Other Malignant Tumors of the Thyroid and Metastatic Tumors to the Thyroid

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Other Malignant Tumors of the Thyroid

- This chapter discusses three other malignant tumors affecting the thyroid:
  - Anaplastic thyroid carcinomas (ATC)
  - Poorly differentiated thyroid carcinoma (PDCa)
  - Primary thyroid lymphoma

Anaplastic (Undifferentiated) Thyroid Carcinoma

- Anaplastic thyroid carcinomas (ATC) classically present as a rapidly growing thyroid mass in an elderly patient. Because of the rapid growth, patients can present with symptoms of compression or involvement of structures adjacent to the thyroid. The symptoms therefore include dysphagia, hoarseness, and dyspnea.
- ATC has an aggressive course, with frequent extrathyroidal extension (ETE) and metastases to regional lymph nodes and distant sites. The mortality rate is over 95% and the mean survival is 6 months from presentation.
- On ultrasonography, ATC appears as large, infiltrative thyroid mass with marked hypoechogenicity, necrosis, hemorrhage, dense calcifications, infiltration into surrounding structures, and cervical lymph node involvement in most cases (Fig. 11.1a).
- Grossly, ATC appears as a large, firm, tan-white to brown mass, with areas of necrosis and/or hemorrhage (Fig. 11.1b). The lesions are widely invasive, often replacing thyroid parenchyma and infiltrating the surrounding structures of the neck.
- On histology, ATC is heterogenous, with a mixture of spindled, squamoid/epithelioid, and pleomorphic giant cells; the dominant pattern varies between these cell types. The spindled variant is the commonest, accounting for about 50% of these tumors. Rare variants include paucicellular, rhabdoid, and small cell.
- Common features for all variants include invasion, extensive tumor necrosis, marked pleomorphism, and high mitotic activity. The tumor grows predominantly as solid sheets and lacks follicles. Colloid is absent; if seen, it is noted in the well-differentiated component (if present) or in pre-existing non-neoplastic follicles infiltrated by the tumor.
- On immunohistochemistry, low molecular weight cytokeratins are probably the most helpful marker, with at least weak or focal staining of the tumor cells.
- There is controversy in the interpretation of thyroglobulin immunoreactivity in ATC. Reactivity for thyroglobulin has been reported in up to 50% of cases and has been described as weak and focal, but this positivity is generally considered to be overinterpretation of positivity in entrapped non-neoplastic follicular cells, well-differentiated components, or diffusion of the stain from normal surrounding thyroid tissue. As such, thyroglobulin is of limited use in the evaluation of ATC. TTF-1 is rarely expressed in ATC.
- Like histology, on cytology, spindled cells are the commonest cell type in ATC. The spindled cells appear enlarged and pleomorphic, with high-grade nuclei, and they show mitotic activity. Usually the spindled cells are admixed with pleomorphic giant cells and/or epithelioid/squamoid–type cells; occasionally, these other cell types may be dominant (Fig. 11.1c–p).
- The presence of spindled cells in the aspirate raises a differential diagnosis that includes medullary thyroid carcinoma (MTC), Reidel thyroiditis, high-grade sarcoma,

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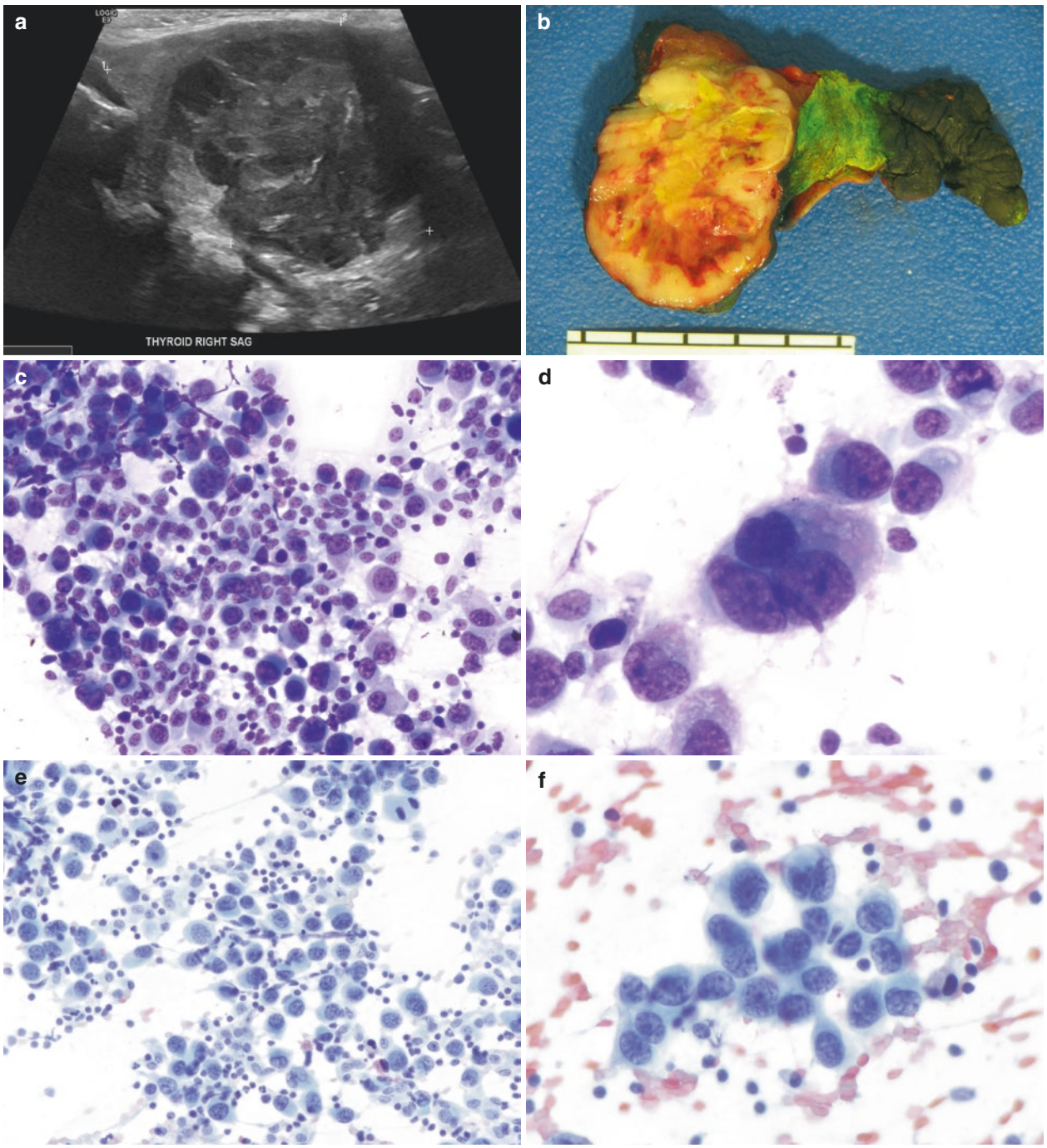
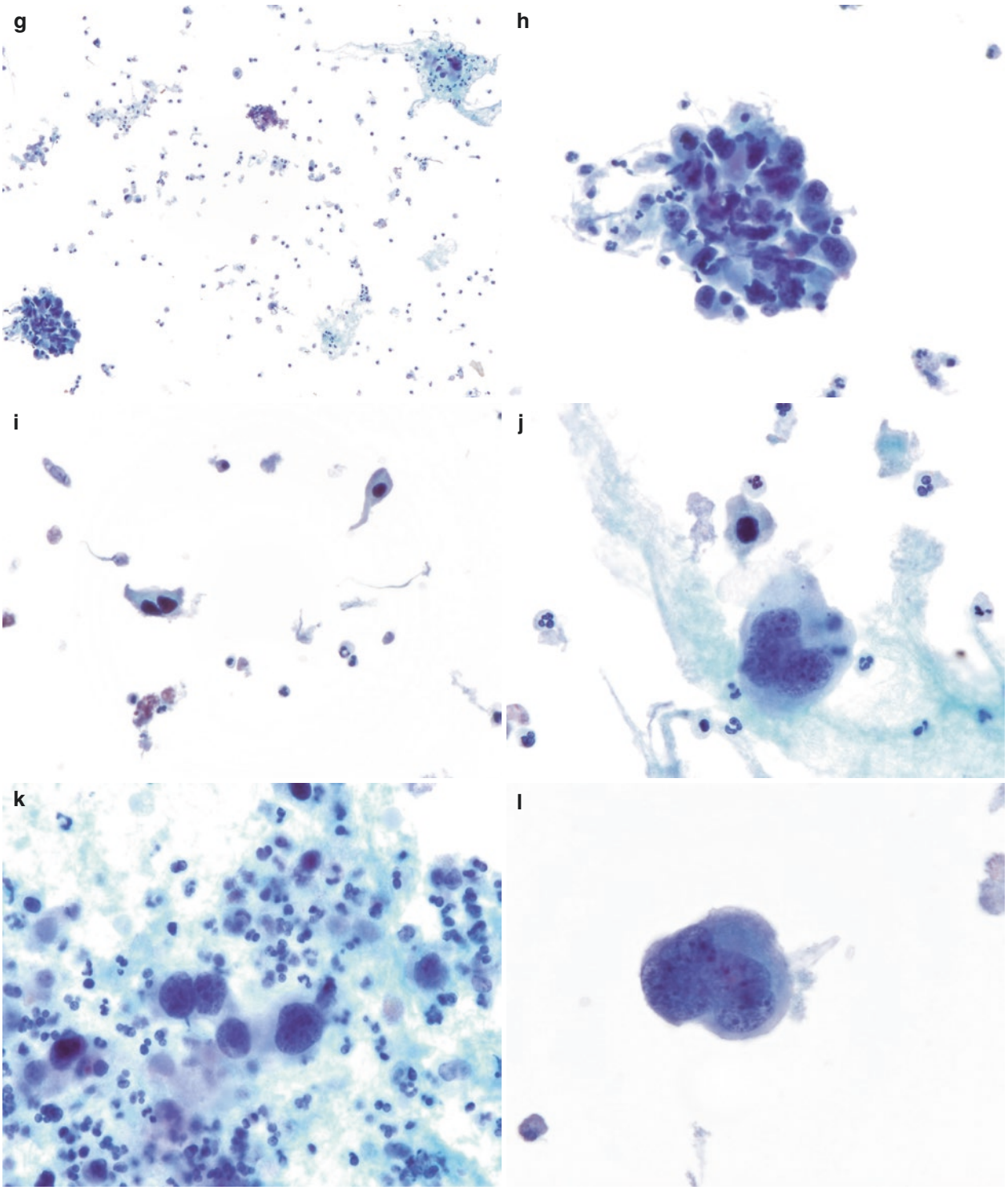


