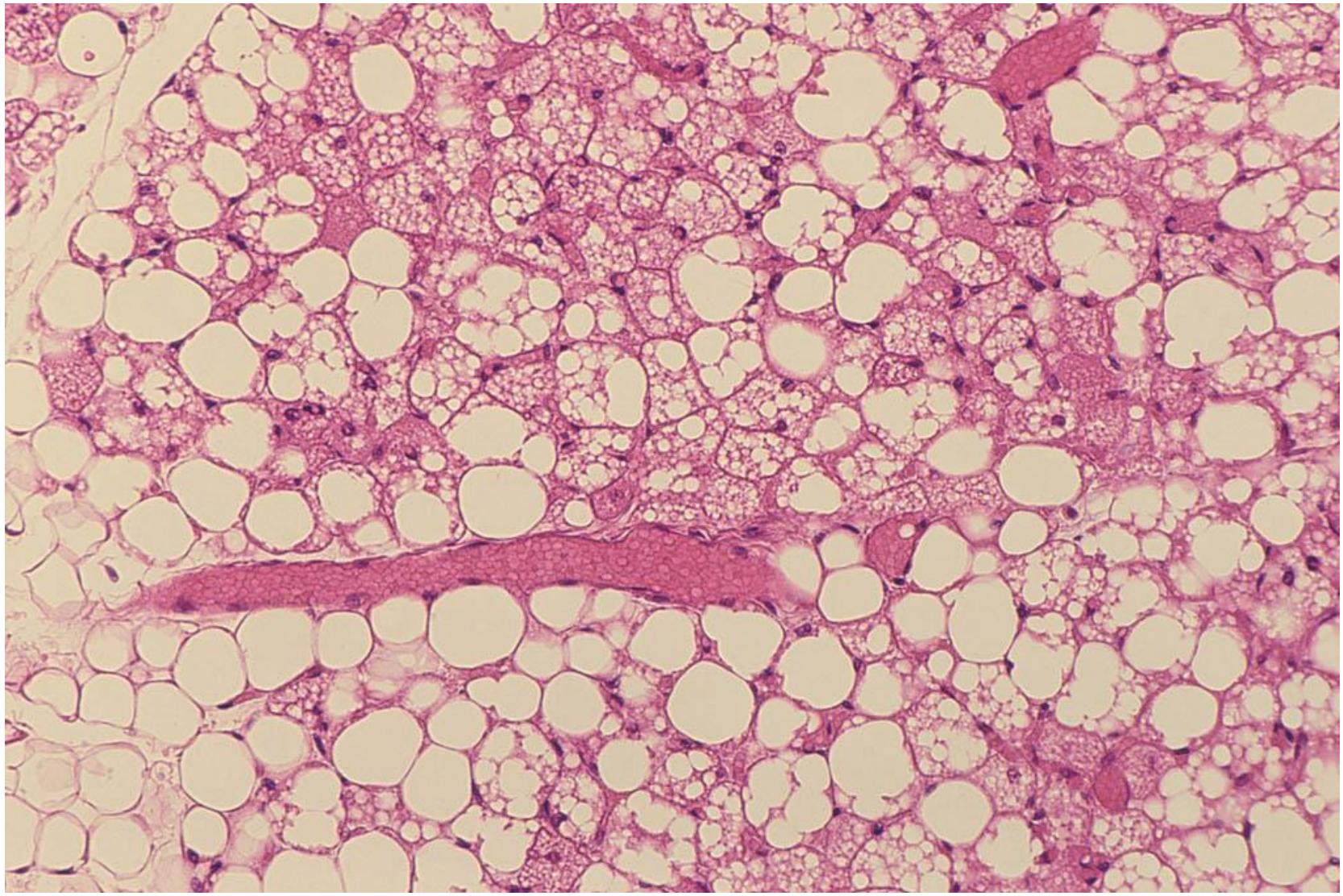
The cut surface of mastectomized breast cancer (arrow). The fat tissue is yellow in color, while the striated muscle is red-colored. The yellow color of the fat is due to high content of lipid-soluble carotenoid.



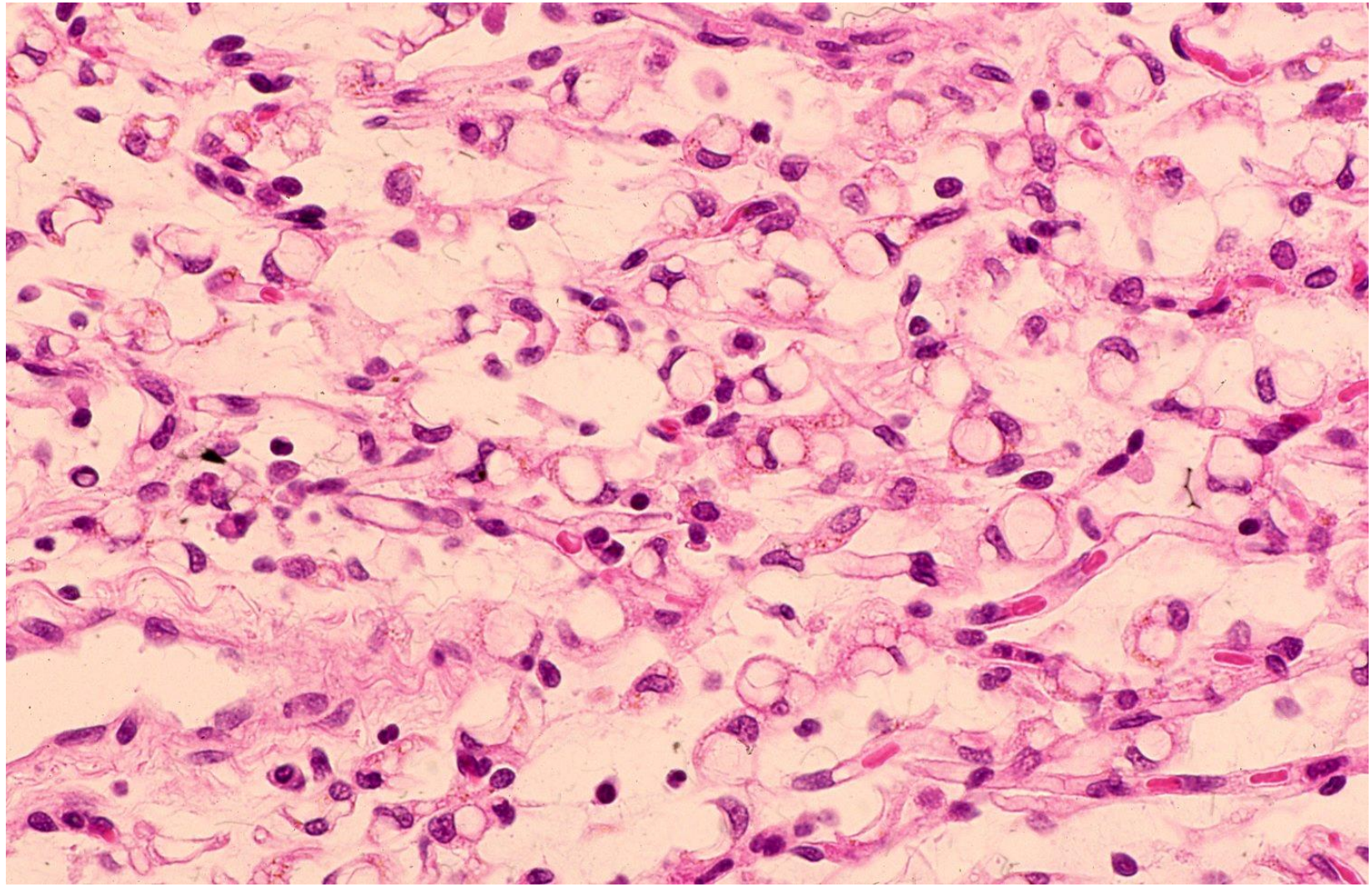
Invasive ductal carcinoma of the breast involving mature fat tissue. H&E



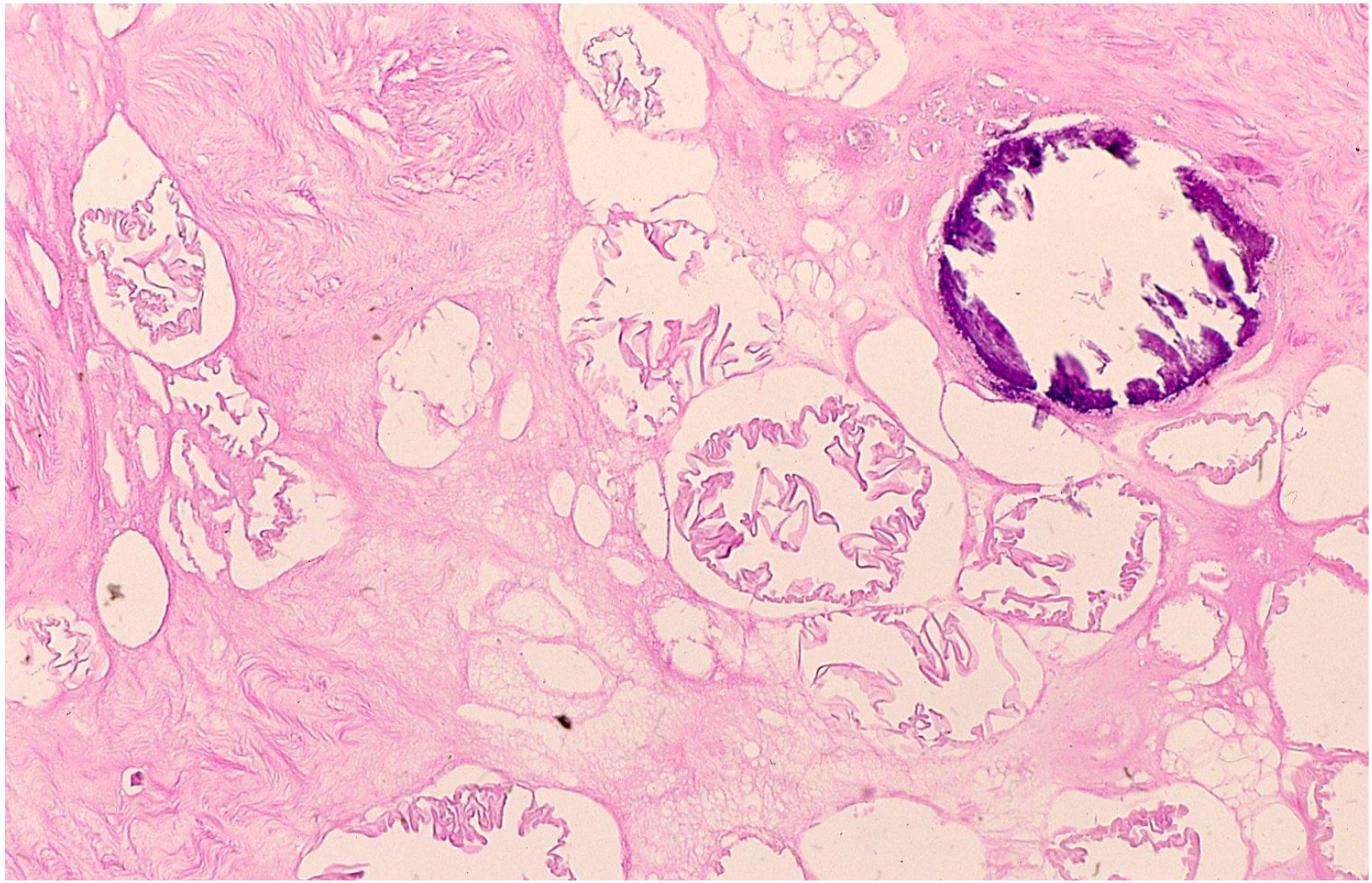
The subcutaneous fat tissue with focal inflammatory change. Mature fat cells are lobulated. H&E



Brown fat cells with foamy cytoplasm are intermingled with conventional mature fat cells. The thermogenic brown fat cells producing heat energy are rich in cytochrome-rich mitochondria. H&E



Serous atrophy of fat cells seen in a cachectic cancer patient. Myxoid stromal change is associated. The atrophic fat cells are rich in glycogen particles. H&E



