Hair Cortex Comedo: A Series of 34 Cases

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Abstract: Hair cortex comedo was described originally in an article detailing 2 cases of a comedo-like clinical lesion that was histologically a keratinous plug with cornification similar to the cortex of the hair shaft. We have collected retro- and prospectively a series of 34 cases of hair cortex comedo. In our series, there was a slight female predominance (Male:Female of 1:1.4), and the mean patient age was 28.8 years. All lesions were solitary, distributed mainly on the head and neck or trunk, and were described clinically as a blue subcutaneous papule or nodule with "cyst" as the most common clinical differential diagnosis. Histologic examination showed a solitary, vertically oriented, uniformly sized oval nodule of compact laminated corneocytes sitting in a patulous invagination lined by epithelium similar to the infundibulum, isthmus, or combinations of them; rarely matrical epithelium was identified. Entrapped melanin (30/34 cases), shadow cells (16/34 cases), and calcification (12/34 cases) were identified commonly. Remnants of a surrounding follicle were noted in 15 cases, with infundibular epithelium in 9 of the cases, isthmic epithelium in 3, and matrical or supramatrical epithelium (or both) in 3. There was an associated dense granulomatous infiltrate in the majority of the cases (25/34). Although hair cortex comedo was thought originally to be a variant of dilated pore of Winer, we believe that these distinctive lesions, which are characterized histopathologically by a uniformly sized vertically oriented dermal plug of laminated corneocytes with entrapped melanin and surrounding granulomatous inflammation, are likely derived from matrical or supramatrical cells (or both).

Key Words: hair cortex comedo, pilomatricoma, matrical differentiation, supramatrical differentiation, isthmic differentiation, solitary lesion

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INTRODUCTION

In the anagen hair follicle, matrical cells are located at the base of the bulb and have small round basophilic nuclei with dispersed chromatin and scant cytoplasm. These cells differentiate along 2 separate pathways to form both the inner sheath and the hair filament (shaft), the latter of which is composed of a cortex and medulla attached to the inner sheath by a cuticle. The cortex, which is the main component of the hair filament, originates from these presumably uncommitted matrical cells and, under normal conditions, commences as completely cornified keratin fibrils that have lost all their organelles.[1] However, faulty attempts at differentiation and cornification of matrical cells are seen in some proliferations, notably pilomatricoma. We present a series of 34 cases where the most striking feature of the lesion is the unusual type of cornification of an eosinophilic plug. The plug is solitary, of uniform size with a vertical orientation, and is composed consistently of concentric compact laminated corneocytes, commonly containing melanin. Often, there are also foci of shadow cells. This pattern of cornification represents a faulty attempt at hair shaft formation, resulting in an abnormally formed hair cortex stuffed within a patulous opening, hence *hair cortex comedo*.

MATERIALS AND METHODS

The cases were collected retrospectively and prospectively from our dermatopathology practice, dating from March 2000 to December 2009. Hematoxylin and eosin–stained sections were examined on all cases. Deeper levels were cut and examined on 10 cases.

Patient demographics, clinical characteristics, and differential diagnoses were gathered from the submitted specimens (Table 1).

RESULTS

The patients ranged in age from 2 to 87 years, with a mean age of 28.8 years. Of the 34 cases, there were 20 women and 14 men.

The lesions were distributed as follows: head and neck (17) [cheek (6), scalp (3), neck (3), forehead (1), preauricular (1), postauricular (1), eyelid (1), jawline (1)], trunk (12) [back (9), chest (3)], and extremities (5) [arm (3), shoulder (1), thigh (1)].

On the basis of clinical information provided, the lesions were described most commonly as a solitary subcutaneous papule or nodule.