Fig. 11.1 Anaplastic thyroid carcinoma (ATC): Imaging, gross, and cytohistologic findings. (**a**) This ultrasound image of a case of ATC shows a large thyroid mass with ill-defined borders and mixed echogenicity. Prominent areas of marked hypoechogenicity are noted, in addition to areas of necrosis and dense calcifications. (**b**) Grossly, ATC appears as a large, firm, tan-white to brown mass, with areas of necrosis and/or hemorrhage. (**c**, **d**) Air-dried aspirate smears from the same case show a dyshesive population of pleomorphic cells, many showing a multinucleate giant cell morphology. The pleomorphism is marked, with nuclear sizes ranging from 1 to >10. The cytoplasm appears granular to mostly vacuolated (Diff Quik, CS). (**e**, **f**) Alcohol-fixed aspirates show similar findings as the air-dried smears, but with better nuclear details. The nuclear chromatin appears dense, coarse, and irregular, with prominent nucleoli. Note the nuclear size comparison of the tumor cells with the adjacent lymphocytes. In this case, the pleomorphic cell type is the most dominant (Pap stain, CS). (**g**–**l**) These images represent the cytologic features of ATC of the pleomorphic giant cell type on a liquid-based preparation (LBP), ThinPrep® (TP). Figures **g** and **i** clearly depict the difference in the background when compared with CS. In LBP, the background appears to have less blood, and in LBP the blood elements appear more granular and contain neutrophils and fibrin material; they can cling to the tumor cells, as seen on images **j** and **k**. The clusters appear tighter on LBP than on CS, as seen in image **h**. The nuclear morphology overall looks like that of the CS (**g**–**l**, Pap stain, TP). (**m**–**p**) The histologic findings seen in image (**m**) mirror that of the cytologic findings. Image (**m**) shows a dyshesive population of pleomorphic cells with vacuolated to granular cytoplasm. The tumor stains for LMWCK (**n**), and shows most tumor cells staining for PAX 8 (**o**). In (**p**), some tumor cells stain for TTF-1, but the adjacent group shows negativity. TTF-1 staining can be positive or negative in ATC; if present, it does not stain as diffusely as PAX 8 (**m**–**p**, Pap stain, TP)



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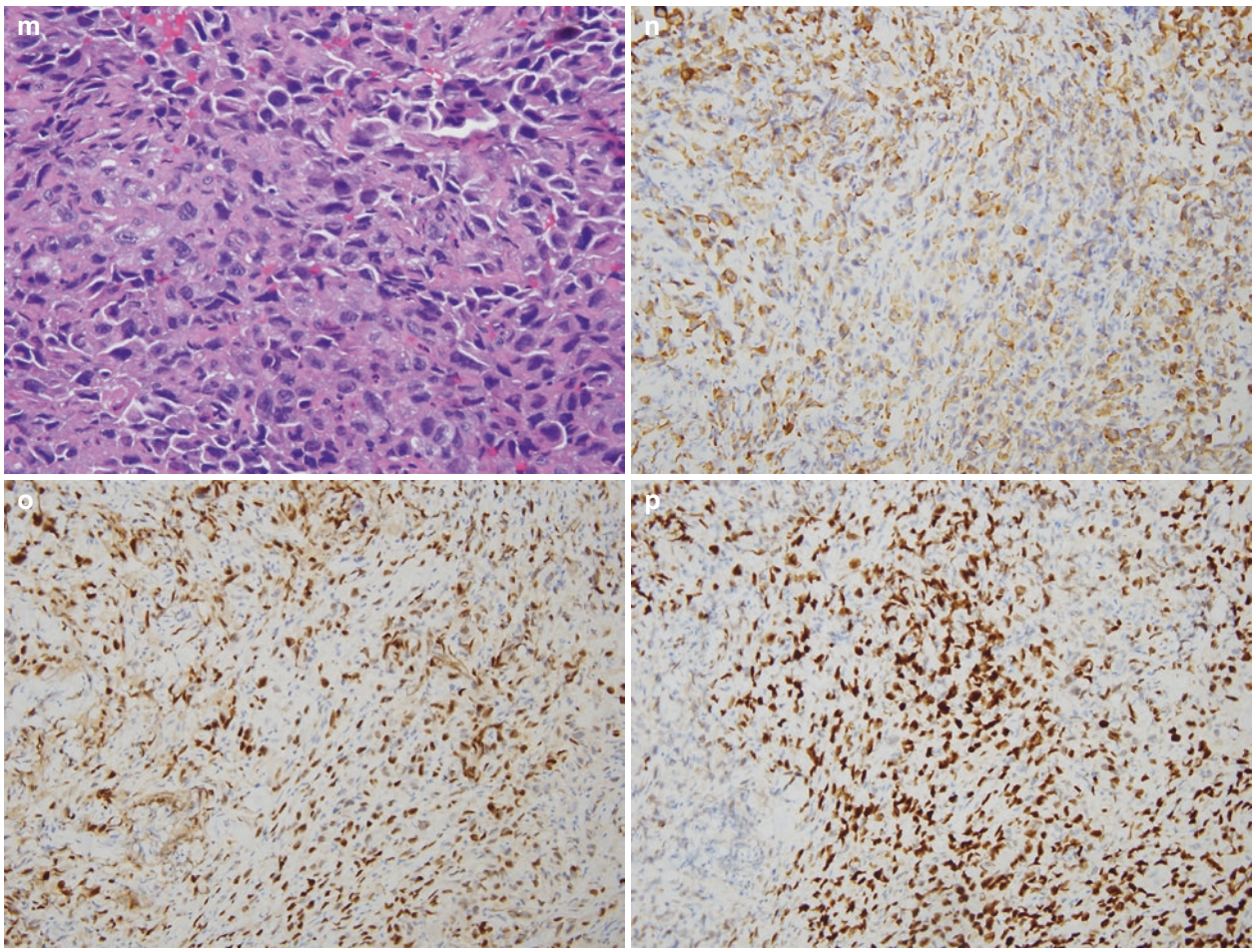


Fig. 11.1 (continued)

melanoma, and metastatic tumors. PAX 8 proves to be a helpful marker when distinguishing ATC from other malignancies with about 75% of ATC showing reactivity (*see* Fig. 11.1). The expression seems to be related to the predominant growth pattern: More than 90% of squamoid variants show reactivity, but reactivity is less frequent in other variants (Table 11.1)

- ATC can occur de novo or can coexist with well-differentiated or poorly differentiated malignancies in the thyroid (Fig. 11.2). The most common is the tall cell variant of papillary thyroid carcinoma (PTC), followed by the oncocytic variant of follicular carcinoma; a poorly differentiated thyroid carcinoma is less likely.
- ATC is characterized by accumulation of several different genetic alterations. Compared with differentiated thyroid carcinomas, ATC tends to have at least two or more mutations. *BRAF*V600E and *RAS* mutations, the most common alterations in well-differentiated thyroid carcinomas, remain the mutually exclusive main driver mutations in ATC, with *BRAF*V600E occurring in 29% of cases and *RAS* mutations in 23%.
- In addition, ATC is associated with a higher rate of telomerase reverse transcriptase (TERT) promoter mutations, seen in almost 73% of cases; these TERT promoter mutations tend to occur with *BRAF* or *RAS* mutations.
- In general, the coexistence of *BRAF/RAS* and TERT promoter mutations is synergistic and confers an aggressive potential to the malignancy and a trend towards greater mortality in ATC.