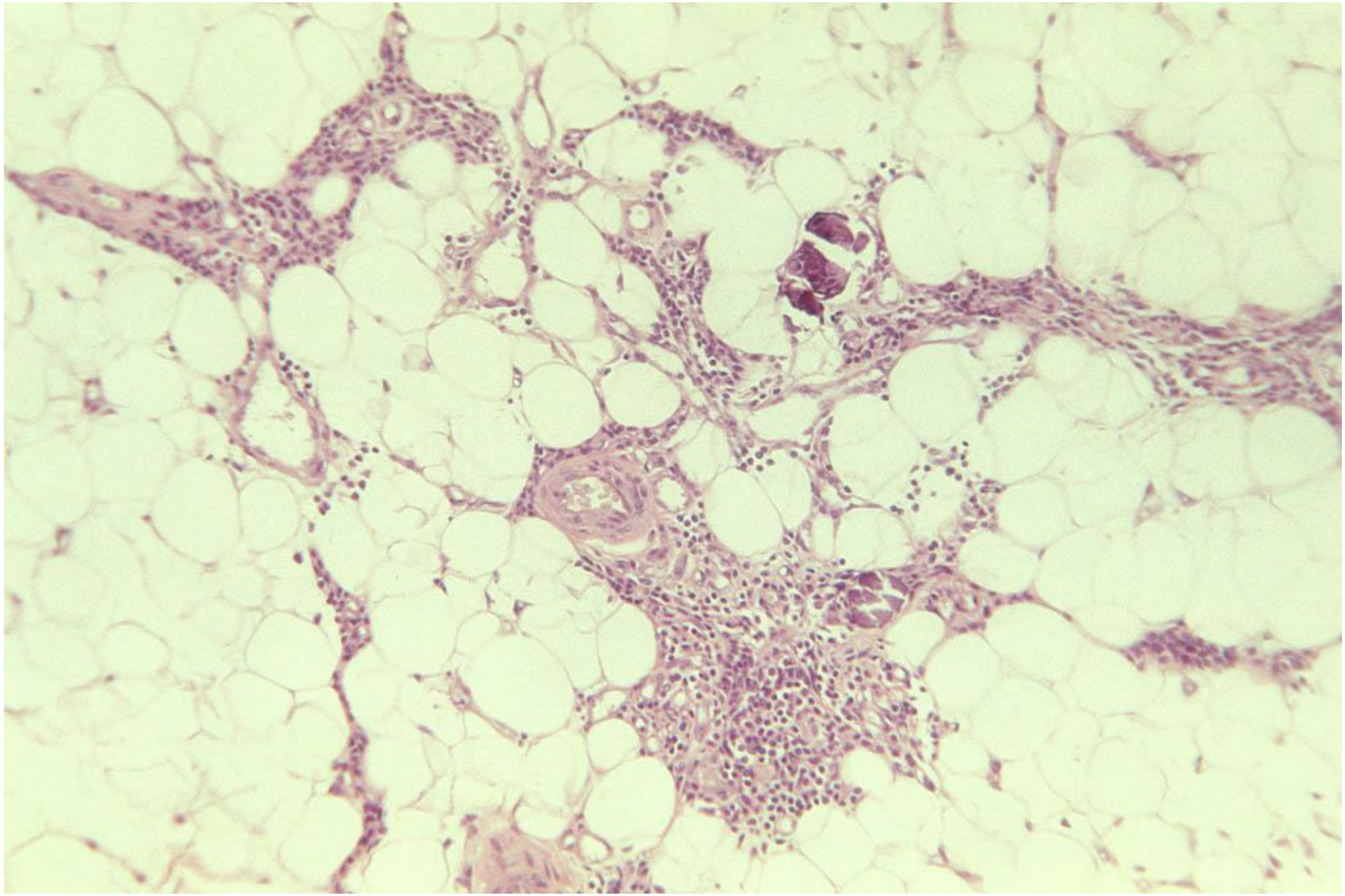
Membranous lipodystrophy-like change. Membranous structures are seen within the cytoplasm of fat cells. Microcalcification is associated. The stroma is fibrotic. H&E

Organs showing lipomatosis (fat cell replacement) when atrophy of the parenchymal cells happens

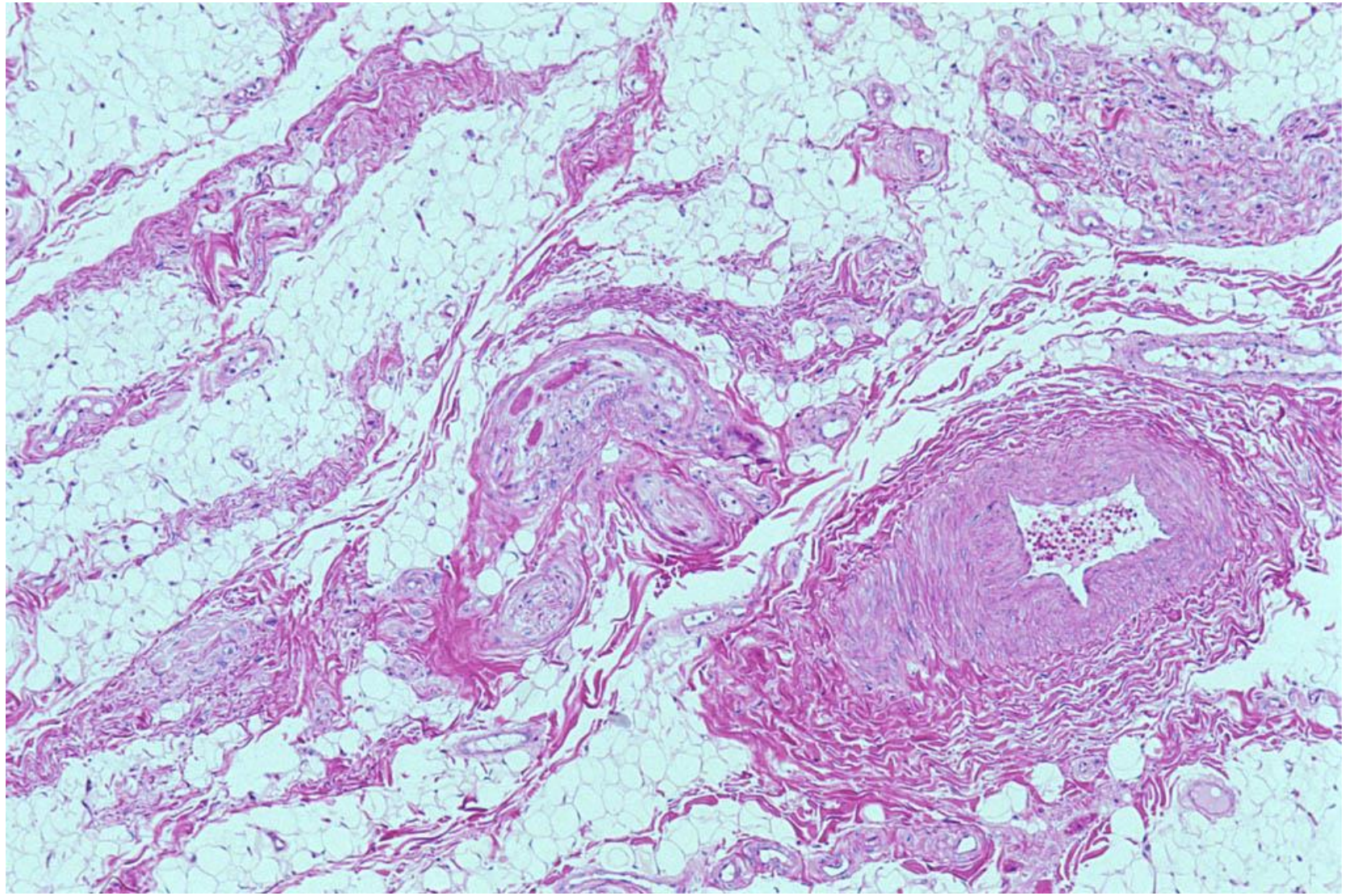
1) Bone marrow (fibrosis seen in myeloproliferative disorders)
2) Thymus
3) Lymph node
4) Striated muscle
5) Heart (fibrosis seen in old myocardial infarction)
6) Pancreas (fibrosis seen in chronic pancreatitis)
7) Salivary gland
8) Parathyroid gland

Organs showing fibrosis when atrophy of the parenchymal cells happens

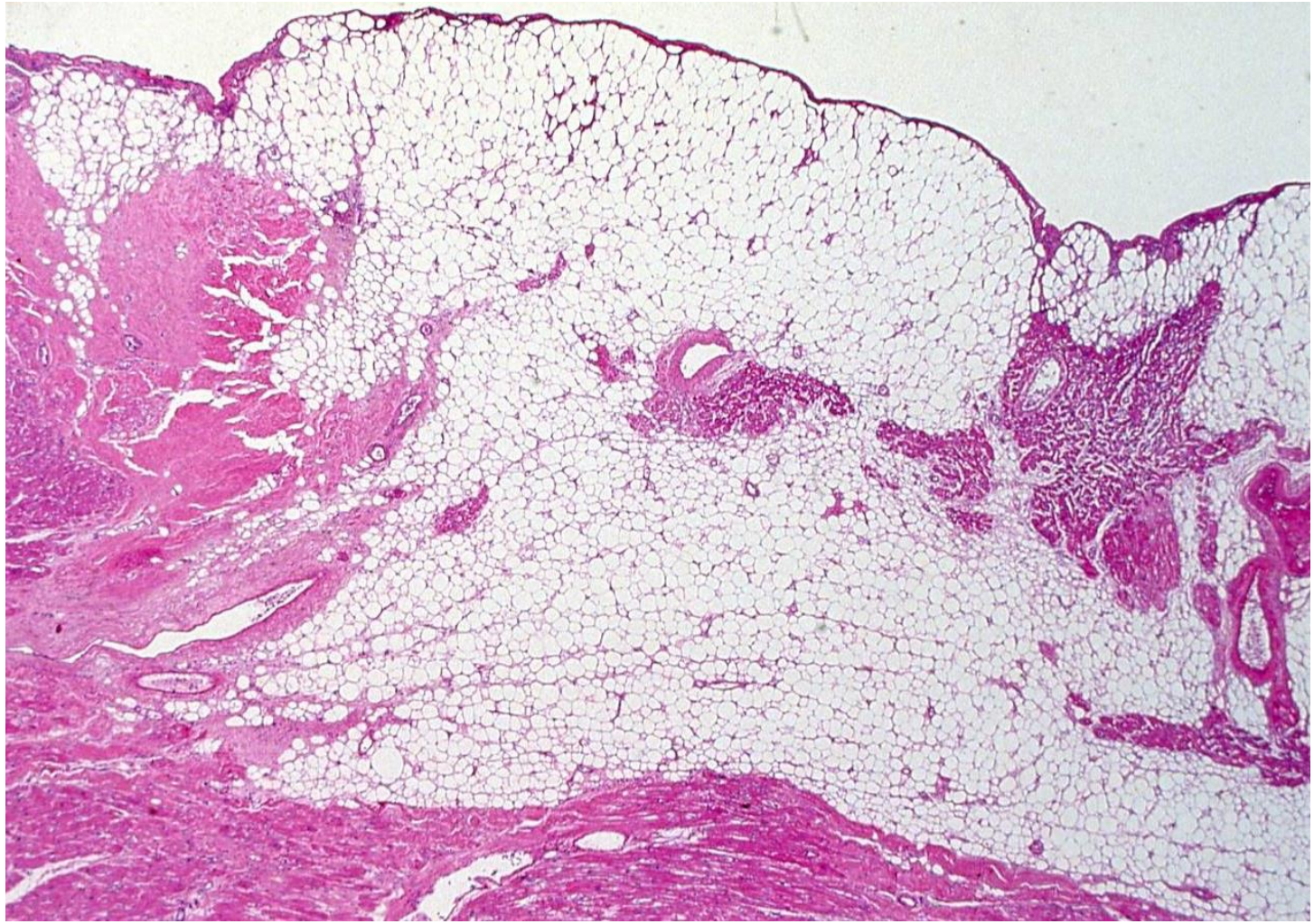
1) Thyroid
2) Urachus
3) Vermiform appendix



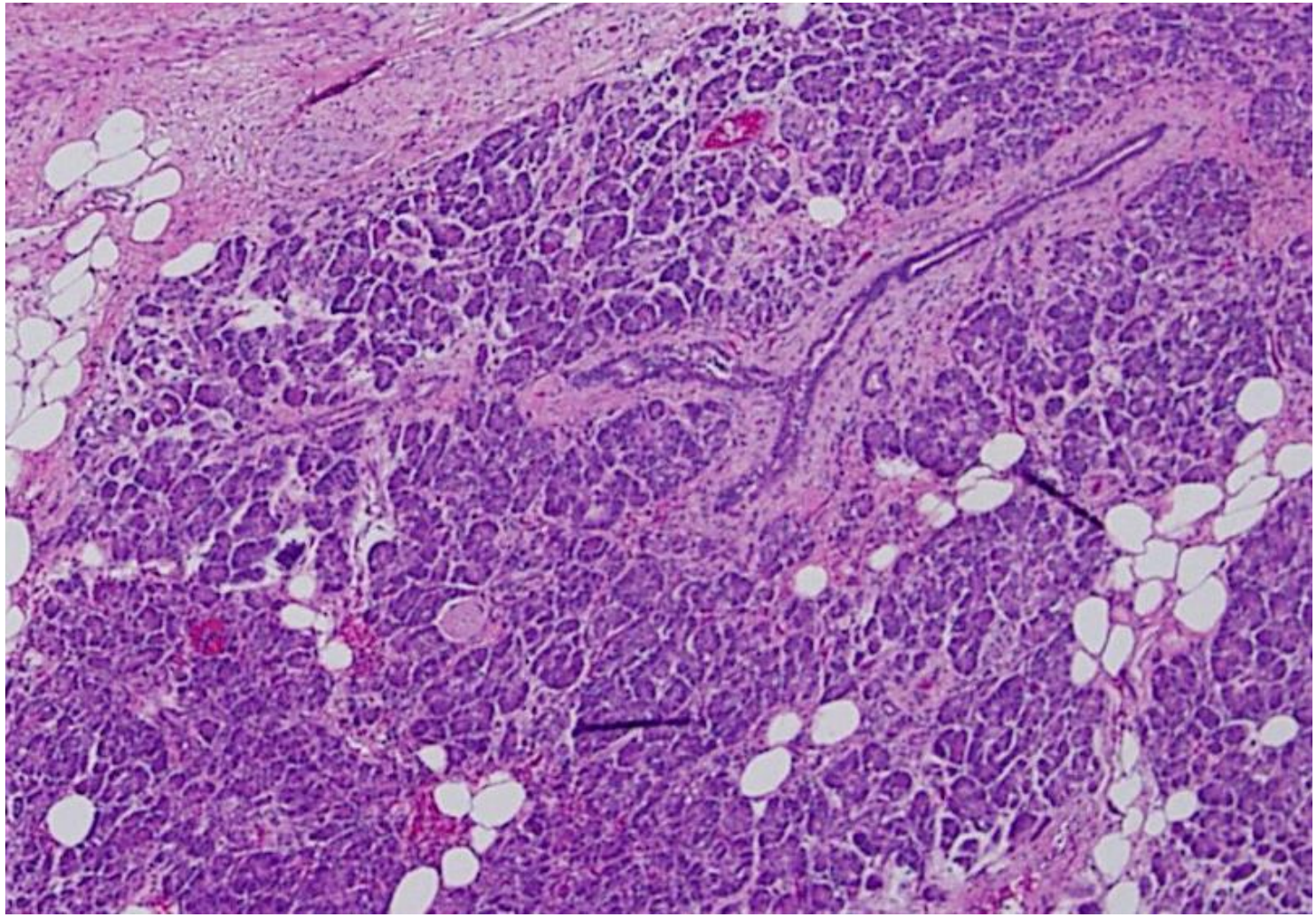
Lipomatosis in involuted atrophic thymus in an adult. H&E