Multiple clinical diagnoses were offered. In order of frequency, these included cyst (14), nevus (7), malignancy [squamous cell carcinoma, basal cell carcinoma, melanoma] (7), pilomatricoma (4), calcinosis or osteoma cutis (3), foreign body with or without reaction (3), dermatofibroma (2), comedone (2), and one each of pyogenic granuloma, juvenile xanthogranuloma, molluscum contagiosum, phlebolith, seborrheic keratosis, acrochordon, appendageal tumor, wart, trichostasis spinulosa, bite, and excoriation.

Microscopically, the lesions were all characterized by a well circumscribed, vertically oriented, solitary, oval, nodular plug of relatively uniform size (range 0.8–4.9mm, mean of 2.3 mm) composed of compact concentrically laminated

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TABLE 1. Clinical Findings in Patients With Hair Cortex Comedo (N/A = not Available)

Case	Age	Sex	Location	Clinical Description	Clinical Differential Diagnosis
1	19	M	Back	Blue crusted nodule	Blue nevus, dermatofibroma
2	10	F	Chest	Bluish papule	Blue nevus
3	36	F	Trunk	Irritated papule	Benign papule
4	55	F	Arm	Gray papule	Cyst, dysplastic nevus
5	20	F	Chest	Nonhealing papule	Irritated nevus
6	41	M	Cheek	Green/black papule	Keratocyst, excoriation
7	71	F	Back	Red papule	Bug bite reaction, foreign body, clogged pore
8	8	M	Scalp	Blue papule	Cyst, nevus
9	14	F	Cheek	Rock hard blue nodule	Pilomatricoma
10	17	F	Back	Enlarging irregular tricolored firm nodule	Comedone, nevus, malignancy
11	15	F	Back	Blue nodule	Calcified cyst, phleboliths
12	54	F	Thigh	Blue-brown papule with a subcutaneous nodule	Dermatofibroma, melanoma
13	7	F	Cheek	Nontender subcutaneous nodule	Pilomatricoma
14	11	M	Back	Inflamed red nodule with indurated blue papule	Foreign body reaction, pilomatricoma, keratinous cyst with scar
15	27	M	Jawline	Cyst	N/A
16	13	M	Shoulder	Blue nodule	Cyst, calcified nodule
17	21	F	Eyelid	N/A	Cyst
18	13	M	Scalp	Oval area of alopecia	N/A
19	14	M	Scalp	N/A	Cyst
20	19	F	Back	N/A	Foreign body
21	33	F	Arm	Gray papule	Seborrheic keratosis
22	5	F	Cheek	N/A	Pilomatricoma, osteoma, calcinosis cutis
23	14	M	Neck	Crusted tan papule	Nevus, irritated acrochordon
24	48	F	Back	Excoriated papule	Inflamed cyst, appendageal tumor, squamous cell carcinoma
25	56	M	Neck	Horn arising from a single pore	Filiform wart, trichostasis spinulosa, squamous cell carcinoma
26	14	M	Back	Subcutaneous nodule	Cyst
27	4	F	Cheek	N/A	Cyst
28	60	F	Arm	N/A	Cyst
29	37	M	Neck	N/A	Cyst
30	11	M	Preauricular	Non-healing, bleeding lesion	Pyogenic granuloma, malignancy
31	49	F	Back	N/A	Cyst
32	77	F	Postauricular	Tender pearly papule	BCC
33	87	F	Eyebrow	Firm papule	BCC
34	2	M	Cheek	Bleeding papule	Molluscum contagiosum, juvenile xanthogranuloma

corneocytes (Fig. 1). In 4 cases (12%), there were a few scattered detached fragments of similar appearing compact laminated corneocytes within the surrounding dermis; in 2 of these cases, the fragments contained shadow cells (Fig. 2). The majority of the cornified plugs contained entrapped melanin (88%) and were surrounded by a dense foreign body like granulomatous reaction composed predominately of epithelioid macrophages, multinucleated giant cells, neutrophils, and lymphocytes (74%) (Figs. 3 and 4). In 15 cases, shadow cells were identified within the cornified plug; in one case, the shadow cells were present only in surrounding detached fragments (Figs. 5 and 6). Foci of calcification, with or without ossification, were identified in 35% of the cases. An epithelial lining surrounded the nodular cornified plug in 15 cases (44%); of these cases, 9 (26%) were similar morphologically to the infundibulum, and 4 (12%) opened to the epidermal surface (Fig. 7). Isthmic-catagen epithelium was identified in 3 cases (9%) (Fig. 8) and matrical or supramatrical epithelium (or both) in 3 (9%) (Fig. 9). The histologic features of all 34 cases are summarized in Table 2.