Table 11.1 Differential diagnosis of anaplastic thyroid carcinoma on FNA

Diagnosis	Cytology	Immunohistochemistry
Anaplastic thyroid carcinoma (ATC)	Spindled cells with high-grade nuclei, pleomorphism, mitoses (includes atypical) Usually admixed with pleomorphic or squamoid cells	*Positive:* LMWCK, PAX 8 *Negative:* Thyroglobulin *Positive or negative:* TTF-1
Squamous cell carcinoma	Lacks extreme pleomorphism Desmoplastic stromal spindle cells lack atypia	*Positive:* LMWCK *Negative:* PAX 8, thyroglobulin, TTF-1
Medullary thyroid carcinoma (MTC)	Spindled and/or plasmacytoid with "salt and pepper" chromatin. Bland nuclei. Endocrine-type atypia. Background can show amyloid.	*Positive:* CEA, calcitonin, neuroendocrine (NE) markers
High-grade sarcoma	Primary or metastatic Depends on the line of differentiation	*Positive:* SMA, desmin (if smooth muscle); CD34, ERG, CD31, FLI1 (if angiosarcoma)
Reidel thyroiditis	Bland-appearing fibroblasts and reactive myofibroblasts admixed with non-granulomatous–type inflammatory cells Can be cellular to paucicellular	*Positive:* SMA *Negative:* CK, EMA
Spindle epithelial tumor with thymus-like differentiation (SETTLE)	Rare Low-grade, bland-appearing spindled cells admixed with glandular epithelial cells No high-grade features such as necrosis, pleomorphism, or increased mitoses	*Positive:* AE1/AE3, CAM 5.2, CK7, vimentin, CD117

LMWCK low molecular weight cytokeratins

- Inactivating mutations in *TP53* play a major role in the tumorigenesis of ATC, with the overall prevalence in some studies being close to 60%.
- The efficacy of conventional treatments is limited in ATC because of the aggressive nature of the malignancy. Whenever possible, a multimodality approach with surgery, adjuvant chemotherapy, and radiation should be used.

Poorly Differentiated Thyroid Carcinoma (PDCa)

- PDCa is rare, about 4–7% of all thyroid cancers. It is biologically intermediate between well-differentiated and undifferentiated (anaplastic) thyroid carcinoma, with a mean survival rate of about 50%.
- It is imperative to distinguish PDCa from other well-differentiated thyroid cancers. Its aggressive nature presents increased chances of early recurrence and metastasis compared to its well-differentiated counterparts, necessitating aggressive therapy.
- On imaging, PDCa occurs as a solitary, large, solid, predominantly hypoechoic oval to round nodule that is mostly well circumscribed and has rich internal vascularity, with or without microcalcifications (Fig. 11.3a).
- Grossly, PDCas are large masses (often exceeding 5.0 cm in size) with a firm, solid, gray-white to brown cut surface with focal areas of necrosis. These tumors often show evidence of gross invasion (Fig. 11.3b).
- On cytology, PDCa shows a highly cellular aspirate composed of small cells arranged in a follicular, solid, syncytial, insular, or trabecular architecture with abundant single cells and bare nuclei on a background of blood. The cytoplasm is scant, and the nuclei are round and regular with granular chromatin and small nucleoli. There is no evidence of colloid and no nuclear features of PTC (Fig. 11.3c, d).
- The findings on liquid-based preparations (LBP) are similar to those on conventional smears (CS). The background may show reduced bare nuclei and necrosis, compared with CS (Fig. 11.3e, f). No studies to date have specifically identified the cytologic features of PDCa on LBP.
- Histologically, the commonest growth pattern is the insular growth pattern, recognized by well-defined nests or insulae with a fibrovascular outline. This can be the dominant pattern, or it can be intermixed with other patterns such as solid, trabecular, and follicular. The tumor cells appear monotonous, with round nuclei, scant cytoplasm, a high N:C ratio, granular chromatin, and small nucleoli. No features of PTC should be noted. Mitoses and necrosis can be observed (Fig. 11.3g, h).

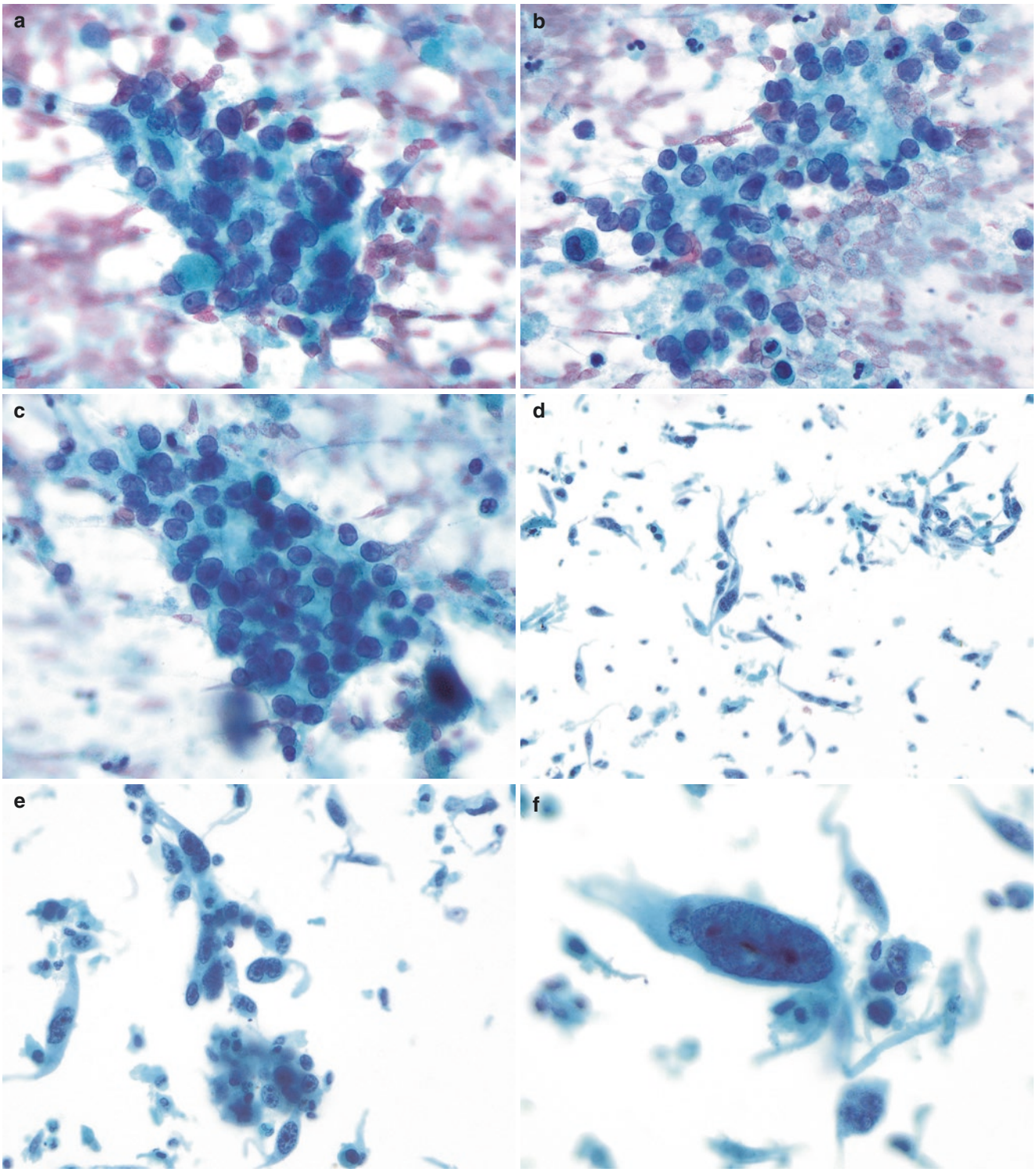
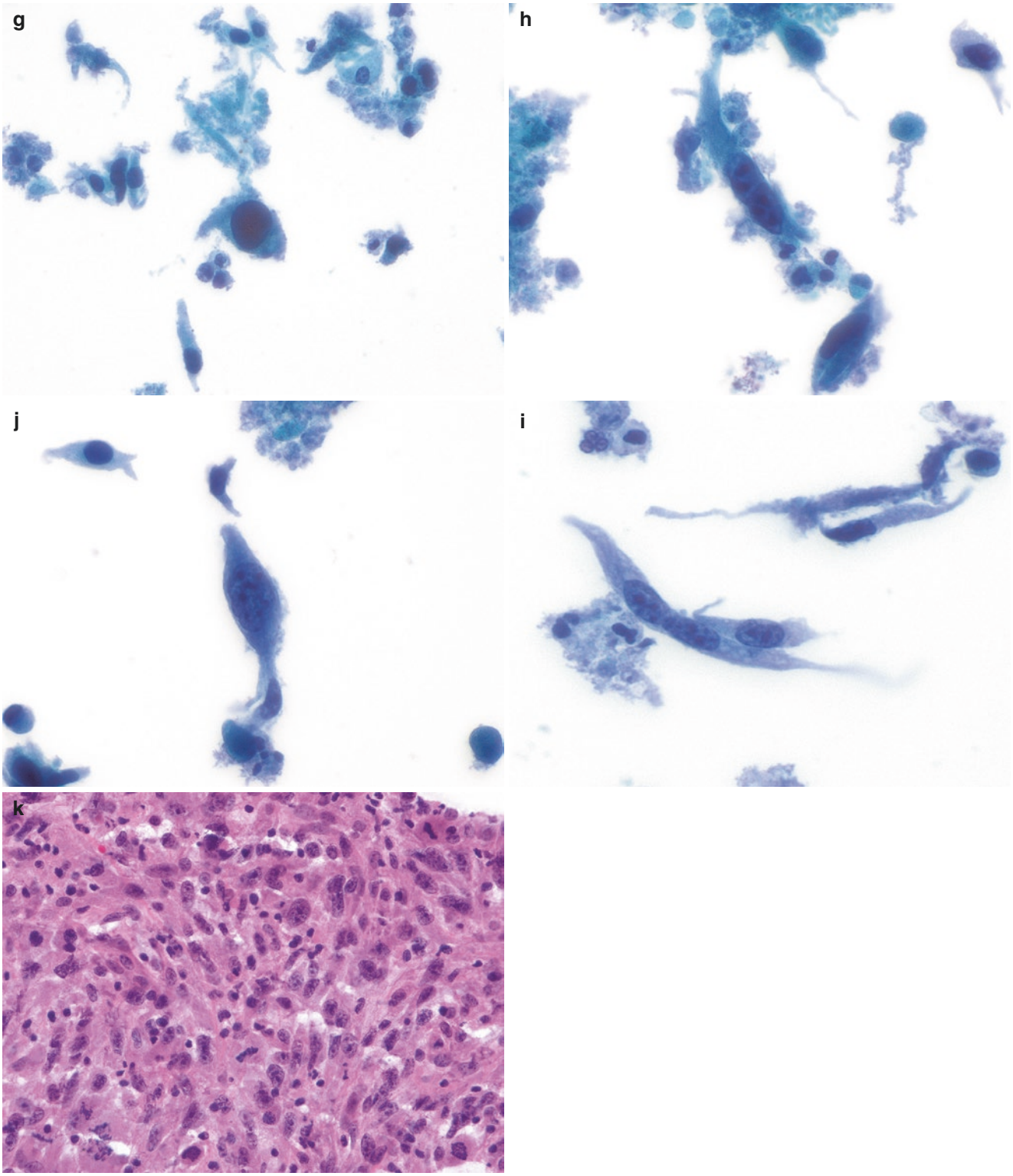