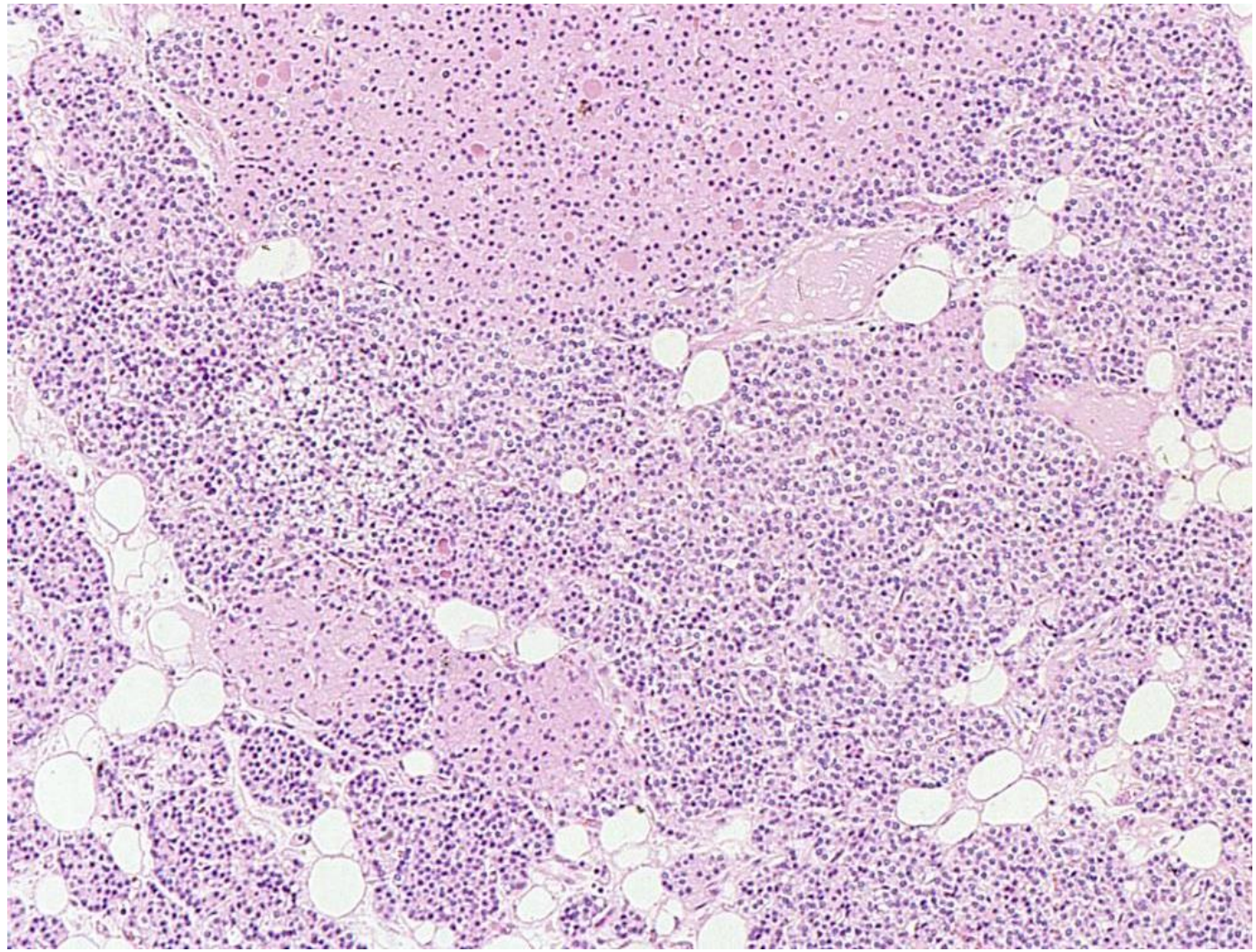
Lipomatosis in Duchenne-type muscular dystrophy. Striated muscle cells are mostly lost, while the muscle spindles are retained. H&E



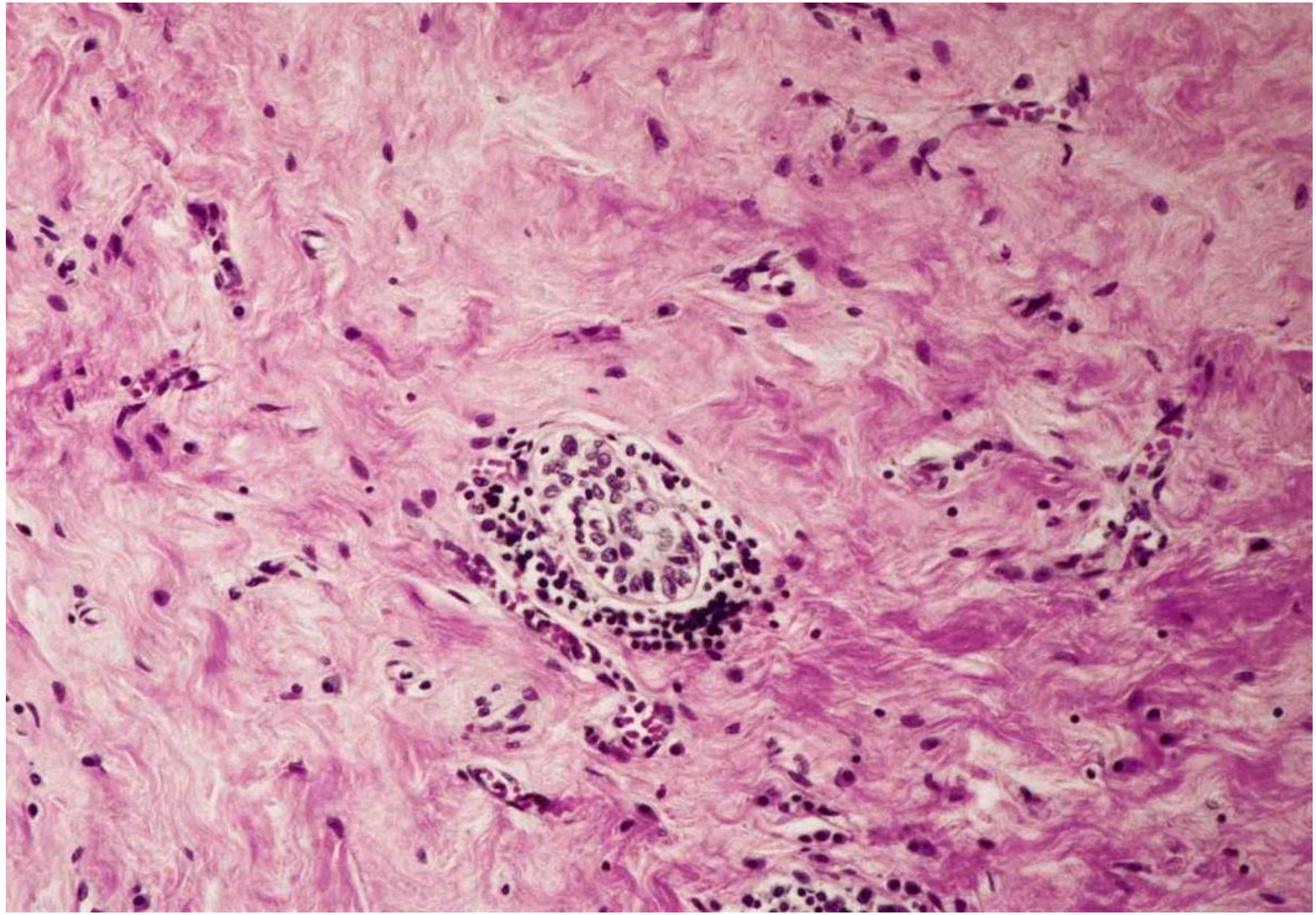
Lipomatosis seen in the right ventricle. The cardiomyocytes are replaced by mature fat cells. H&E



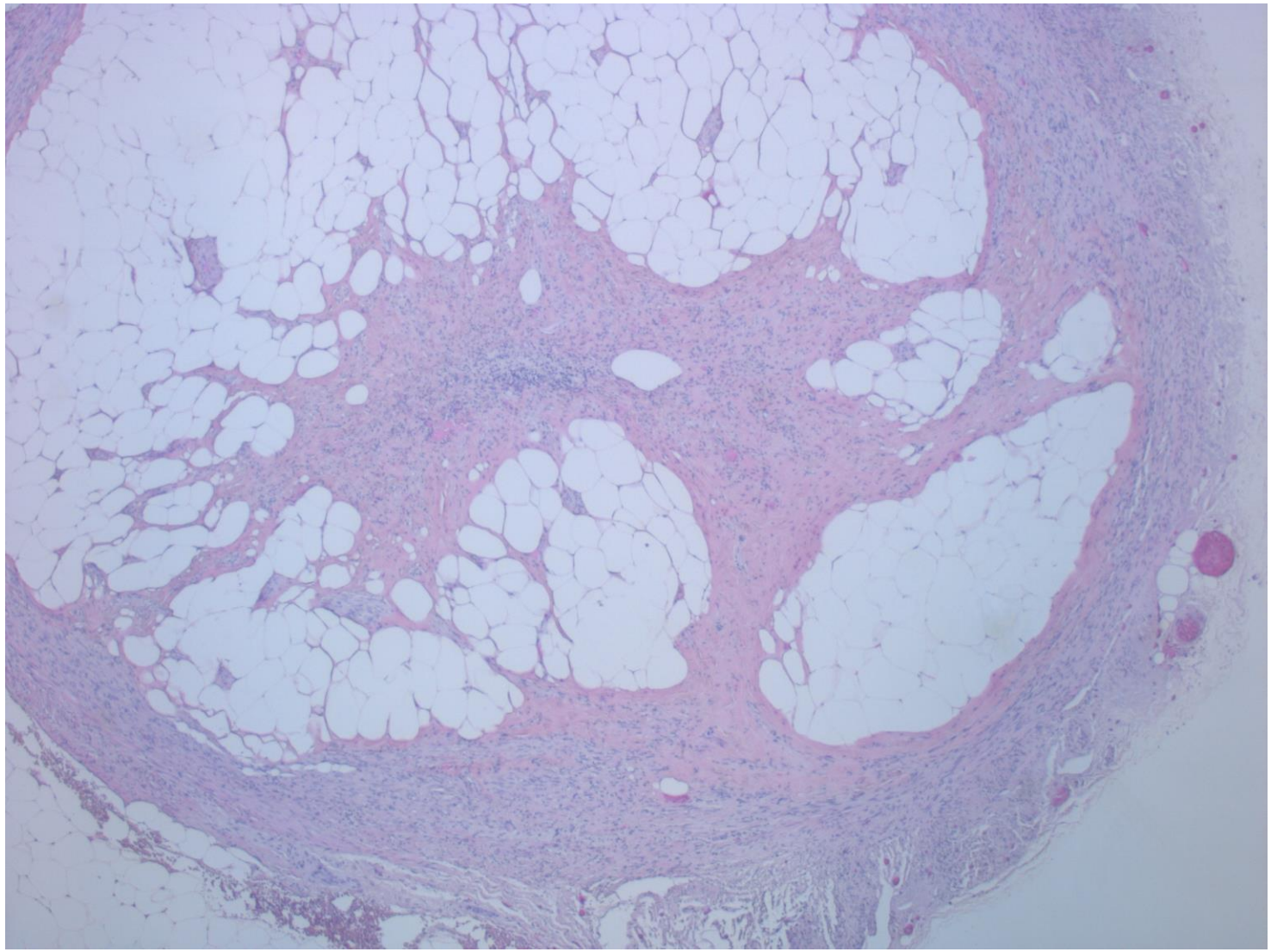
Lipomatosis of the pancreas. Fat cell infiltration is seen in the pancreatic parenchyma. H&E



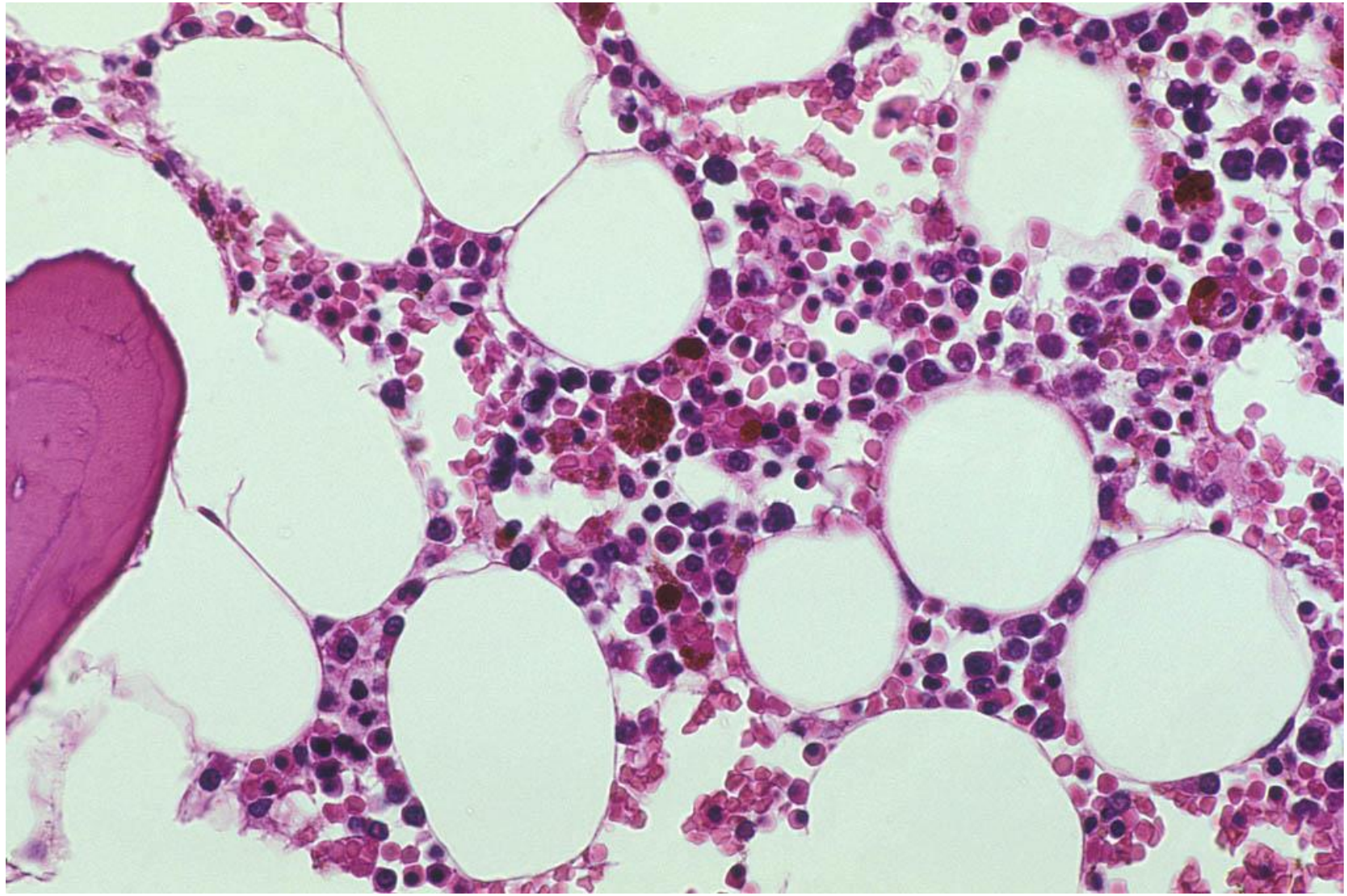
Lipomatosis in the parathyroid gland. Normal and hyperplastic parathyroid glands reveal a variable degree of fat cell infiltration, while parathyroid adenoma fundamentaly lacks lipomatosis. H&E