DISCUSSION

To date, there is only one report in the English literature describing hair cortex comedo.[2] This article details 2 cases, one occurring in a 20-year-old man and the other in a 12-year-old girl. Both lesions were described as well-circumscribed firm blackish papules, ranging from 3 to 4 mm, and clinically resembling a comedo. One lesion was present on the upper region of the eyebrow, and the other was located on the upper back. Microscopic characteristics included a V-shaped squamous epithelium-lined invagination that lacked a granular layer but was contiguous with the epidermis and had an aggregation of basophilic matrical cells at the base. There was a central comedo-like plug composed of stratified layers of eosinophilic material containing melanin pigment, resembling

TABLE 2. Histologic Features of 34 Cases of Hair Cortex Comedo

Case	Size (mm)	Well Circumscribed Oval Nodule	Compact Laminated Keratin	Entrapped Melanin	Shadow Cells	Calcification	Epithelial Lining	Granulomatous Reaction
1	1.7	Y	Y	Y	Y	N	N	Y
2	1.8	Y	Y	Y	N	N	N	Y
3	1.2	Y	Y	Y	N	N	Y (isthmic-catagen)	Y
4	1.1	Y	Y	Y	N	N	Y (infundibular)	N
5	1.2	Y	Y	Y	N	N	N	Y
6	2.0	Y	Y	Y	Y	Y	N	Y
7	2.8	Y	Y	Y	Y	Y (+ossification)	N	Y
8	4.3	Y	Y	Y	Y	Y	Y (infundibular, connects to epidermis)	Y
9	3.8	Y	Y	Y	Y	N	N	Y
10	3.0	Y (+detached fragments)	Y	Y	Y	N	Y (infundibular, connects to epidermis)	Y
11	2.5	Y	Y	Y	N	N	N	N
12	1.3	Y	Y	Y	Y	N	N	Y
13	3.6	Y	Y	Y	Y	Y	N	Y
14	3.3	Y	Y	Y	Y	Y	N	N
15	1.4	Y	Y	Y	N	N	N	Y
16	4.9	Y	Y	Y	N	N	N	Y
17	1.3	Y	Y	Y	Y	N	Y (matrical, supramatrical)	N
18	1.9	Y	Y	Y	N	Y	N	Y
19	1.9	Y (+detached fragments)	Y	Y	Y	Y (+ossification)	N	Y
20	4.5	Y	Y	Y	N	Y	N	Y
21	2.0	Y	Y	Y	Y	N	Y (infundibular)	Y
22	1.9	Y	Y	N	N	N	N	Y
23	1.7	Y	Y	Y	Y	Y	Y (infundibular, connects to epidermis)	N
24	1.9	Y	Y	Y	Y	N	Y (infundibular, connects to epidermis)	Y
25	4.1	Y	Y	Y	N	Y	Y (infundibular, connects to epidermis)	N
26	3.3	Y	Y	N	N	N	Y, (isthmic-catagen)	N
27	1.3	Y (+detached fragments with shadow cells)	Y	N	N	Y	Y (infundibular)	Y
28	2.0	Y	Y	Y	Y	N	N	Y
29	1.6	Y	Y	Y	N	N	N	Y
30	2.3	Y	Y	Y	N	Y	N	Y
31	0.8	Y	Y	Y	N	N	Y (infundibular)	N
32	0.8	Y	Y	Y	N	N	Y (infundibular)	N
33	1.3	Y	Y	Y	Detached fragments only	N	Y (isthmic, +detached matrical)	Y
34	0.4	Y	Y	N	N	N	Y (matrical)	Y

the cortex of the hair shaft. Spindled fibroblasts were present in the stroma surrounding the lesion.

