Nodular-cystic fat necrosis

A reevaluation of the so-called mobile encapsulated lipoma

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We describe five patients with distinct posttraumatic subcutaneous nodules that usually evolved for several months before diagnosis. The nodules occurred in the subcutis of the elbow or hip of women, 33 to 74 years old, and in the hip of a 16-year-old boy. Histologically the fully developed lesions were totally or nearly totally encapsulated by thin, fibrous tissue. All contained well-preserved outlines of nonnucleated adipocytes; there was no inflammation or saponification. In one patient's lestion the viable subcutaneous tissue merged into several partially encapsulated necrotic nodules. In another case a smaller nodule was found within a larger, mostly calcified nodule. Names such as *nodular-cystic fat necrosis, mobile encapsulated lipoma,* and *encapsulated necrosis* have been offered to designate the lesion. Its pathogenesis seems to be related to trauma, rapid vascular insufficiency, and subsequent fibrous capsule formation. Many previously reported patients, however, had no history of trauma. The lesion must be distinguished histologically from lipoma, angiolipoma, α_1-antitrypsin deficiency–associated panniculitis, membranous fat necrosis, and pancreatic fat necrosis. Simple excision is the treatment of choice. (J Am Acad Dermatol 1989;21:493-8.)

We report the clinical and pathologic findings of five patients with a distinct, benign subcutaneous lesion characterized histologically by encapsulated fat necrosis. Although some lesions were clinically nondescript, others could be moved freely within the subcutis. Other authors have proposed various names for this lesion, but many of these names do not precisely correlate the clinical presentation with the histologic appearance. We prefer the name *nodular-cystic fat necrosis.*[1] Our purpose is to define clearly the clinical and pathologic spectrum of findings, to review previously reported cases, to propose a theory of pathogenesis, and to review the relevant differential diagnoses.

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MATERIAL AND METHODS

Four cases were obtained prospectively after recognition of the first case. Paraffin-embedded, hematoxylin-and-eosin–stained sections were reviewed on all cases. Follow-up information was obtained by contacting the referring physicians.

RESULTS

The patients ranged in age from 16 to 74 years (mean 45 years) and had no underlying disease. Four lesions occurred in women; one lesion was found in a teenaged boy. Three patients had a history of trauma at the site of development of the lesion. One patient who denied elbow trauma was an active tennis player. The lesions had been present from 2 weeks in one patient to 1 year in three patients. One patient had multiple nodules, which ranged in size from approximately 1 to 15 mm; all were removed by excisional biopsy. Two nodules were excised from the subcutis of the patient's right elbow, two from the right hip, and one from the left hip. The clinical diagnoses were varied; keratinous cyst, adnexal tumor, foreign body reactions, lipoma, nodule, rheumatoid nodule, and calcinosis cutis were considered. At surgical excision some nodules were found within cysts and "popped" free or were easily separated from the adjacent adipose tissue.