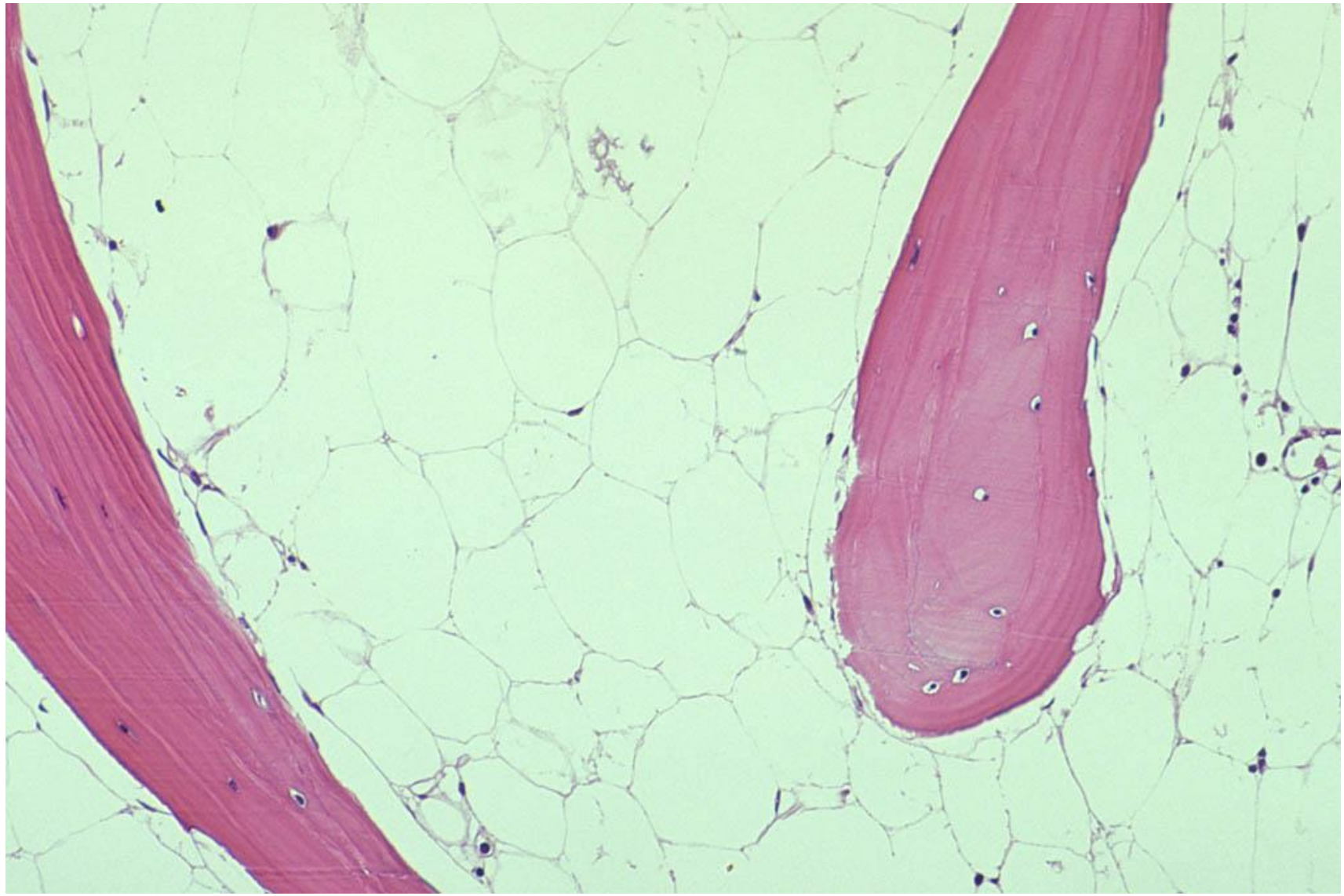
Riedel thyroiditis (IgG4-related sclerosing thyroiditis). The thyroid gland is diffusely replaced by fibrosis. Lymphocytic clustering is focally associated. H&E



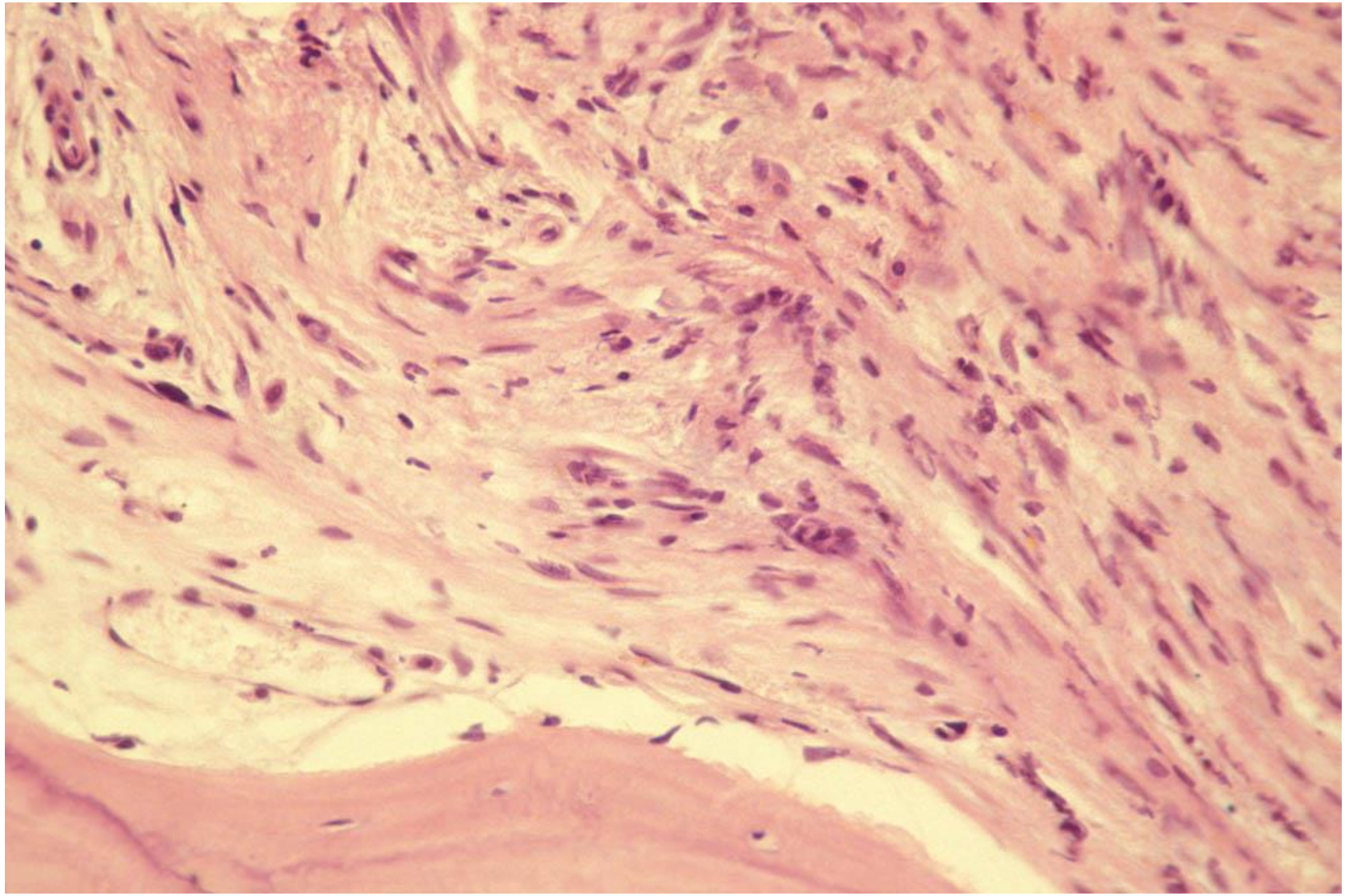
Atrophy and loss of appendiceal mucosa (age-related physiological obstruction of the appendiceal lumen). The mucosa is replaced by fibrosis and the lumen is lost. Lipomatosis is also associated. H&E



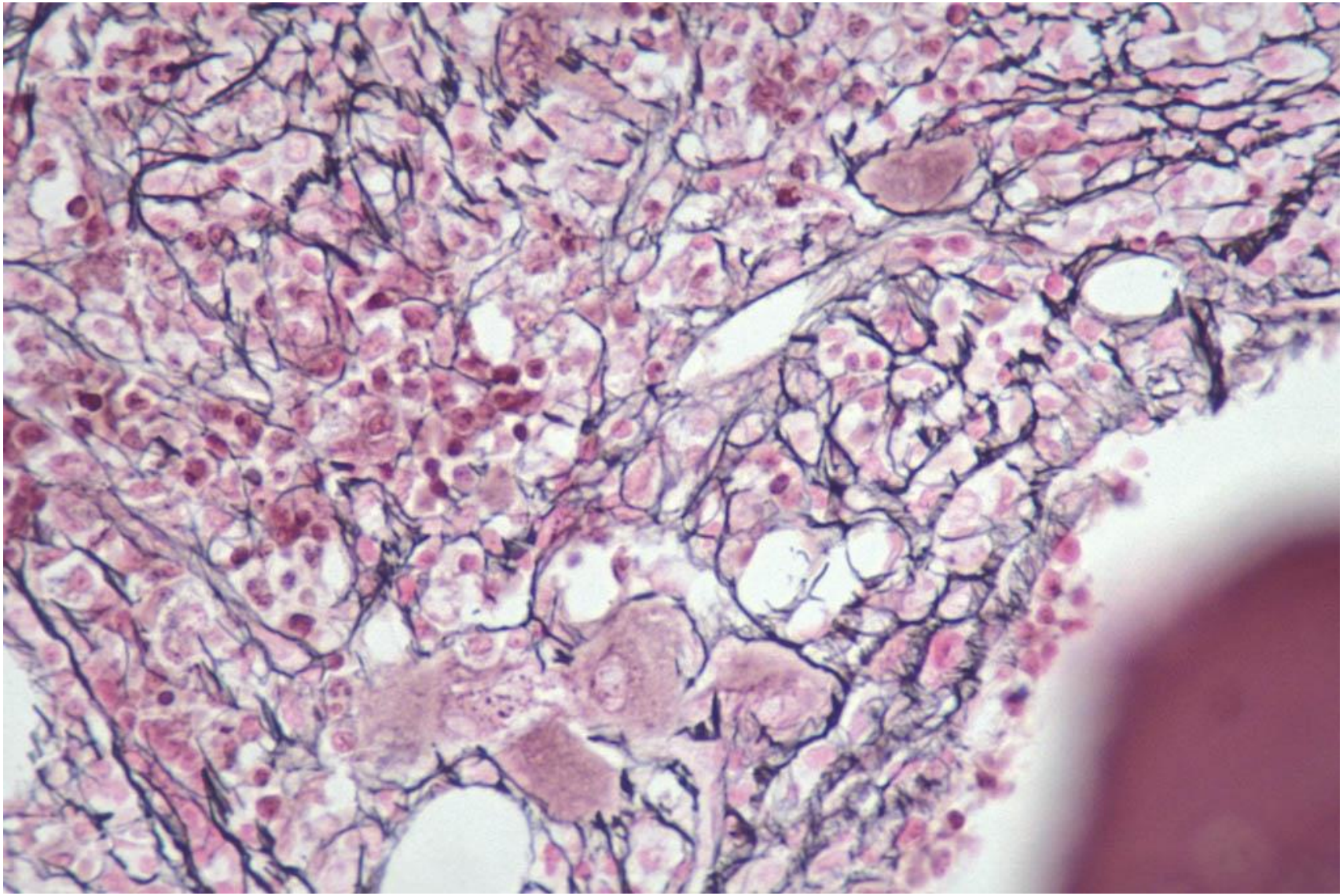
Normal bone marrow tissue with scattered mature fat cells among the hematopoietic cells. H&E



Aplastic anemia showing loss of hematopoietic cells. The marrow space is totally replaced by mature fat cells. H&E



Primary myelofibrosis in chronic myeloproliferative disorders. The marrow space is replaced by reticulin fibrosis with fibroblastic cells. H&E