We detail 34 cases of this unusual lesion. In our series, women were affected slightly more often than men. The lesions were described usually as a solitary blue subcutaneous papule or nodule with the most common clinical diagnosis of cyst. Comedo was offered as a clinical diagnosis in only 2 cases. The head and neck and trunk were the predominate sites of lesion location. Histologic examination showed a uniformly sized solitary vertically oriented well-circumscribed oval plug composed of concentrically laminated corneocytes which often contained entrapped melanin, shadow cells, foci of calcification, or combinations of these findings. In some cases, surrounding epithelium was identified, most commonly infundibular, which, in some cases, connected to the epidermis. An associated granulomatous reaction was usually identified.

In the original article, hair cortex comedo was thought to represent a histologic variant of a dilated pore of Winer.[2] Dilated pore was first described by Winer in 1954 as a pore filled with a cornified plug that occurred mainly on the face.[3] Histologically, dilated pores have a single widened infundibulum with circumferential radiations of rete ridges along the outer surface, a granular layer lining the inner surface, and basket weave laminated corneocytes within the central cystic

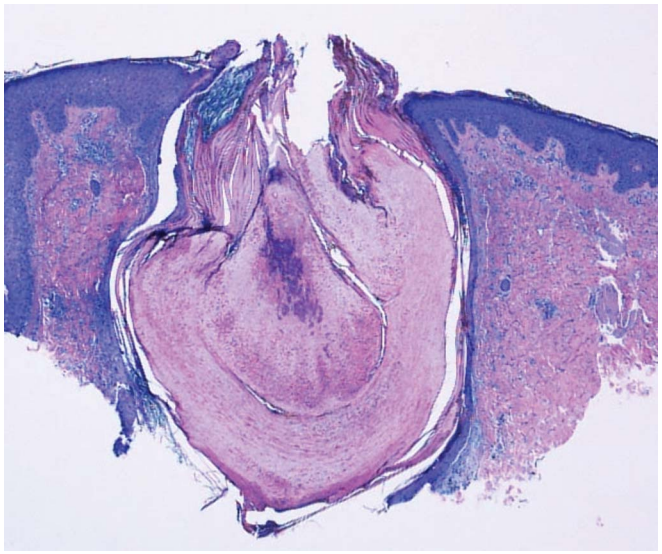

FIGURE 1. Low-power magnification shows a well-circumscribed solitary vertically oriented oval nodular plug of compressed corneocytes, similar to that of the hair cortex.

cavity. Originally thought to be a trichoepithelioma, dilated pore is now regarded by some as the superficial portion of an infundibular cyst and by others as being derived from the outer root sheath.[1,3,4] In our series, flattened infundibular epithelium with and without an opening to the epidermis was seen in 9 cases. In 5 cases, matrical and supramatrical epithelium and/or isthmic-catagen epithelium was identified also. The presence of matrical, supramatrical, isthmic, infundibular epithelium, or combinations of these, associated with a dense cornified plug suggests that there is an attempt at hair shaft