Fig. 11.2 ATC: Appearance on LBP. These images show an example of the spindled-cell variant of ATC on LBP (both TP and SurePath™ [SP]), associated with a well-differentiated component, papillary thyroid carcinoma (PTC). (**a**–**c**) These alcohol-fixed aspirates show the well-differentiated component, which was a PTC, as identified by the constellation of nuclear features, including nuclear overlap, grooves, membrane irregularity, pallor, and nuclear pseudoinclusions (**a**–**c**, Pap stain, CS). (**d**–**f**) The SP slides show the ATC component with prominent spindled cells showing high-grade nuclei. In these SP images, you can appreciate the dimensionality of the aspirate with blurring of some cells in the background. Just as on TP, the background in SP shows less blood (**d**–**f**, Pap stain, SP). (**g**–**j**) Compared with SP, TP is a monolayered preparation, which lacks dimensionality. The nuclear morphology otherwise looks fairly similar. On LBP, the single tumor cells appear more in number because of the preparatory technique (**g**–**j**, Pap stain, TP). (**k**) The surgical pathology follow-up of the tumor shows the prominent spindled cells with nuclear features similar to those seen in the SP and TP images. Note the high mitotic activity (H&E)



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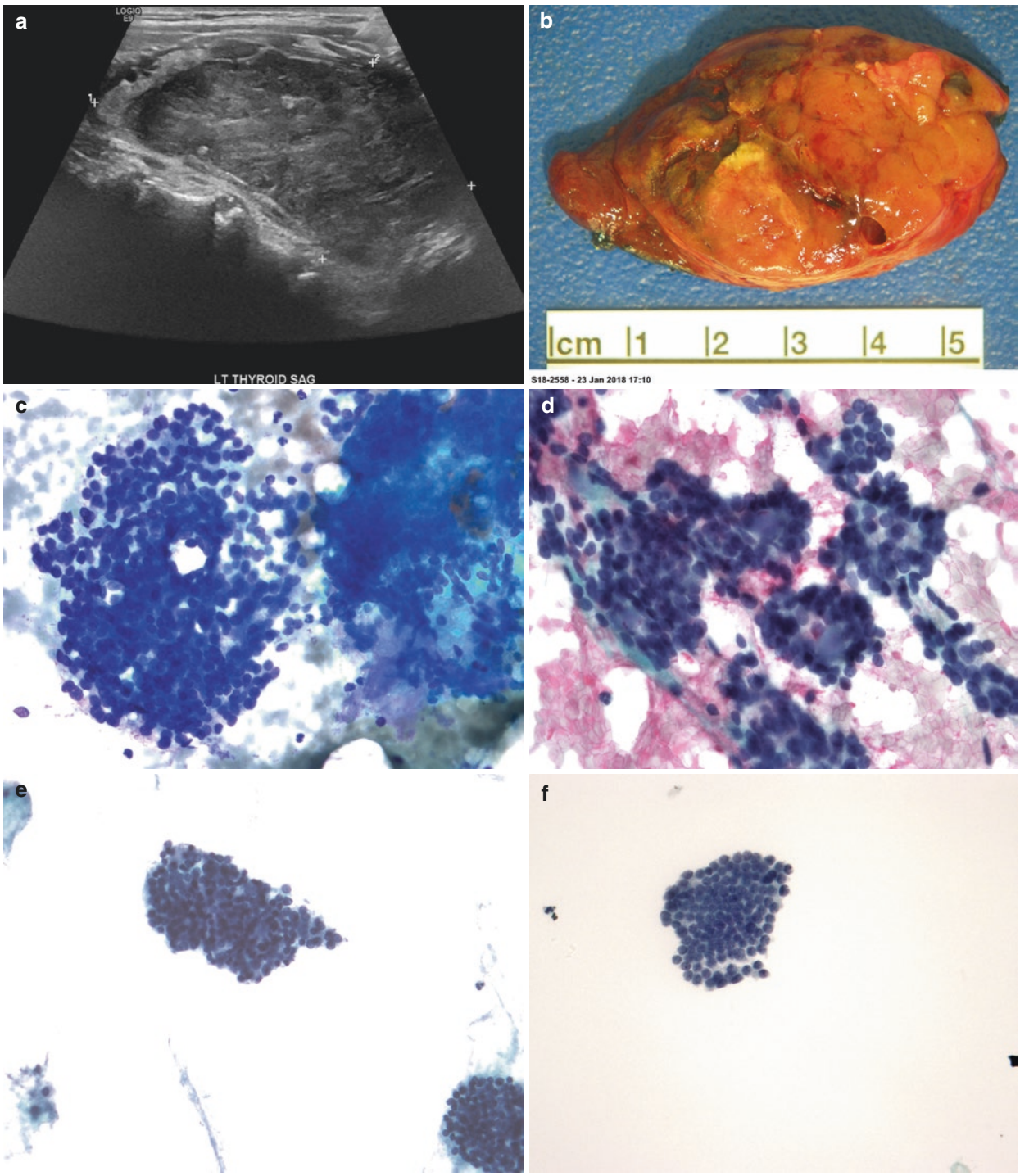

Fig. 11.3 Poorly differentiated thyroid carcinoma (PDCa): Imaging, gross, and cyto-histologic findings. (**a**) Ultrasonography shows a large mass in the thyroid with irregular borders and evidence of invasion. The mass shows mixed echogenicity with hypoechoic foci, possible areas of necrosis, and calcifications. (**b**) Grossly, the mass shows a firm, solid tan-brown to yellow cut surface; focal areas of necrosis and hemorrhage are noted. The borders of this mass appear lobulated in some areas and irregular in other areas. (**c**) This air-dried aspirate shows small cells arranged in a microfollicular architecture on a background of blood. The cytoplasm is scant and the nuclei are round and regular, with granular chromatin and small nucleoli. There is no evidence of colloid and no nuclear features of PTC (Diff-Quik, CS). (**d**) This alcohol-fixed aspirate shows similar features as seen on the air-dried aspirate. The nuclear chromatin is granular, and no nuclear features of PTC are seen (Pap stain, CS). (**e**, **f**) LBP of the same case with cytologic features similar to CS. Unlike the CS, the background here is cleaner. The cell groups show microfollicular architecture and appear to be tighter than the groups in the alcohol fixed aspirates. The chromatin details are similar to that of CS (**e**, **f**, Pap stain, TP). (**g**, **h**) Histology images of the mass showing features similar to those noted in cytology, such as microfollicular architecture. The nuclei appear round and regular; small nucleoli are seen. Wide areas of invasion are noted (H&E). (**i**, **j**) Another case of PDCa with an insular growth pattern. On this LBP, the clusters appear tighter and the background is clean. Note that the cells are small, with round nuclei. The cytoarchitectural pattern here is key in helping with the diagnosis of poorly differentiated thyroid carcinoma (Pap stain, TP)