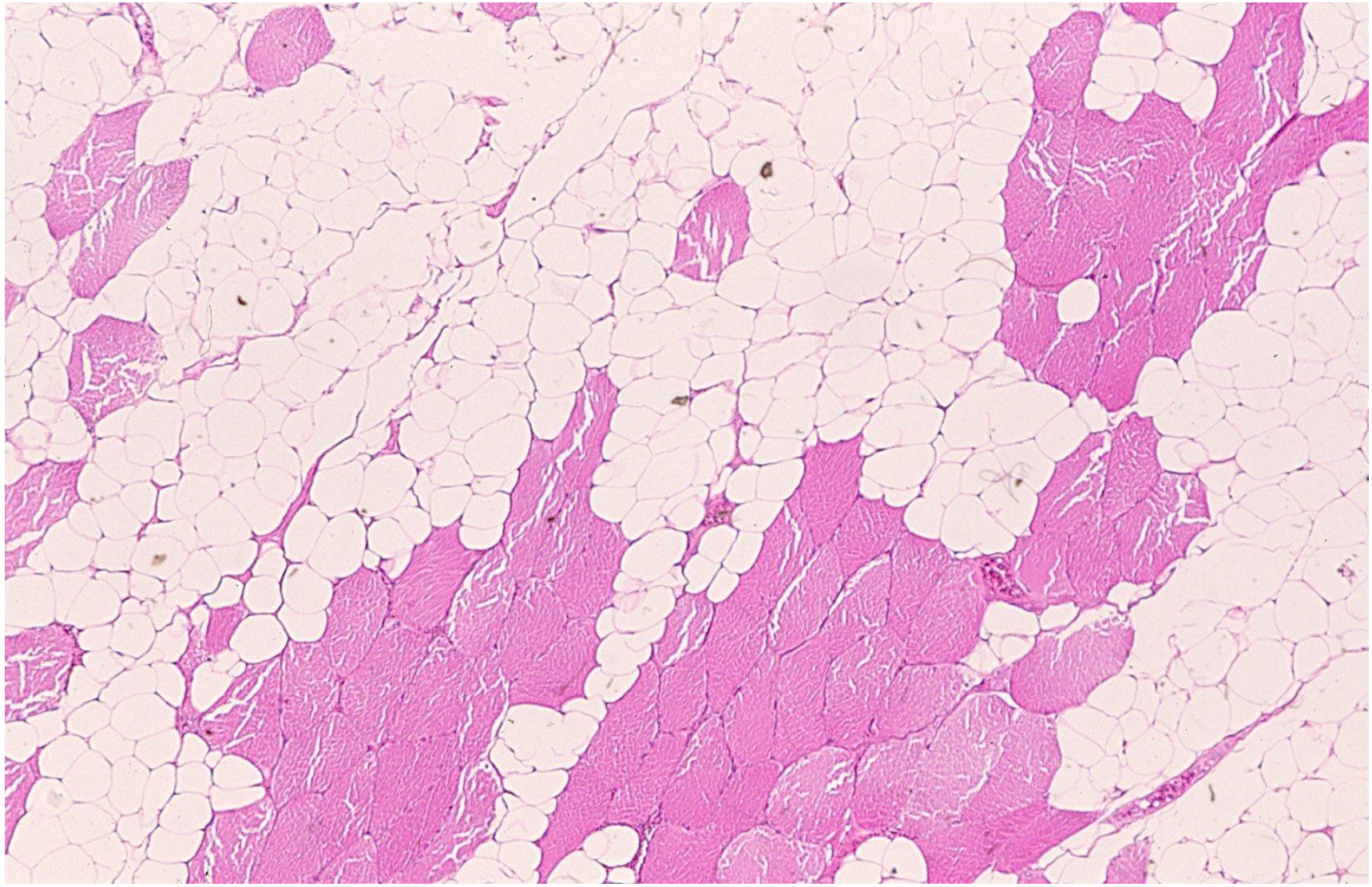


Primary myelofibrosis in chronic myeloproliferative disorders. The marrow space is replaced by reticulin fibrosis with fibroblastic cells. Silver impregnation

Features of neoplasms of fat cell origin

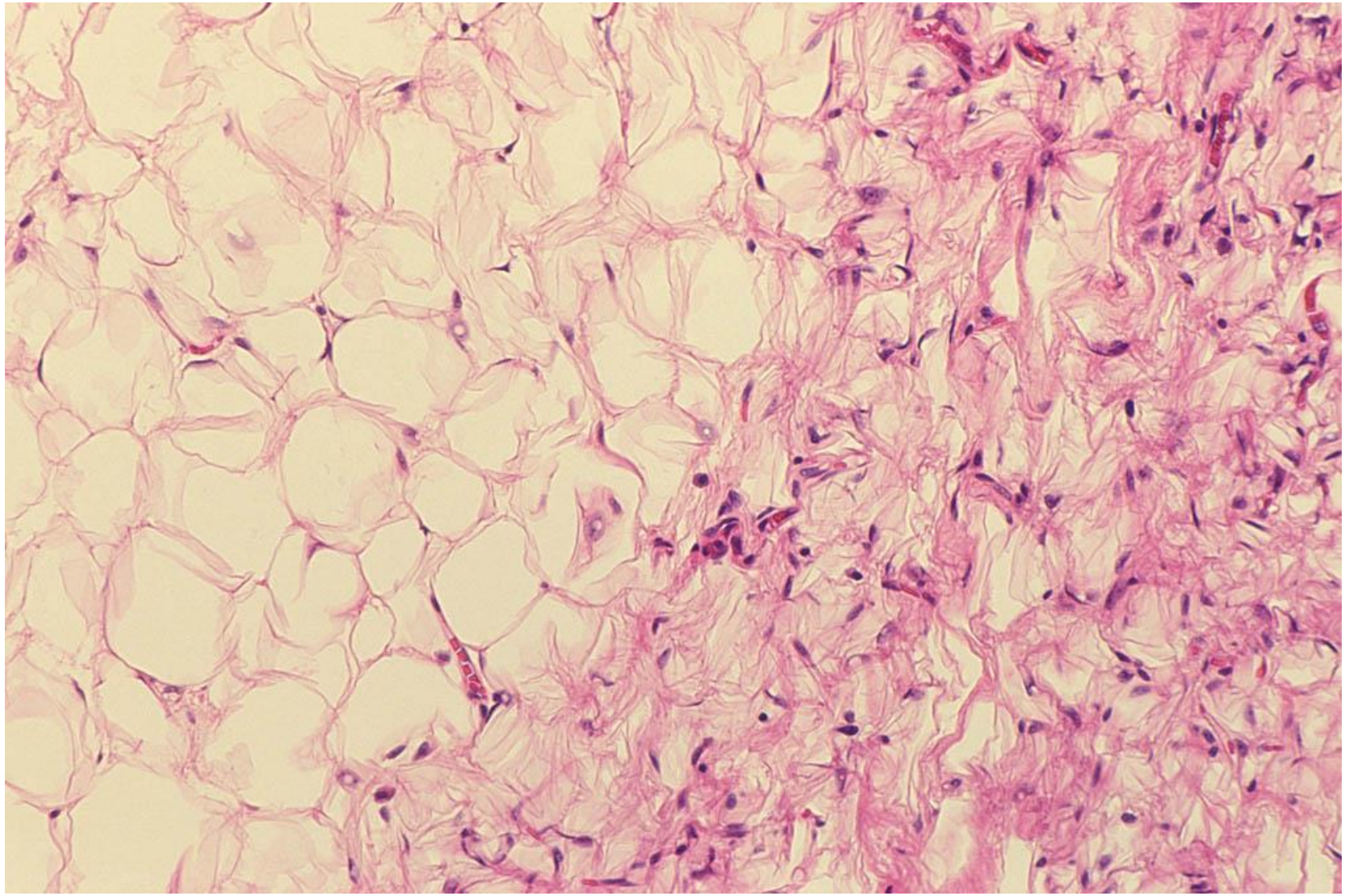
1) The benign lipoma group is often seen in the subcutaneous fat tissue.
2) Liposarcomas solely occur in the deep fat tissue, while the subcutaneous fat tissue never becomes malignant.
3) Neoplastic fat tissue often accompanies spindle cell growth with fibrosis. Fibrosis seen in the subcutaneous lipoma group should not be regarded as malignancy.

Benign lipoma group-1



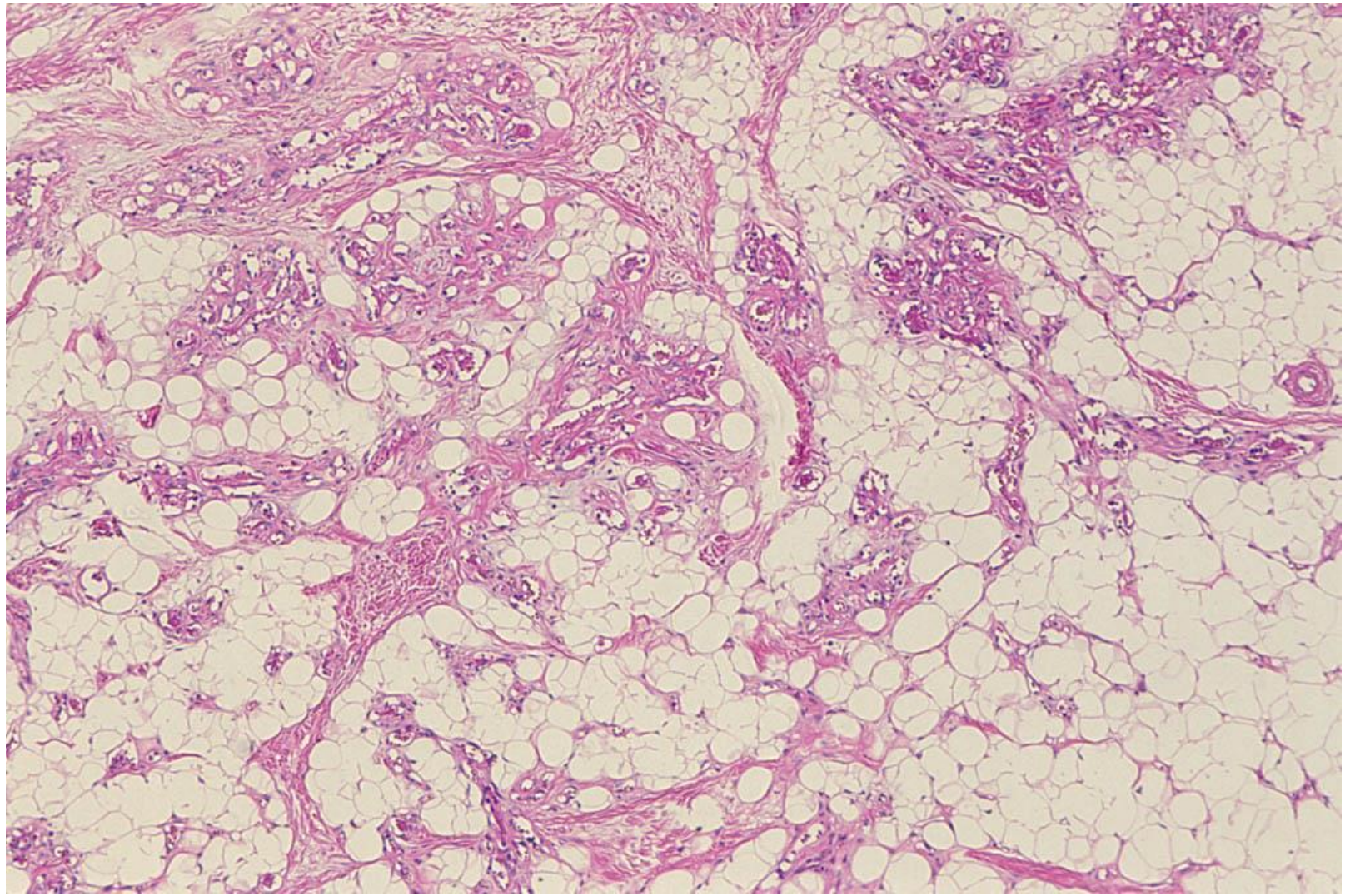
Intramuscular lipoma. Mature fat cells grow among the striated muscle cells. H&E

Benign lipoma group-2



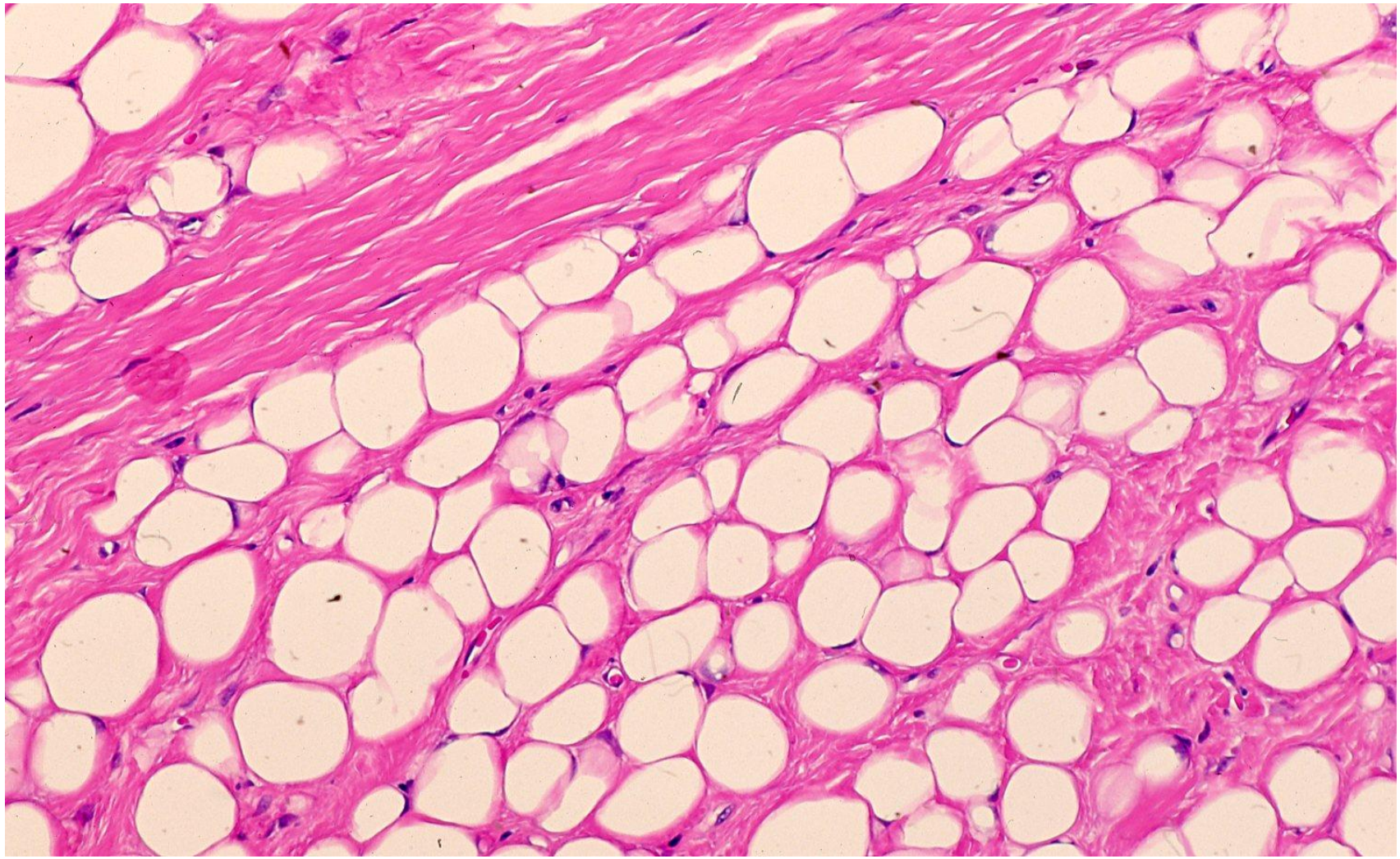
Subcutaneous lipoma with focal myxoid change. The myxoid area contains shrunken fat cell components. H&E