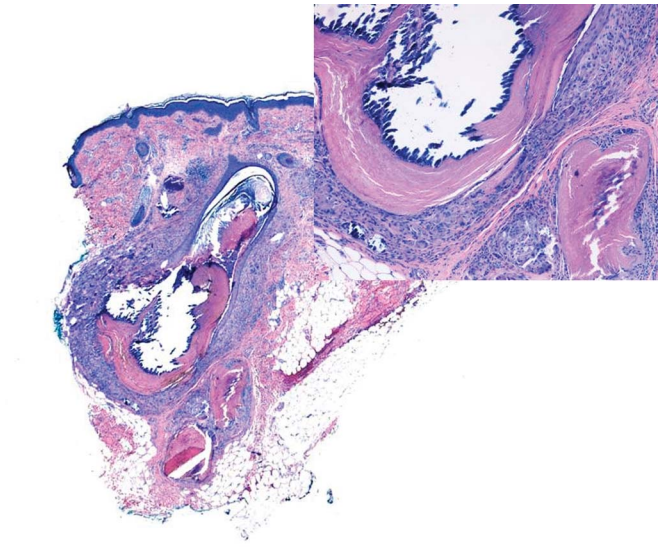

FIGURE 2. Case 27 highlights a central nodular cornified plug, and detached fragments of similar appearing compact laminated corneocytes, all of which are surrounded by a granulomatous reaction. Calcification is also seen within the center of the nodular plug.

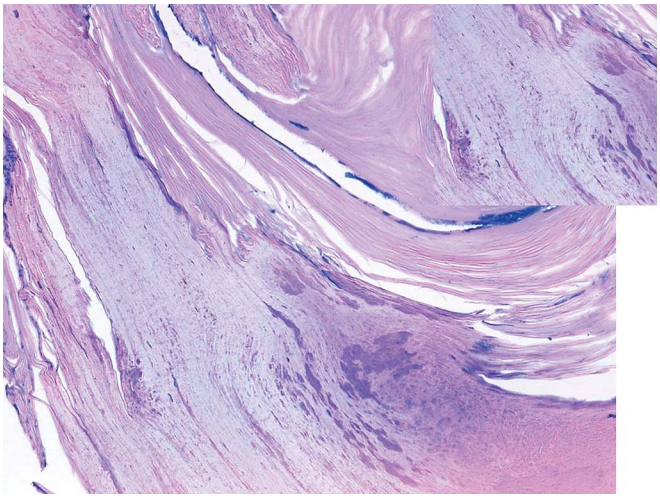

FIGURE 3. A high-power view (including the inset) of the concentrically laminated corneocytes which have entrapped melanin.

formation and differentiation that culminates in the well circumscribed, uniformly sized nodule of compact laminated corneocytes attempting (but not succeeding) to form the cortex of a hair shaft. Therefore, we do not believe that hair cortex comedo is a variant of dilated pore of Winer.

Although matrical differentiation is characteristic of pilomatricoma, it can occur in other lesions, including infundibular cysts (Gardner cysts), cutaneous mixed tumors, keratoacanthomas, and adnexal carcinomas.[5] Shadow cells, which represent cornified products of matrical cell maturation that have attempted to become hair and have failed, also are not pathognomonic of pilomatricoma and are seen in various

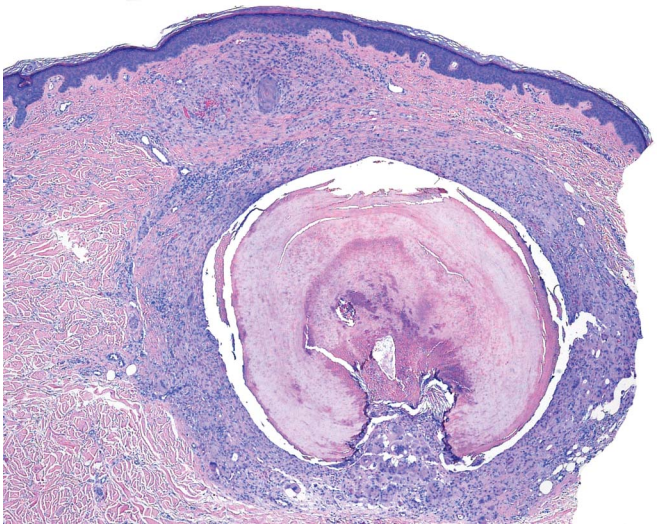

FIGURE 4. Dense granulomatous inflammation, consisting mainly of lymphocytes, macrophages, and multinucleated giant cells, surrounds the nodular plug in the majority of cases of hair cortex comedo.