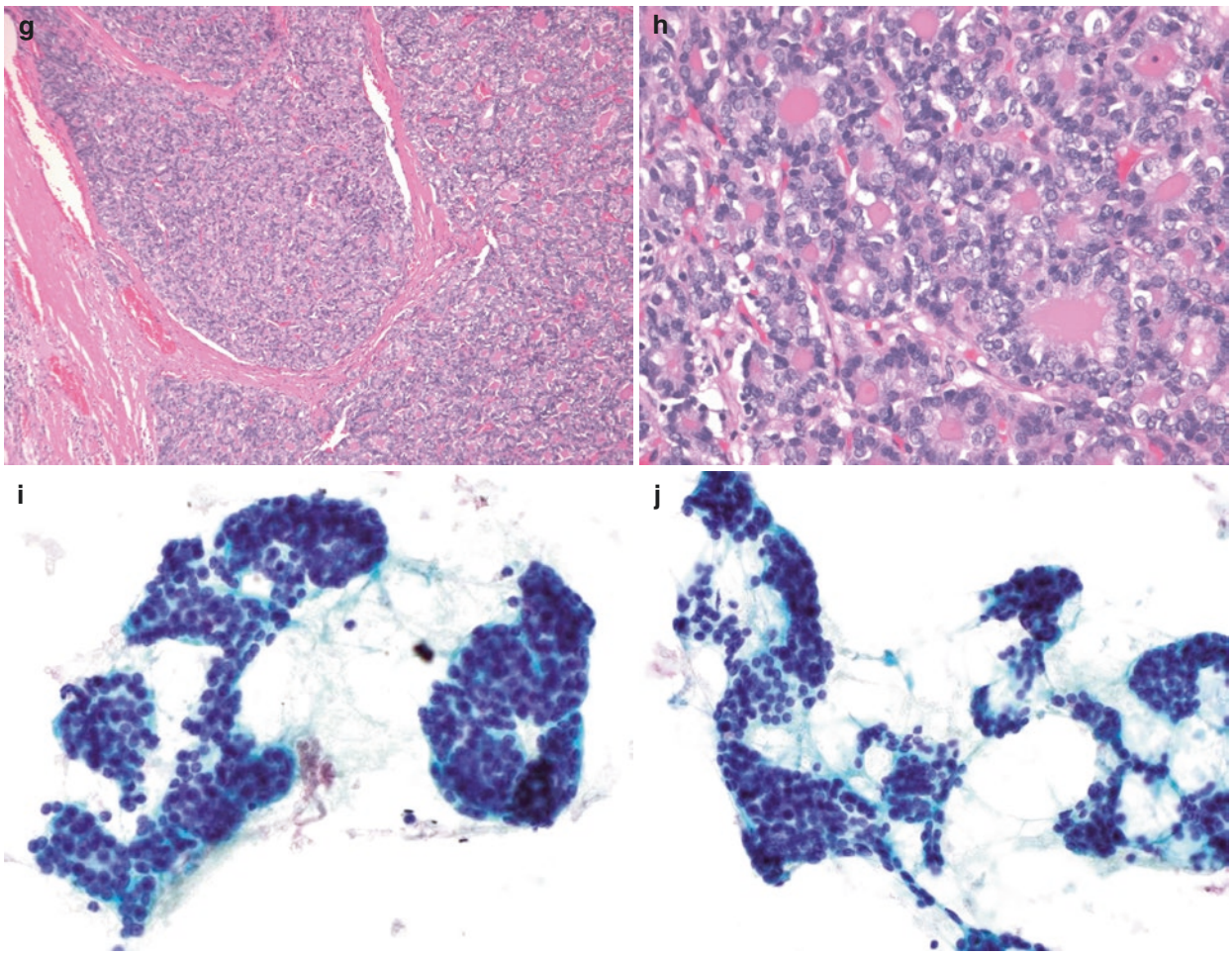

Fig. 11.3 (continued)

- Studies so far indicate that solid, trabecular, insular (STI) cytoarchitectural patterns and high cellularity are strong cytologic indicators in diagnosing PDCa (Fig. 11.3i, j), in addition to small cells, single cells, high N:C ratio, granular chromatin, severe crowding, and mitotic activity are strong cytologic indicators in aspirates.
- Bongiovanni et al. [5] noted that the combined presence of an STI cytoarchitectural pattern, single cells, high N:C ratio, and severe crowding was highly predictive of PDCa.
- Because of the prominent follicular architecture in some cases and the lack of obvious papillary-like nuclear features, PDCa is often classified as a follicular neoplasm (Bethesda IV/VI).
- The differential diagnosis of PDCa include follicular neoplasms, MTC, ATC, lymphoma, and metastases. The variable cytoarchitectural patterns, markedly increased cellularity, granular chromatin, presence of mitoses and necrosis, and lack of colloid help distinguish PDCa from other follicular neoplasms. The cytoarchitectural patterns and the lack of "salt and pepper" chromatin, along with a lack of immunoreactivity to calcitonin, CEA, and neuroendocrine markers, help distinguish it from MTC. The cytoarchitectural pattern of PDCa and the lack of immunoreactivity to lymphoid markers helps to distinguish it from lymphoproliferative neoplasms. Immunoreactivity to thyroglobulin, TTF-1, and PAX 8 as a panel helps to distinguish PDCa from other secondary malignancies to the thyroid.
- These tumors frequently carry *RAS* or *BRAF* mutations. Additional TERT promoter, *TP53*, and *EIF1AX* mutations have also been observed and are implicated in the aggressive nature of the malignancy and the associated worse prognosis.

Lymphomas Involving the Thyroid Gland

- Primary thyroid lymphoma (PTL) is a rare malignancy. It accounts for approximately 1–5% of all thyroid malignancies.
- It is most common in middle-aged to older women, with a mean age of 60–65.