Benign lipoma group-3



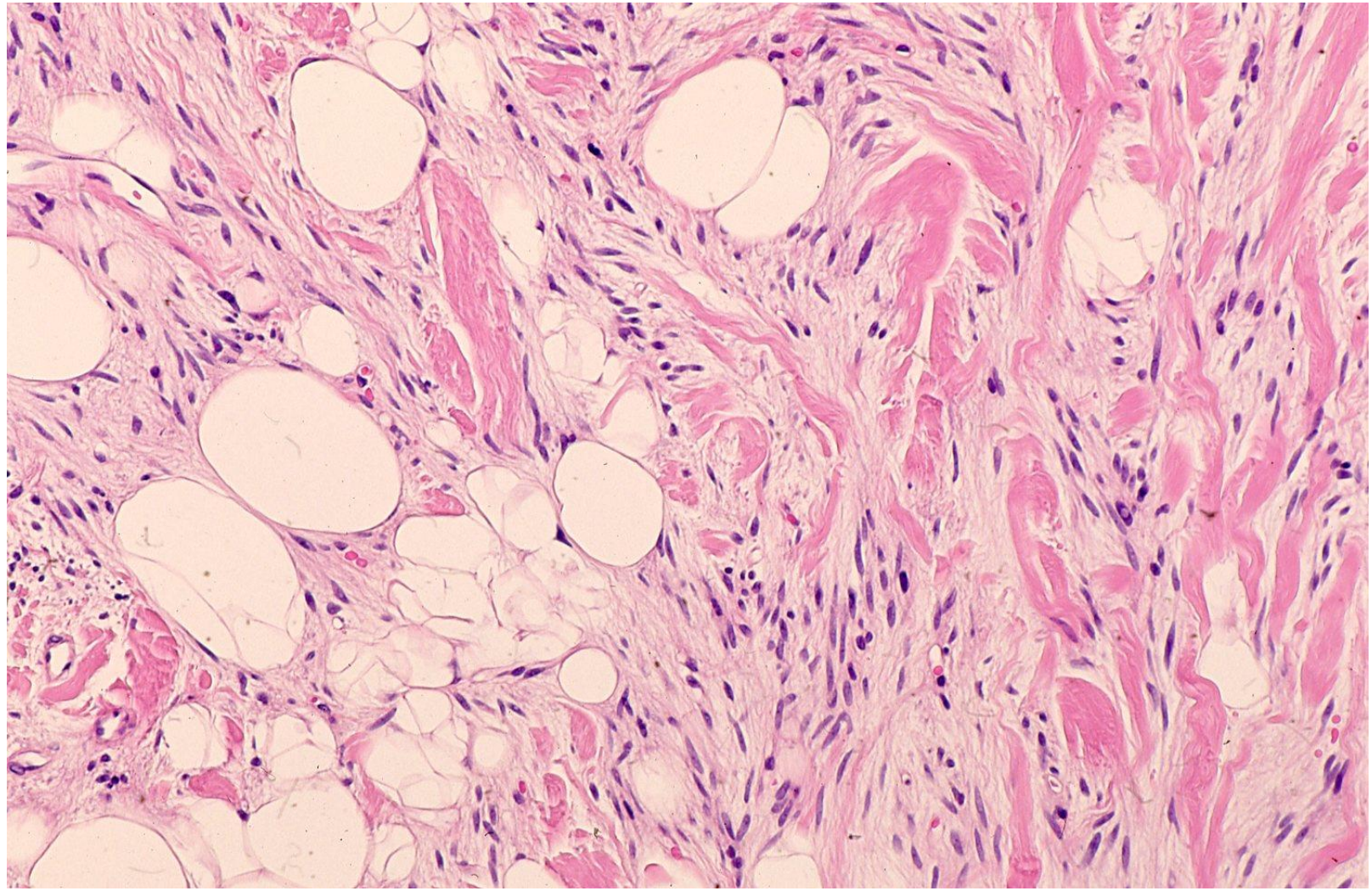
Angiolipoma. Capillary vessels are rich among mature fat cells. H&E

Benign lipoma group-4



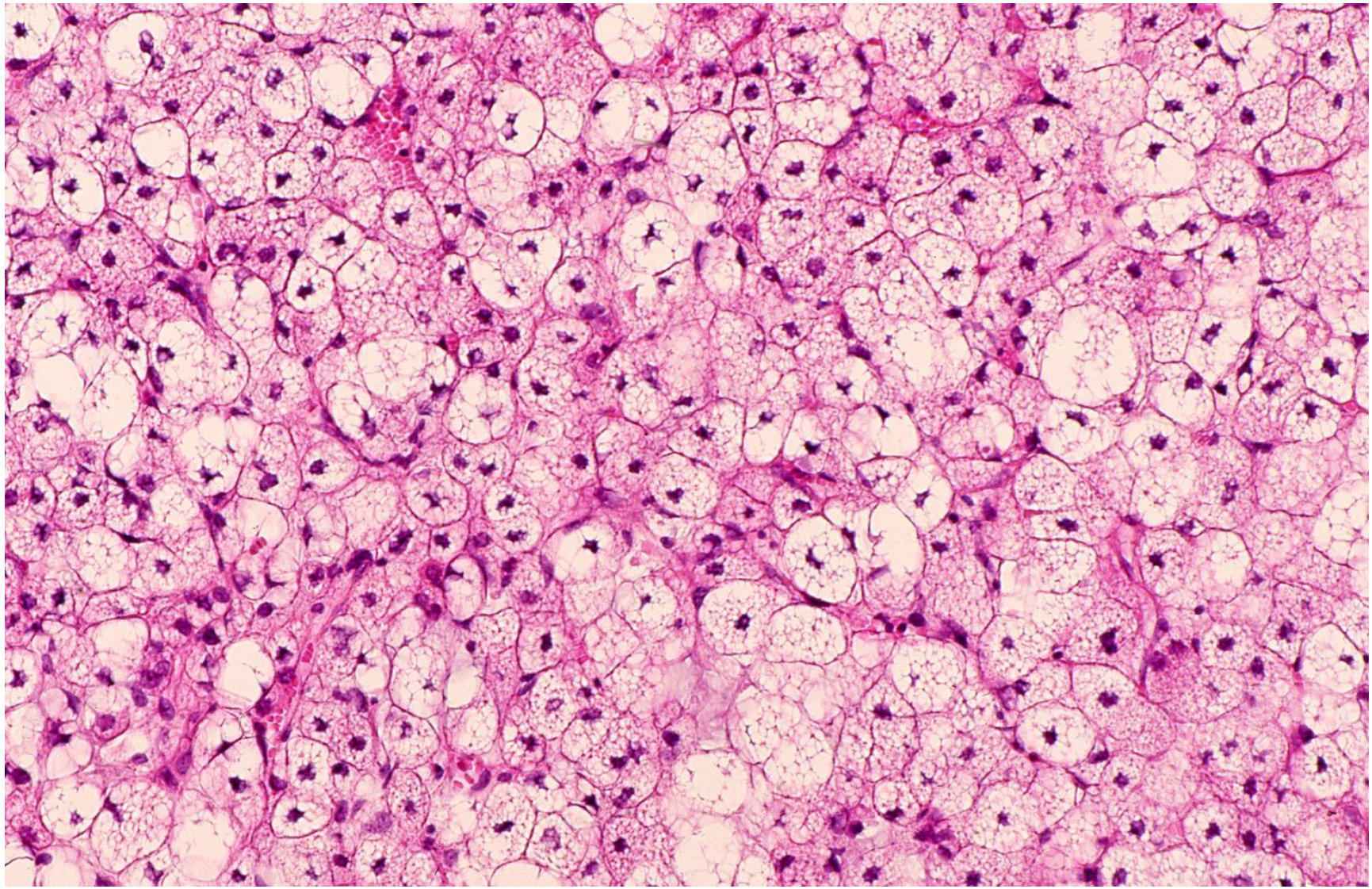
Fibrolipoma. The matrix of the lipomatous tissue is fibrotic. H&E

Benign lipoma group-5



Spindle cell lipoma. Spindle cells are observed in the matrix of benign mature fat cell growth. H&E

Benign lipoma group-6-1

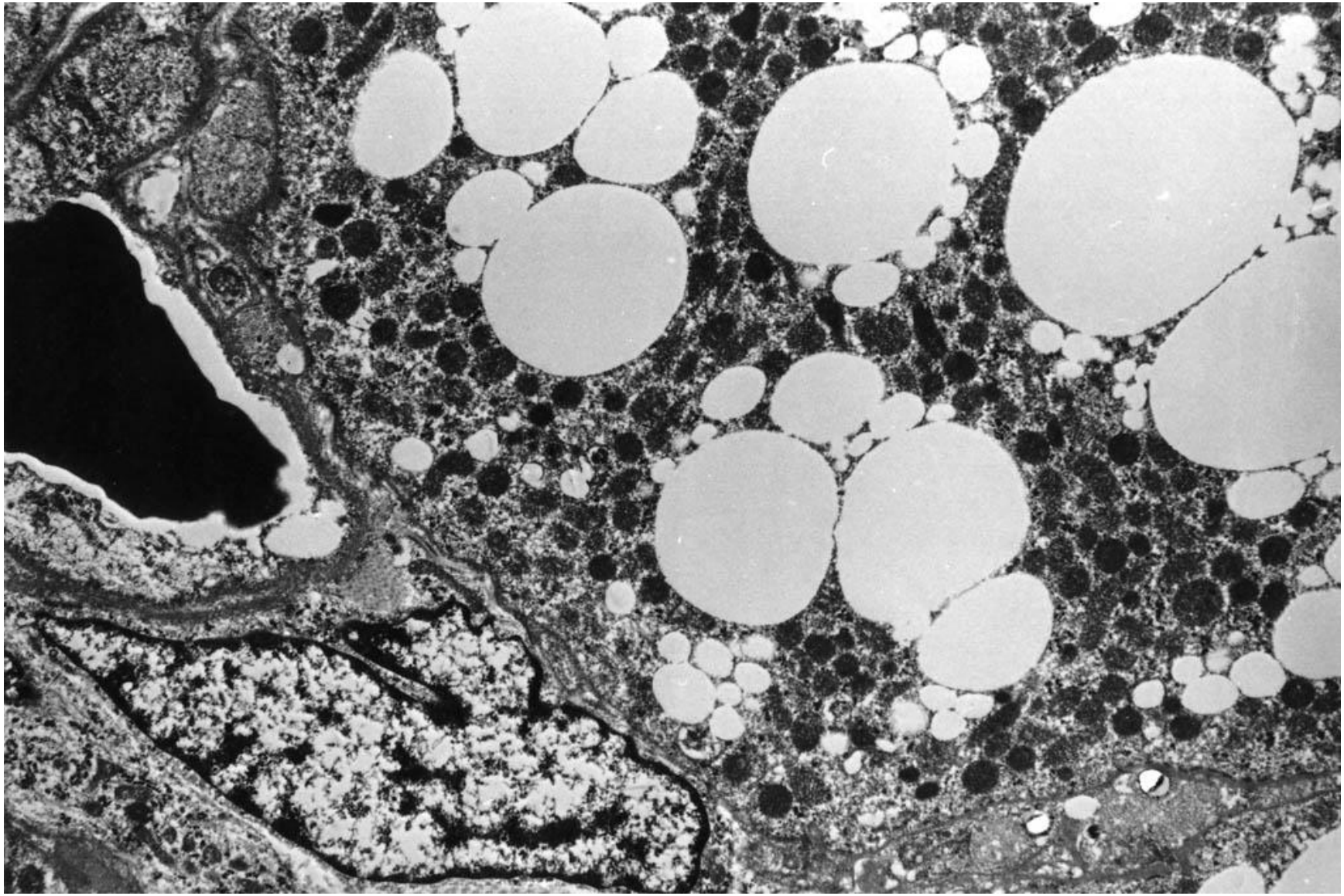


Hibernoma. A benign tumor of brown fat cell origin. H&E

Benign lipoma group-6-2

Gross appearance of hibernoma. A benign tumor of brown fat cell origin, colored brownish yellow.