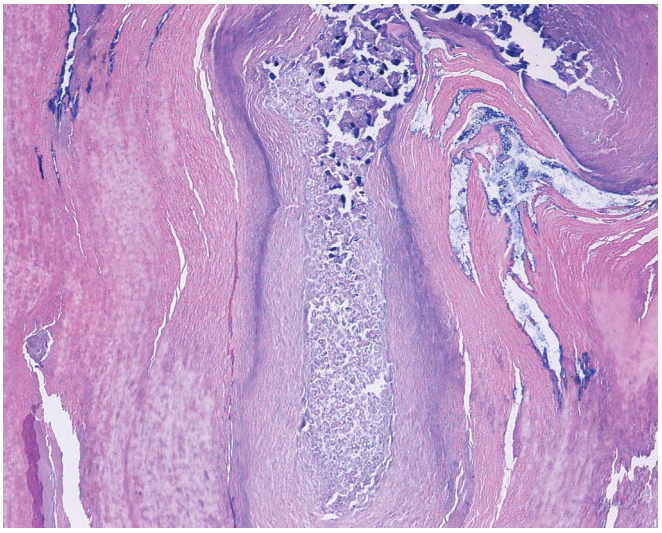

FIGURE 5. At high-power, a central collection of shadow cells within the cornified plug can be appreciated.

neoplasms unrelated to a matrical cell origin.[6] Matrical cells, shadow cells or both were identified in 17 of the 34 cases in our series and in both cases described by Toshitani et al.[2] We believe hair cortex comedo is derived fundamentally from matrical or supramatrical cells. The frequent presence of shadow cells, matrical cells, or both, is evidence of differentiation, albeit faulty, toward hair. Four of the cases included in our series had the well-circumscribed, uniformly sized nodular plug of abnormal cornification characteristic of hair cortex comedo, but also had a few scattered detached irregular fragments with similar cortex-like cornification, including 2 cases with fragments containing shadow cells, similar structurally to a pilomatricoma. In addition, we have seen cases with features characteristic of a pilomatricoma but with foci of cornification similar to the plug of hair cortex comedo. Such findings could also indicate that hair cortex comedo is a very organized, differentiated form of pilomatricoma. We have also seen fragments of faulty cornification similar to that of the hair cortex comedo in lesions other than pilomatricoma, such as basal cell carcinomas and