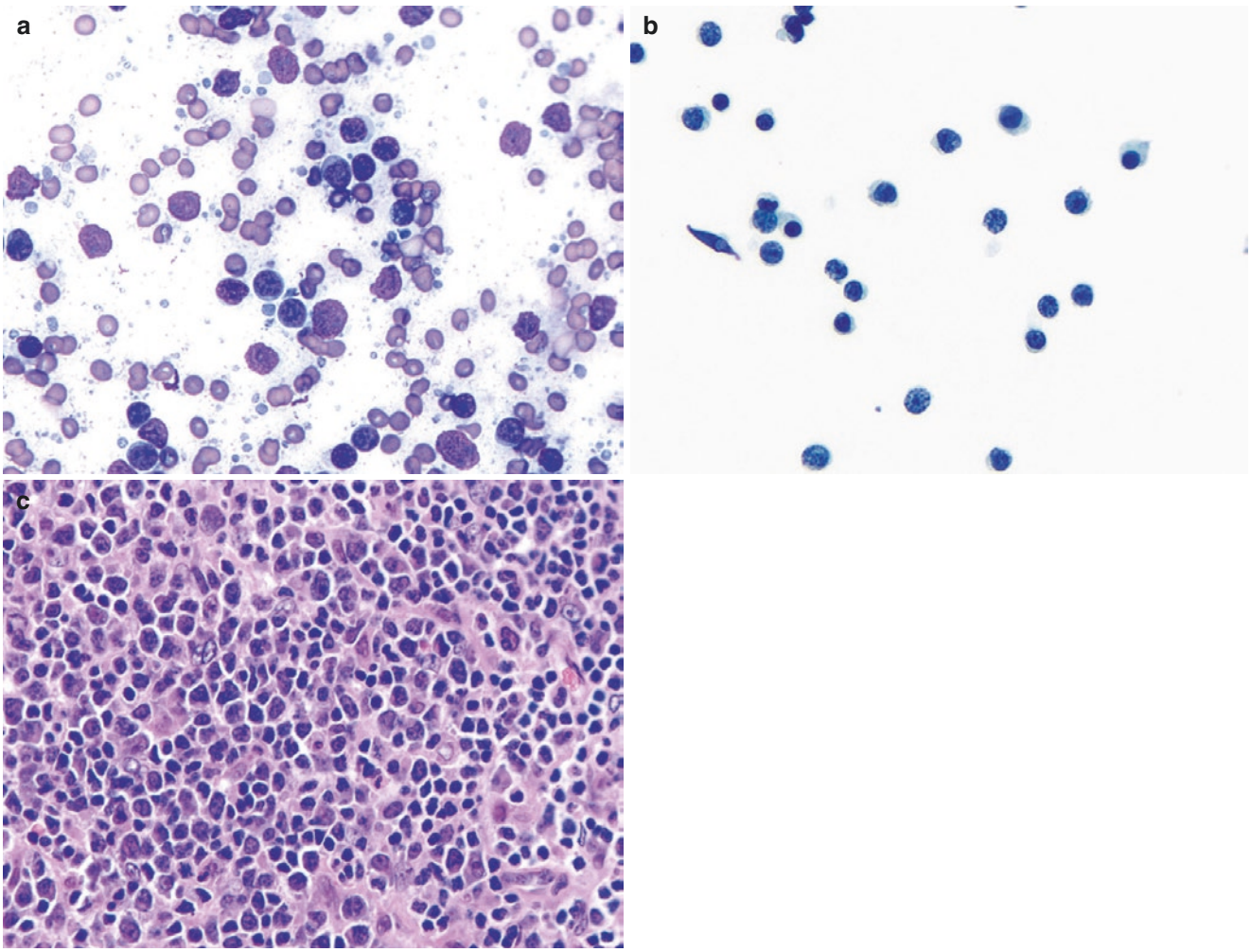

Fig. 11.4 Diffuse large B-cell lymphoma in the thyroid gland: Cytohistologic findings. (**a**) Air-dried aspirates are the best for lymphoid lesions. The background here shows red blood cells and lymphoglandular bodies (bits of bluish-gray cytoplasmic material). The malignant lymphoid cells appear enlarged (with nuclear sizes two to three times that of a red blood cell), with virtually no cytoplasm, and prominent nucleoli. Fewer intermediate-sized lymphoid cells are also noted in the background (Diff Quik, CS). (**b**) On LBP, the cells appear smaller than on the air-dried aspirate, but note that the malignant lymphoid cells show virtually no cytoplasm and appear larger, with prominent nucleoli. The background is very clean, devoid of lymphoglandular bodies or blood (Pap stain, TP). (**c**) The surgical follow-up showed a diffuse large B-cell lymphoma (H&E)

- Patients usually present with a mass that has rapidly enlarged. Compressive symptoms due to mass effect may be reported. Most patients are either euthyroid or hyperthyroid.
- Lymphomas are most frequently of the B-cell type. The most common subtypes are diffuse large B-cell lymphoma (DLBCL, 60–70%) (Fig. 11.4) and extranodal marginal zone lymphoma of mucosa-associated lymphoid tissue (MALT lymphoma, 20–30%).
- Almost all cases of PTL arise in the setting of Hashimoto thyroiditis, with an estimated relative risk of 67 to 80.
- On ultrasound imaging, the mass appears hypoechoic and asymmetrical.
- Grossly, the tumor can vary in size, and it may involve one lobe or both lobes. Tumors are lobular, multinodular, or diffuse and have a bulging, tan to white-grey cut surface.
- Microscopic appearance depends on the lymphoma subtype. The lymphoma usually effaces the normal thyroid parenchyma.
- Sheets of large, atypical lymphoid cells with destruction of thyroid parenchyma characterize DLBCL, the most common lymphoma subtype. The lymphocytic infiltrate often extends into adjacent fat and skeletal muscle. The cells have the appearance of centroblasts or immunoblasts. The tumor can be divided into germinal center–like and non-germinal center–like.
- Immunohistochemically, the tumor cells are positive for CD20, CD79a, and PAX-5.
- MALT lymphoma can demonstrate a nodular to diffuse pattern. It is composed predominantly of small cells, including marginal zone cells, monocytoid-like B cells,

and plasma cells. Scattered large cells resembling centroblasts or immunoblasts can be seen.
- Lymphoepithelial lesions consisting of glandular epithelium infiltrated by lymphoma cells, with destruction of the epithelium, are frequently seen. Lymphoma cells may colonize the germinal centers of reactive follicles and mimic follicular lymphoma.
- Immunohistochemically, MALT lymphoma is characterized by CD20, CD79a, and BCL-2 positivity; the tumor cells are negative for CD10, BCL-6, and CD5.
- Treatment usually consists of adjuvant chemotherapy and radiation. Prognosis varies depending on the subtype. Patients with MALT lymphoma have a higher 5-year disease-specific survival.
- Sensitivity for diagnosing PTL in cytology has varied from 39% to 72%.
- Aspirates are generally cellular and consist of noncohesive cells. Lymphoglandular bodies can be seen in the background.
- FNA of large B-cell lymphomas are highly cellular and consist of large cells with coarse chromatin, prominent nucleoli, and basophilic cytoplasm. Necrotic debris may be seen.
- Aspirates from low-grade lymphomas such as MALT lymphoma show predominantly small lymphocytes and plasma cells. The small cells have vesicular chromatin, small nucleoli, and a moderate amount of cytoplasm. Occasionally, larger cells with prominent nucleoli may be seen (Fig. 11.5).

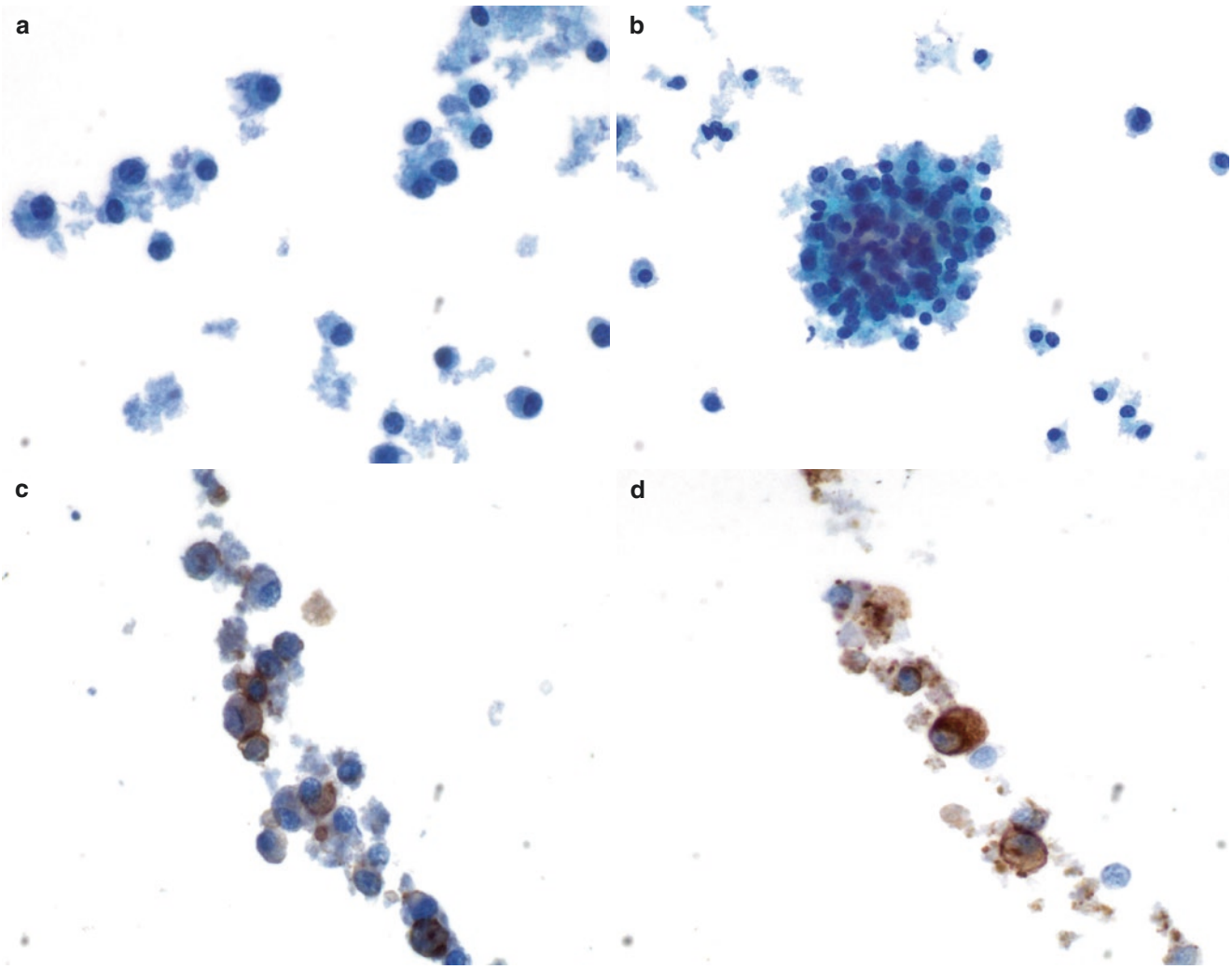

Fig. 11.5 Lymphoplasmacytic lymphoma involving the thyroid gland: Cyto-histologic findings. (**a**, **b**) LBP showing small to intermediate-sized lymphoid cells; the majority show a plasmacytoid morphology. The cell outlines appear poorly defined (Pap stain, TP). (**c**) Immunostain for leukocyte common antigen (LCA) is positive, highlighting these plasmacytoid lymphoid cells (IHC). (**d**) Immunostain for CD38 is positive in lymphoplasmacytic lymphoma (IHC)

- Because PTL typically arises in the background of Hashimoto thyroiditis, it may be difficult to make a diagnosis on FNA. The absence of oncocytes and follicular cells can help to distinguish lymphoma from Hashimoto thyroiditis.
- In equivocal cases, flow cytometry and immunohistochemical studies are helpful.