Benign lipoma group-6-3

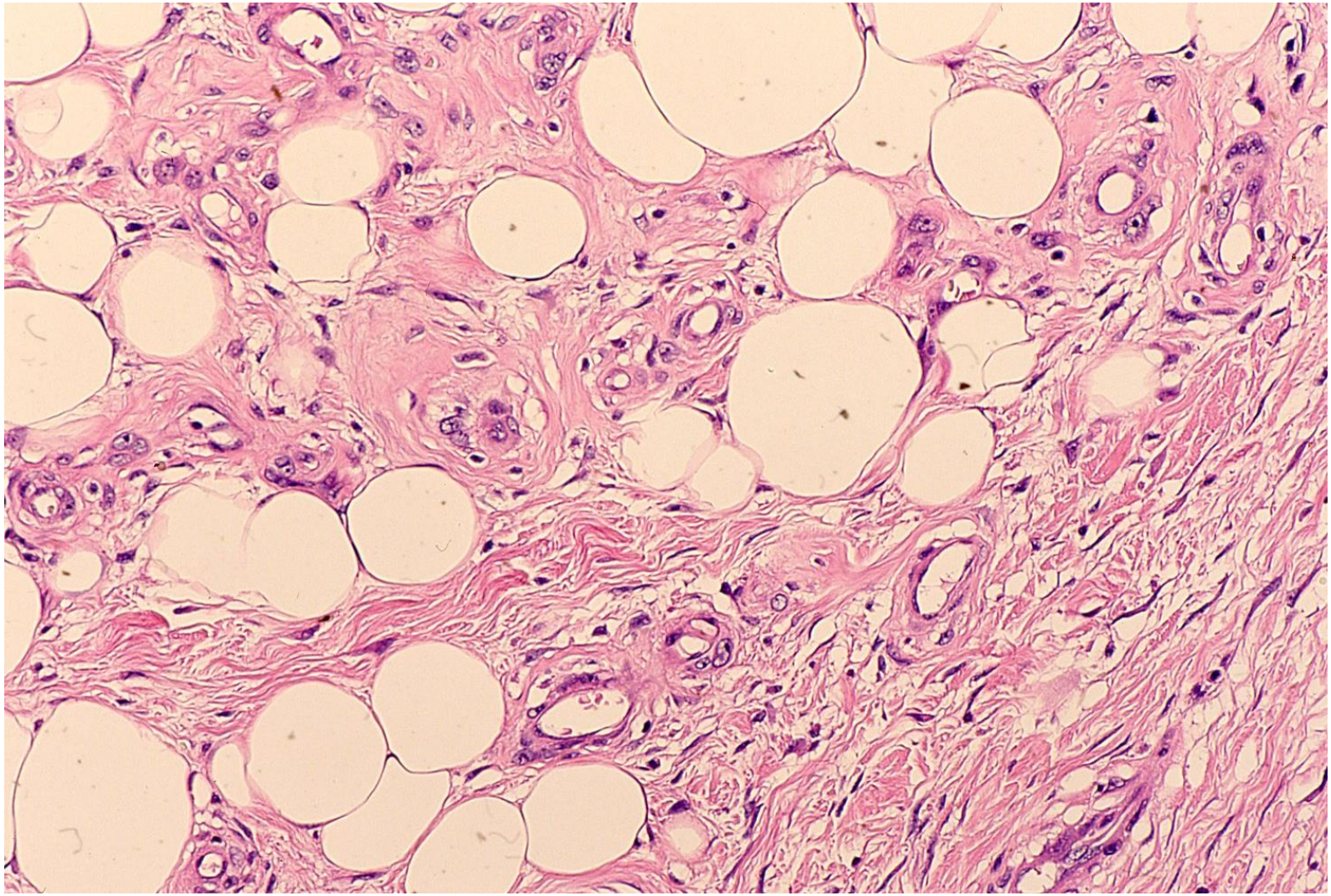


Ultrastructure of hibernoma. A benign tumor of brown fat cell origin. The tumor cells are rich in mitochondria, in addition to small fat vacuoles. EM

Liposarcoma group-1-1

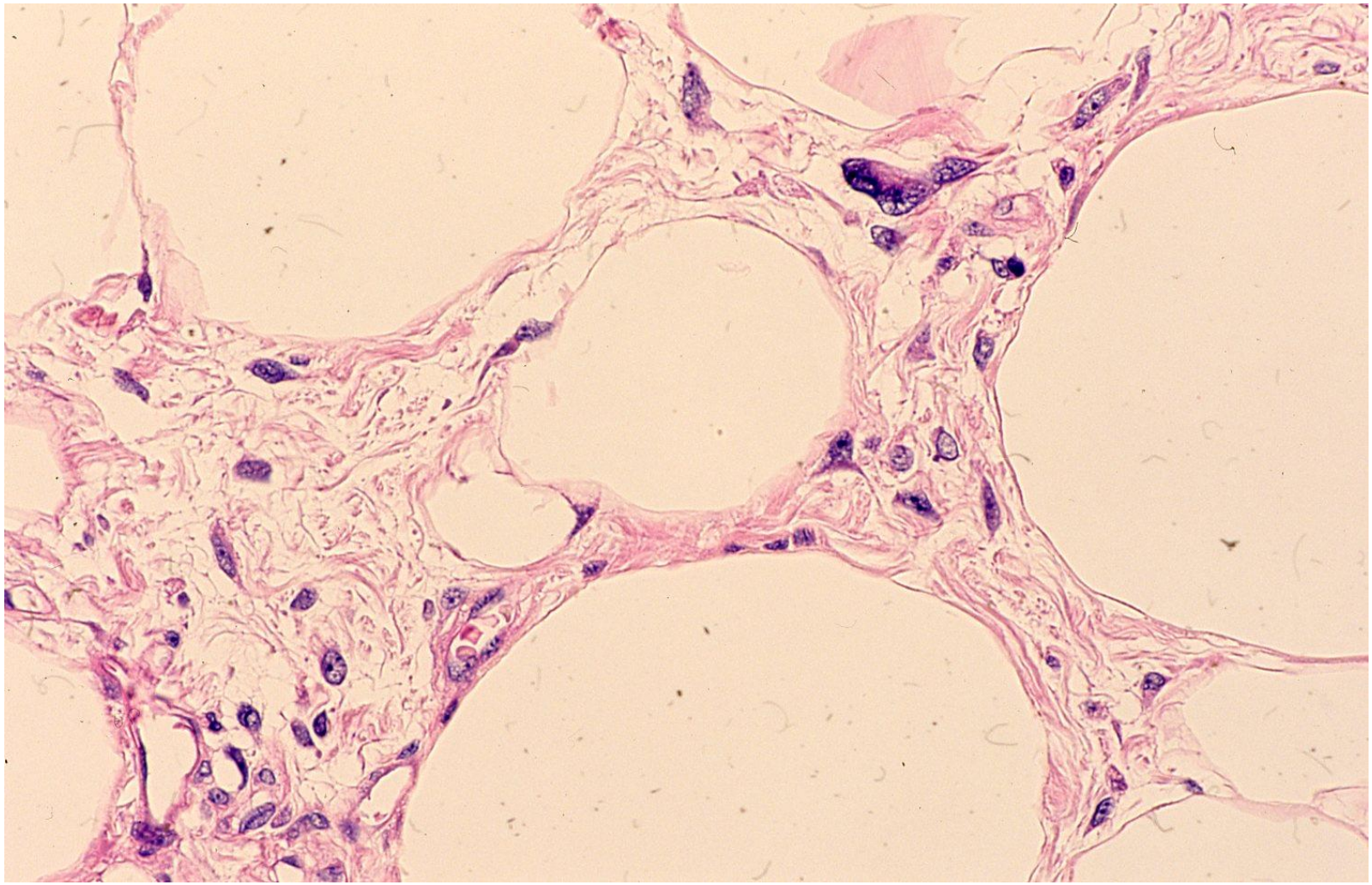
Gross appearance of retroperitoneal liposarcoma, well-dsifferentiated. Lobulated growth of solid tumor with yellowish color is evident.

Liposarcoma group-1-2



Well-differentiated liposarcoma. Mature-looking fat cells are clustered among fibroblastic stroma. Anisonucleosis of the spindle cells is noted. H&E

Liposarcoma group-1-3

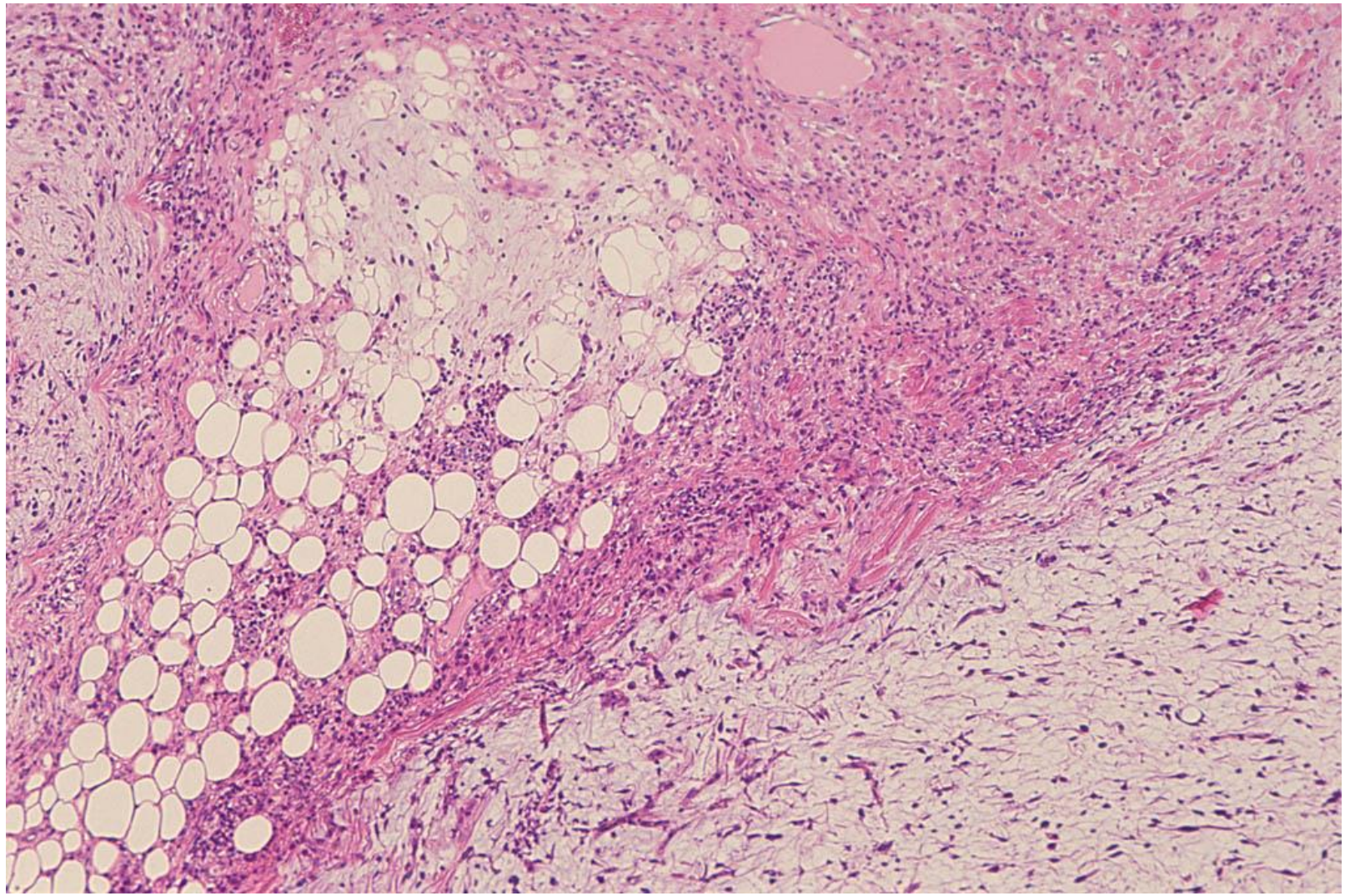


Well-differentiated liposarcoma. Mature-looking fat cells are clustered among fibroblastic stroma. Anisonucleosis of the spindle cells is noted. Bizarre nuclei are focally observed. H&E

Liposarcoma group-2-1

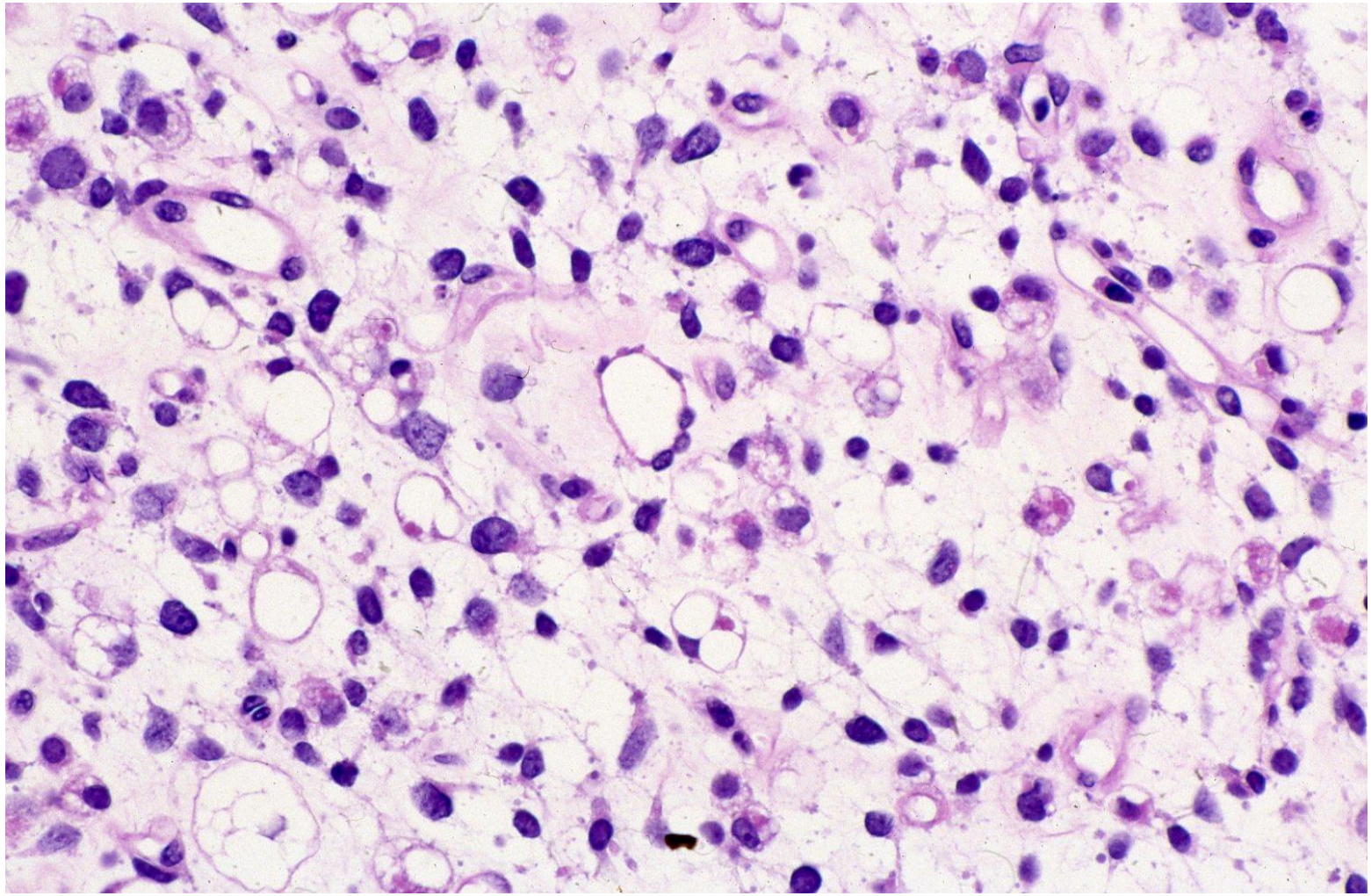
Gross appearance of retroperitoneal myxoid liposarcoma.
Compressive growth of solid myxoid tumor is noted.