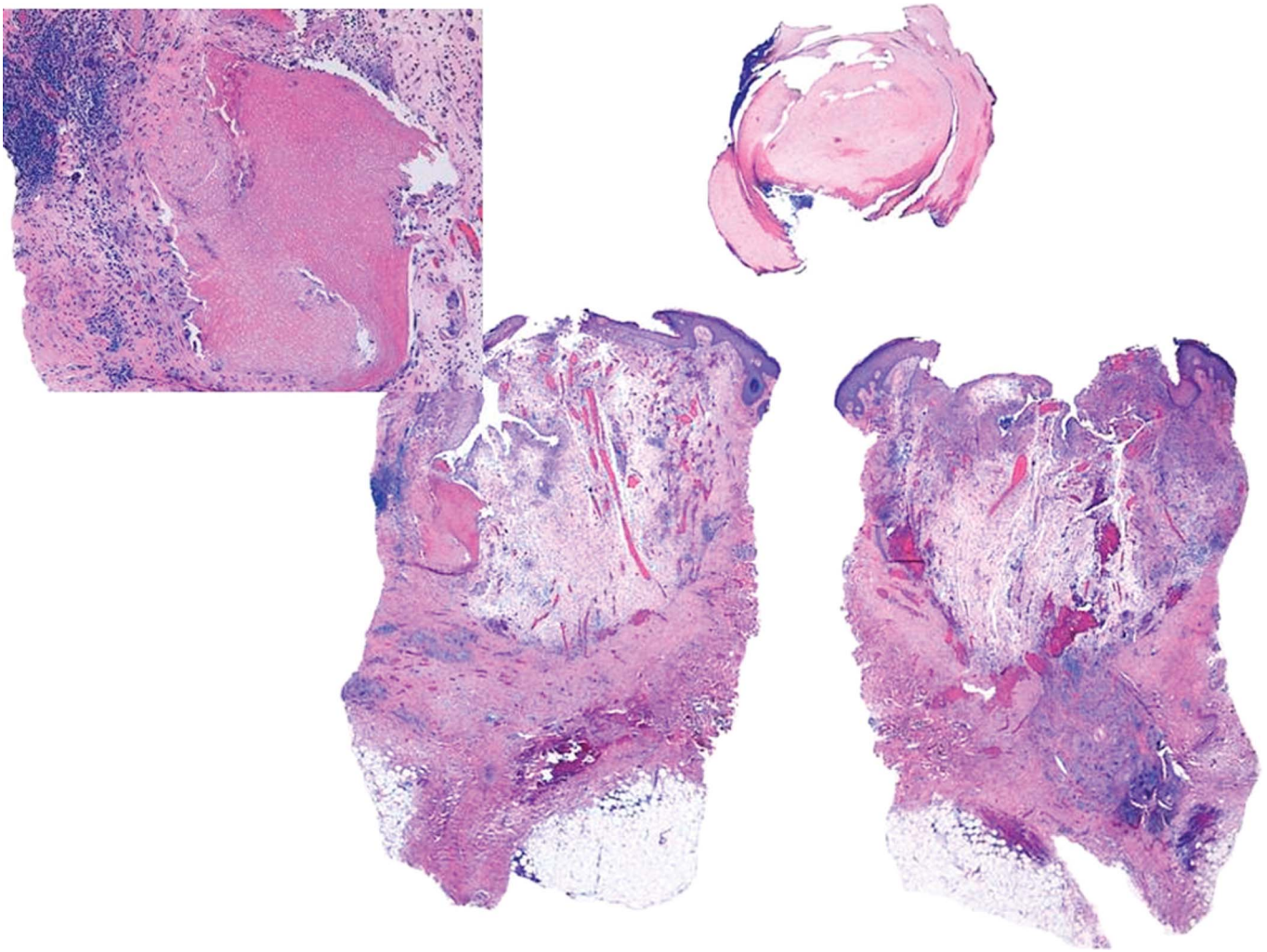

FIGURE 6. The cornified plug is located at the top of the image in case 10. There is a prominent granulomatous response in the dermis, as well as detached fragments of shadow cells (inset).

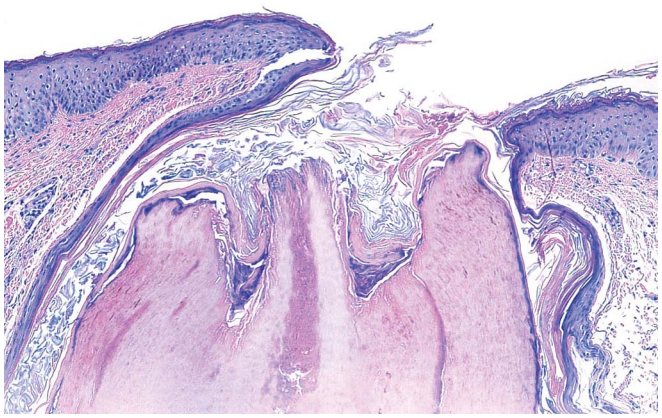

FIGURE 7. The epithelial lining in case 4 which contains a granular layer, is similar to the infundibulum, and opens to the epidermal surface.

a tricholemmal cyst. These findings underscore the probability that the faulty pattern of cornification is unique to hair cortex comedo, and suggest it is a pattern that can be seen in other follicular proliferations.