Metastatic Tumors to the Thyroid Gland

- Metastatic tumors to the thyroid are uncommon but not rare, encompassing about 1.4–3% of all thyroid malignancies, increasing to 24% in autopsy studies.
- The interval from the diagnosis of the primary to the diagnosis of metastases can vary from months to years; some have been reported more than 20 years after the diagnosis of the primary.
- In patients with prior malignancies, metastases should be entertained in the differential diagnosis of any nodular enlargement in the thyroid.
- As always, FNA is the effective first step in managing thyroid nodules and ruling out the possibility of metastases to the thyroid. Nevertheless, diagnosing metastases without the history of a known primary could be challenging on FNA.
- Although FNA has been shown to achieve diagnostic accuracy of >90% in diagnosing metastases to the thyroid, some studies report lower accuracy rates (~58%) than when diagnosing a primary thyroid malignancy (90%). This difference could be due in part to the difficulty in ruling out metastases in aspirates that are rich in spindled, clear, or pleomorphic (anaplastic) cells.
- The pathway of tumor seeding in the thyroid gland is through the lymphovascular route or through direct extension. The mechanism of tumor seeding in the thyroid is controversial at best. Some studies postulate that the high blood flow and increased velocity prevent tumors from depositing in the thyroid gland, and the high oxygen and iodine content does not cater to tumor growth in the thyroid gland, but destruction of the thyroid parenchyma by a disease process sets the stage for tumors to proliferate.
- Tumor-to-tumor metastasis can also happen in the thyroid gland; for example, tumor metastasis from other organs has been known to occur within a primary thyroid neoplasm such as a follicular adenoma.
- The most common primaries to metastasize to the thyroid gland include kidney (~34%), lung, breast, GI tract, melanoma, and head and neck cancers. Less common are metastases from gynecologic, hematopoietic, soft tissue, and genito-urinary tract malignancies.
- The overall management includes surgical resection of the metastatic lesion; patients treated surgically have longer survival than those treated using non-surgical approaches.
- The cytologic features of the metastases are similar to the primary tumors for both CS and LBP. In almost all cases, the clinical history, morphologic comparison with the patient's primary, and/or further workup using ancillary studies on cell block material are necessary for diagnostic confirmation (Table 11.2, Figs. 11.6 and 11.7).

Table 11.2 Ancillary immunohistochemical studies helpful in differentiating the metastatic tumors to the thyroid gland

Tumor	Tests
Renal cell carcinoma	*Positive:* CD10, RCC, PAX-8, CAIX (renal cell markers) *Negative:* TTF-1 and thyroglobulin (thyroid follicular cell markers); calcitonin (medullary cancer marker).
Breast carcinoma	*Positive:* GATA3, estrogen receptor (ER) *Negative:* TTF-1, PAX-8, thyroglobulin, calcitonin
Lung adenocarcinoma	*Positive:* TTF-1, napsin A, +/− P63 *Negative:* PAX-8, thyroglobulin, calcitonin
Squamous cell carcinoma (lung and other)	*Positive:* P40, P63 *Negative:* TTF-1, PAX-8, thyroglobulin, calcitonin
Colorectal primary	*Positive:* CK20, CDX2 *Negative:* CK7, TTF-1, thyroglobulin, PAX-8, calcitonin

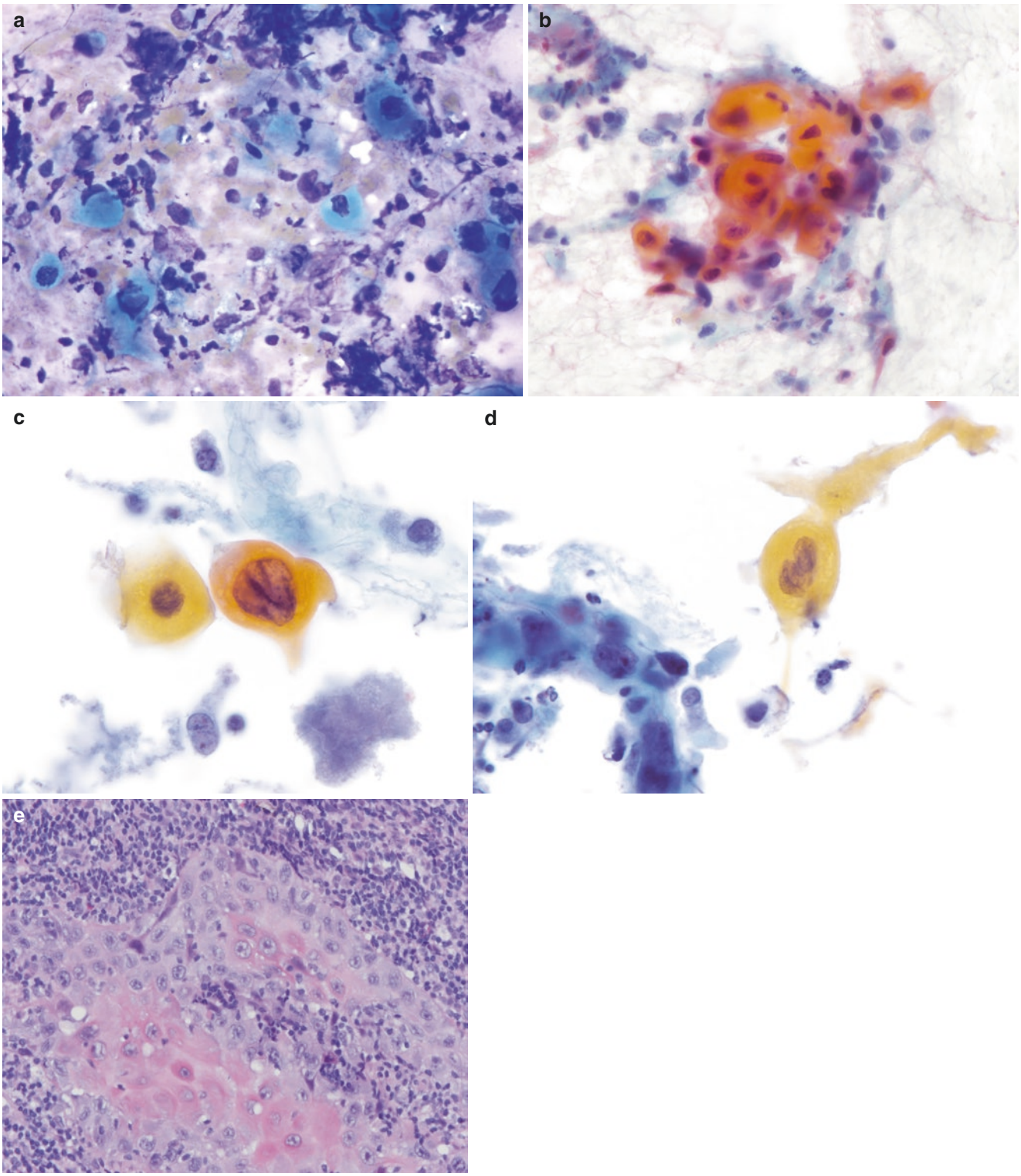

Fig. 11.6 Metastatic squamous cell carcinoma to the thyroid gland. This is an example of esophageal squamous cell carcinoma metastasizing to the thyroid gland. (**a**) This air-dried aspirate shows single cells with dense blue cytoplasm, also referred to as "Robin's egg blue" cytoplasm. This blue color is suggestive of keratinization in these tumor cells (Diff Quik, CS). (**b**) The alcohol-fixed smear shows single cells and loose clusters of malignant squamous cells with orangeophilia in the cytoplasm, compatible with keratinizing squamous cell carcinoma (Pap stain, CS). (**c**, **d**) The LBP of the same case shows keratinized malignant squamous cells, which appear fairly similar to those seen in the alcohol-fixed CS. In (**d**) we can appreciate a cluster of non-keratinized malignant squamous cells adjacent to the keratinized malignant cell. The background is less striking, with less blood. The cytoplasm can appear orange to yellow and refractile in keratinized malignant squamous cells (**c**, **d**, Pap stain, TP). (**e**) Histologic follow-up showing squamous cell carcinoma (H&E)