Liposarcoma group-2-2



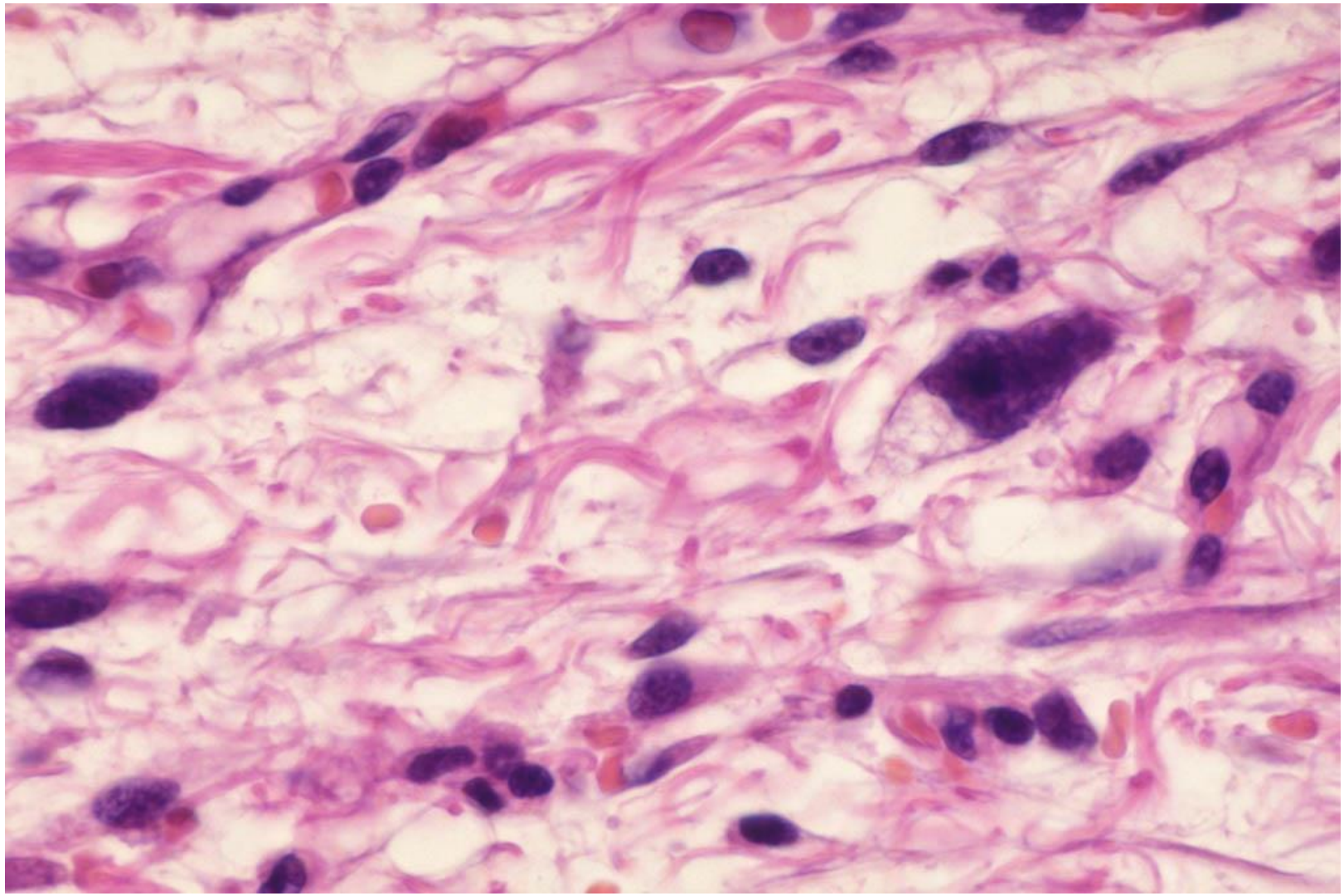
Retroperitoneal myxoid liposarcoma. Three areas can be recognized: mature-type fat cell area, spindle cell area and myxoid loosely cellular area. H&E

Liposarcoma group-2-3



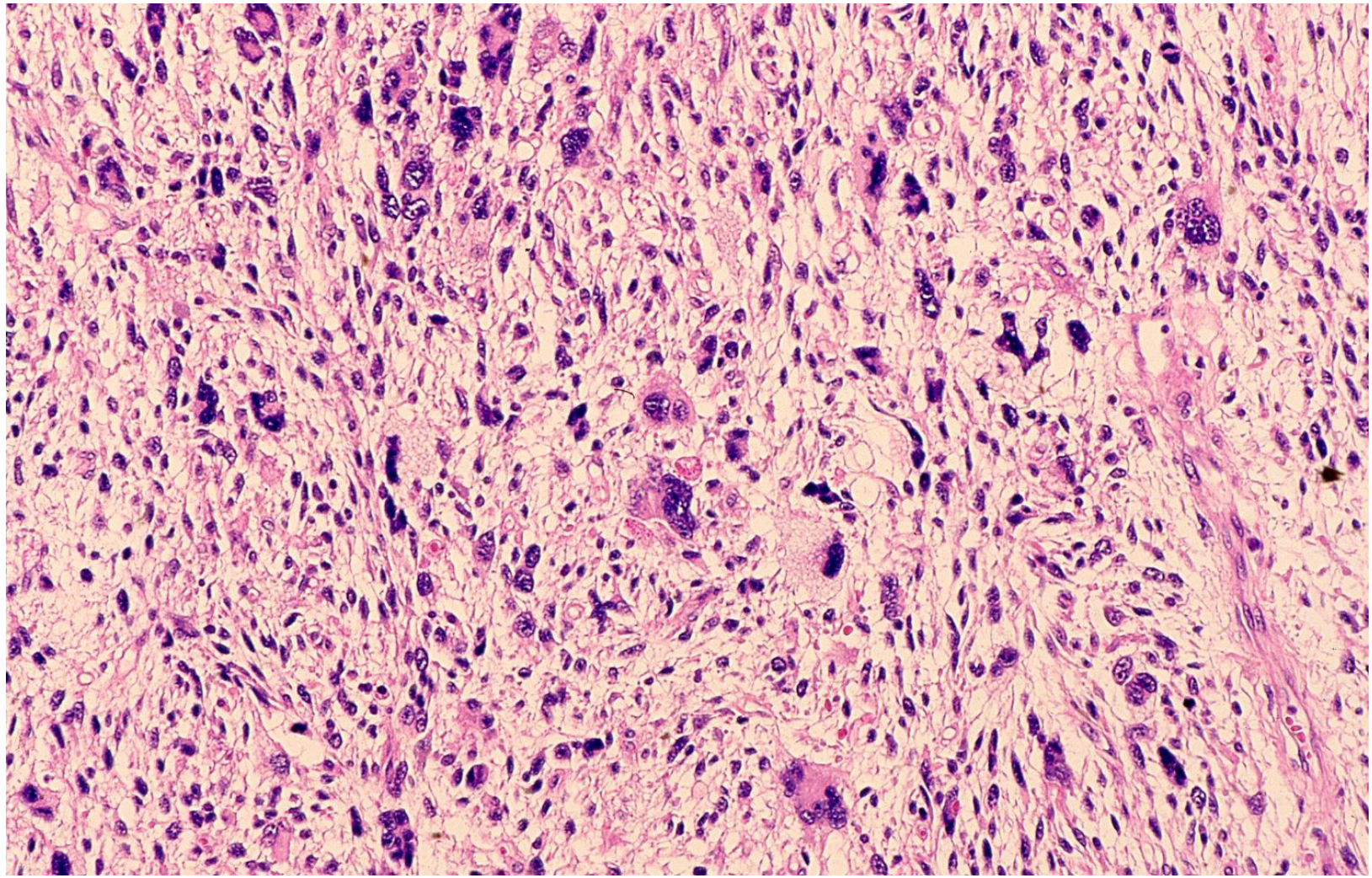
Retroperitoneal myxoid liposarcoma. In the myxoid area, rounded or spindled tumor cells with mild nuclear pleomorphism are dispersed. Immature fat cells are intermingled. H&E

Liposarcoma group-2-4



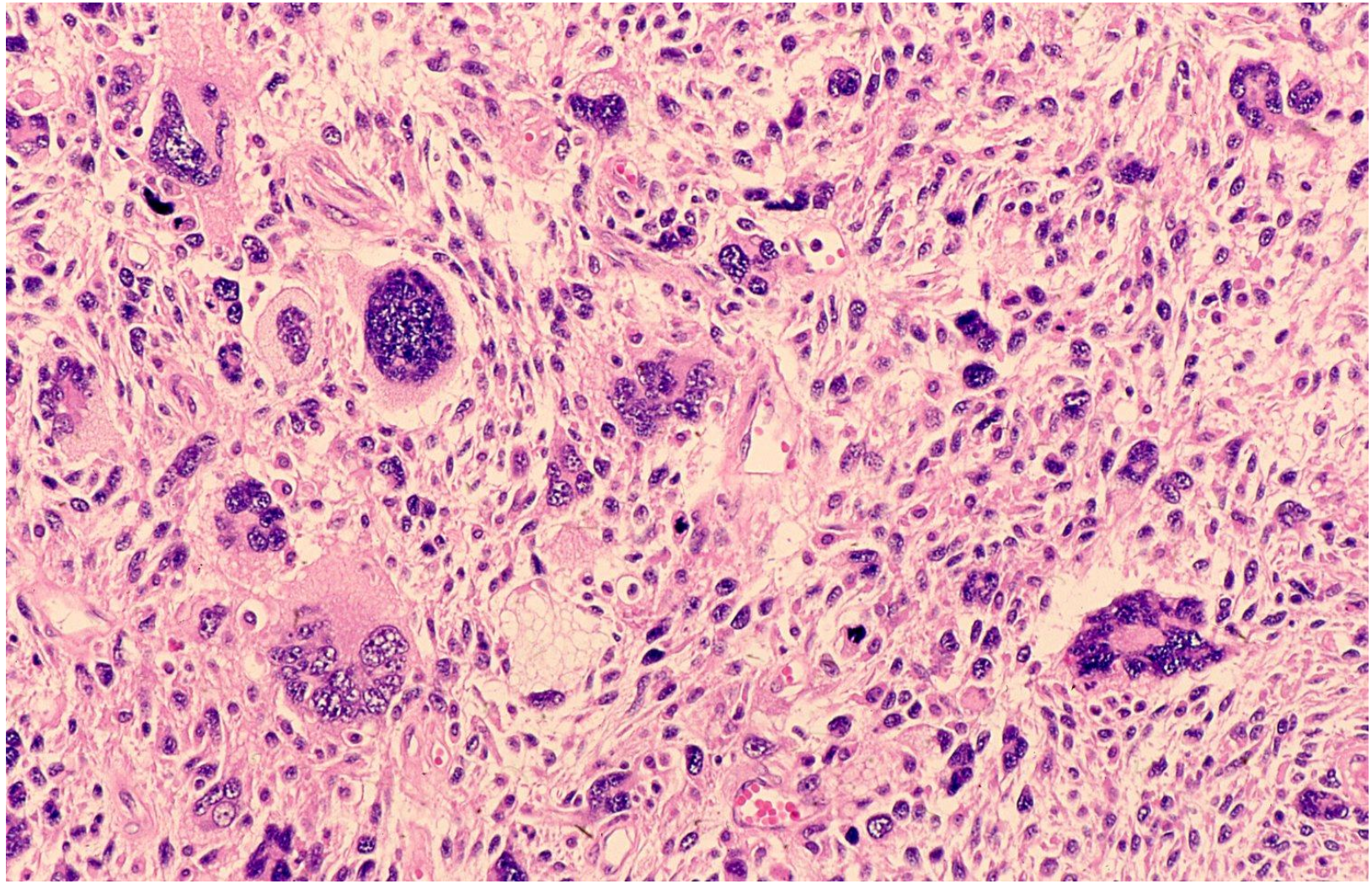
Retroperitoneal myxoid liposarcoma. In the myxoid area, bizarre hyperchromatic tumor cells are observed. H&E

Liposarcoma group-3-1



Pleomorphic liposarcoma of the thigh. Highly pleomorphic and multinucleated liposarcoma cells are seen in the spindle cell background. Lipoblasts are dispersed. H&E

Liposarcoma group-3-2



Pleomorphic liposarcoma of the thigh. Highly pleomorphic and multinucleated liposarcoma cells are seen in the spindle cell background. Lipoblasts can be observed. H&E