Other than the well-circumscribed, uniformly sized, vertically oriented plug of compact laminated corneocytes found in all of the cases in our series, consistent histological findings included entrapped pigment, central calcification, and a granulomatous reaction. Melanin is present often in the cortex of the hair shaft, derived from clipped off ends of matrical melanocytes. The presence of melanin amongst the laminated corneocytes supports also the matrical origin of the lesion. Calcification, ossification, or both are seen commonly in various proliferations independent of their cell of origin; we believe this is a sign of senescence and therefore is not specific for hair cortex comedo. The cornified plug resulting from

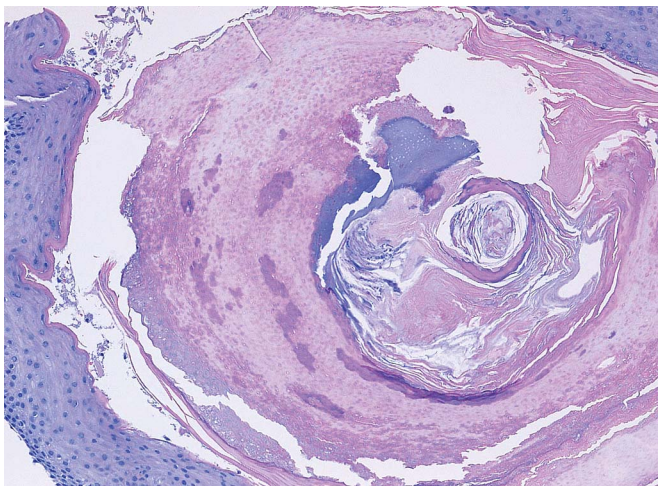

FIGURE 8. Ishmic-catagen epithelium, with the corrugated surface and absent granular layer, surrounds the nodular plug in case 33.

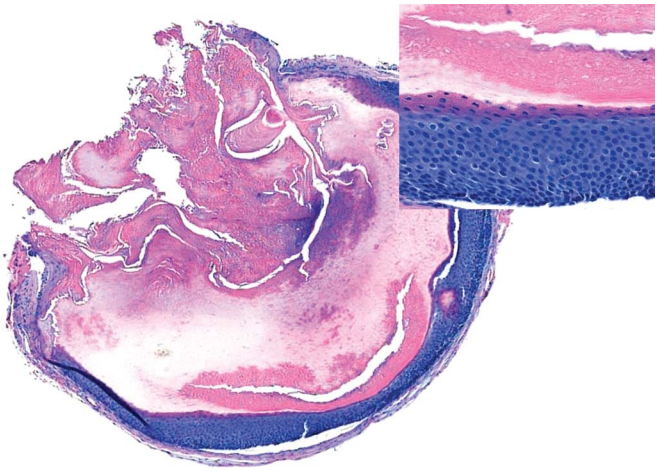

FIGURE 9. The epithelium surrounding the cornified plug in case 17 is composed of basophilic cells with a transition to compact eosinophilic cells, which is characteristic of the matrical/supramatrical portion of a hair follicle.

faulty hair shaft formation seems to incite a granulomatous response, which was present in 74% of the cases.

In sum, hair cortex comedo is a histologically distinctive lesion, probably representing an acquired malformation (in contrast with the classical congenital malformation), but conceivably could be a senescent benign neoplasm, that occurs uncommonly in children and young adults. There is a female predominance, and lesions occur most commonly on the head and neck or trunk. Histologic diagnosis can be made by recognition of a well defined, vertically oriented, uniformly sized nodular plug of compressed corneocytes with entrapped melanin similar to that of the hair cortex. Surrounding matrical/supramatrical, isthmic, or infundibular epithelium can be present, and a granulomatous reaction is seen frequently. Although the pathogenesis is not completely clear, we believe these lesions, which have an abnormal pattern of cornification similar to the cortex of a hair shaft, are derived from matrical or supramatrical cells (or both).

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