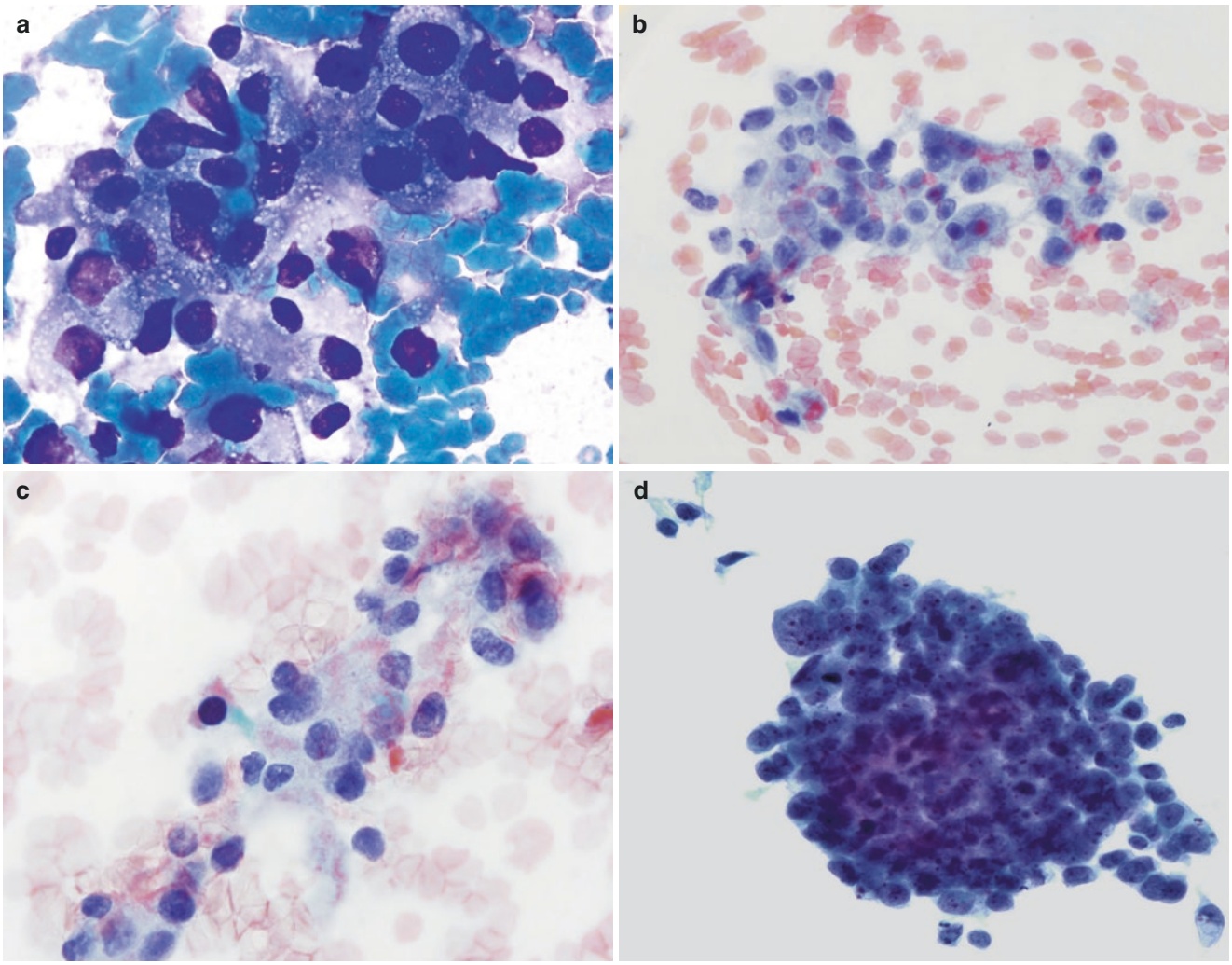

Fig. 11.7 Metastatic breast carcinoma to the thyroid gland. (**a**) Air-dried aspirate showing a loose cluster of malignant cells with vacuolated cytoplasm and markedly enlarged and hyperchromatic nuclei with nucleoli (Diff Quik, CS). (**b**, **c**) Alcohol-fixed smears showing a similar-looking cluster. The chromatin is coarse and the nucleoli appear large and prominent. The cytoplasmic details are not so clear as in the air-dried aspirate (Pap stain, CS). (**d**) On LBP, the similar clusters appear more cohesive and tighter, but the nuclear details are almost identical to those on the CS (Pap stain, TP). (**e**) The accompanying cell-block section shows cytomorphologic details similar to those noted on CS and LBP (H&E). (**f**) A GATA3 stain is positive in a breast primary and is staining the tumor cell nuclei (IHC). (**g**) The resection sample was a metastatic breast carcinoma (H&E)

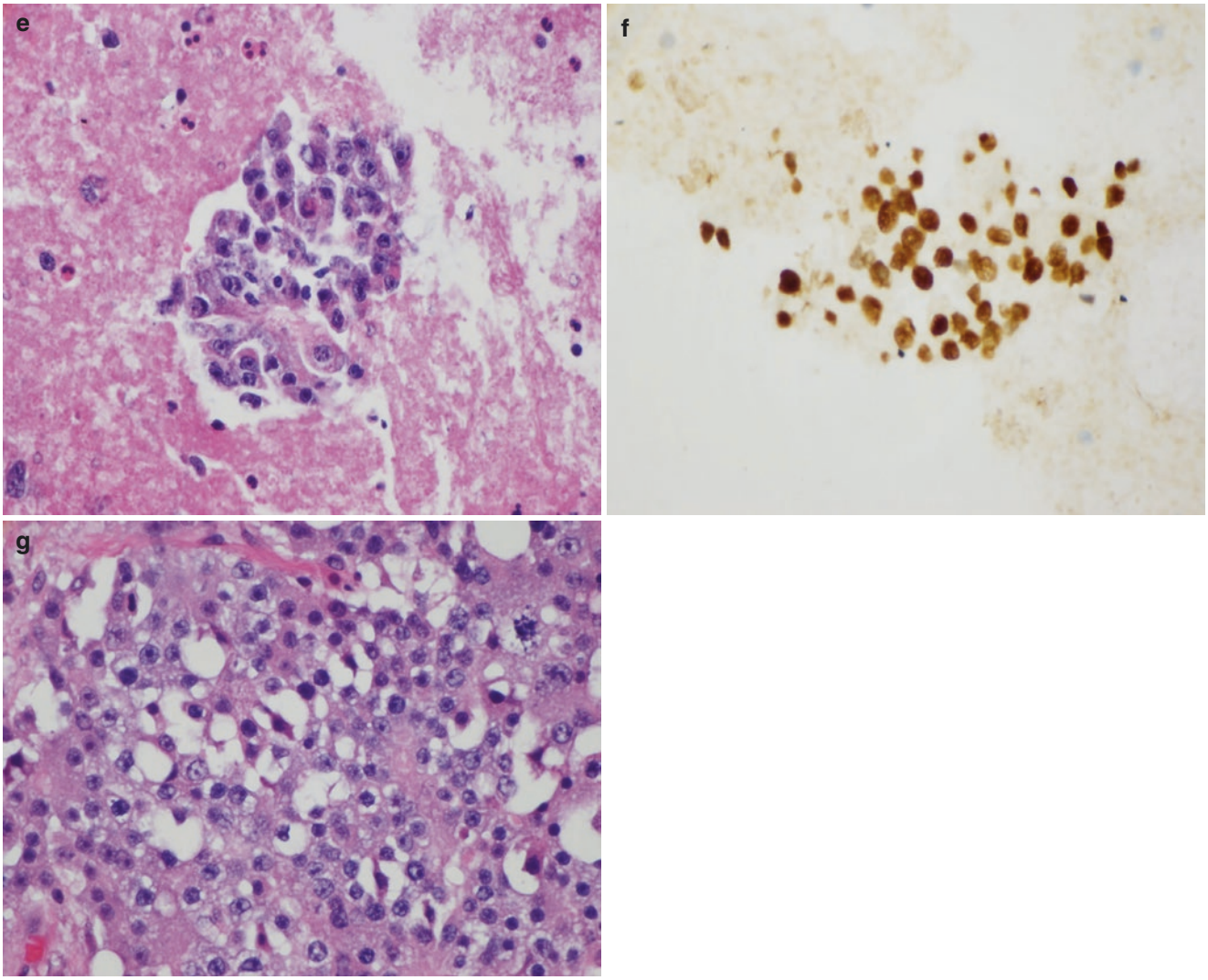

Fig. 11.7 (continued)

Suggested Reading

Anaplastic Thyroid Carcinomas

1. Molinaro E, Romei C, Biagini A, Sabini E, Agate L, Mazzeo S, et al. Anaplastic thyroid carcinoma: from clinicopathology to genetics and advanced therapies. Nat Rev Endocrinol. 2017;13:644–60. https://doi.org/10.1038/nrendo.2017.76.
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Poorly Differentiated Thyroid Carcinoma

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