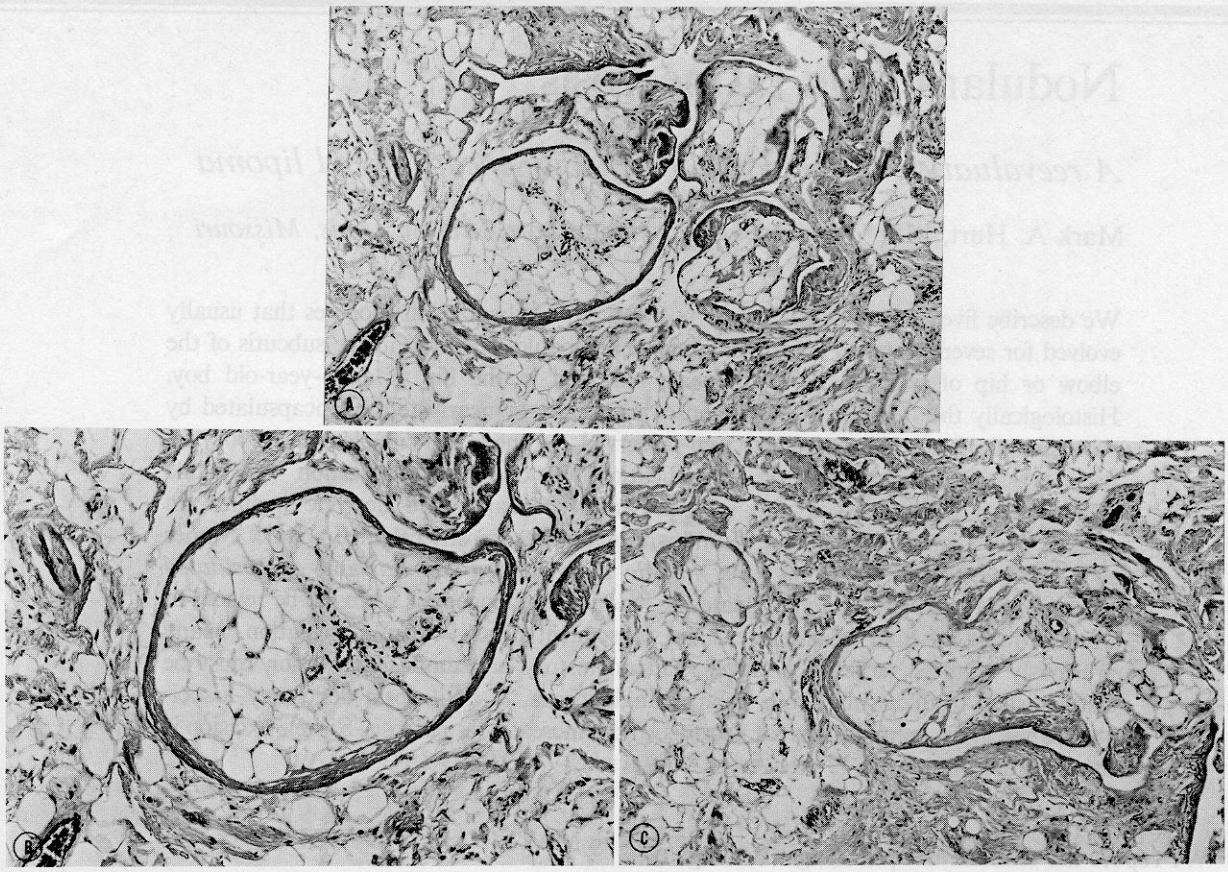

Fig. 1. A to **C,** Patient 1. Entral portions of three small encapsulated lesions show capillaries and adjacent viable adipocytes. Peripheral portions near capsule are essentially necrotic cellular "ghosts." Some areas show transition to viable adipose tissue. (×90.)

Pathologic findings

The greatest dimensions of the lesions ranged from approximately 1 to 15 mm. Four patients had solitary lesions, whereas multiple small lesions were found in one patient. They were pale yellow, smooth, and translucent. Cross sections were yellow and focally showed cystic changes.

Histologically, all lesions were completely or almost completely encapsulated with a sharp cleavage plane from the surrounding viable tissue. A tissue specimen from patient 1 showed multiple lesions with gradual transition from viable to nonviable tissue (Fig. 1). These multiple small lesions exhibited variable amounts of fat necrosis at the periphery, adjacent to the capsule. Centrally a capillary vascular supply was found, and immediately adjacent adipocytes were viable. In patients 2, 3, and 4 the similar findings of complete encapsulation of the lesion were seen (Figs. 2 and 3). In these lesions, however, no viable tissue was found within the center of the lesion, except focally in patient 4. Instead, well-maintained outlines or "ghosts" of the adipose tissue cells were noted. The lesion from patient 4 (Fig. 3, *A*) also showed several intervening fibrous septae. A considerable portion of patient 5's lesion was calcified. Within this lesion a circumscribed, encapsulated focus showed fat necrosis and fibrosis (Fig. 3, *B*).

DISCUSSION

The examples described herein illustrate what we believe is a spectrum of changes we term nodular-cystic fat necrosis, consistent with the findings of Przyjemski and Schuster.[1] The tissue from patient 1 represents the earliest recognizable lesion, specimens from patients 2, 3, and 4 represent the fully formed lesion, and tissue from patient 5 represents the end-stage lesion. We believe that early lesions begin as multiple, single, or partial lobules of adipose tissue that, because of rapidly

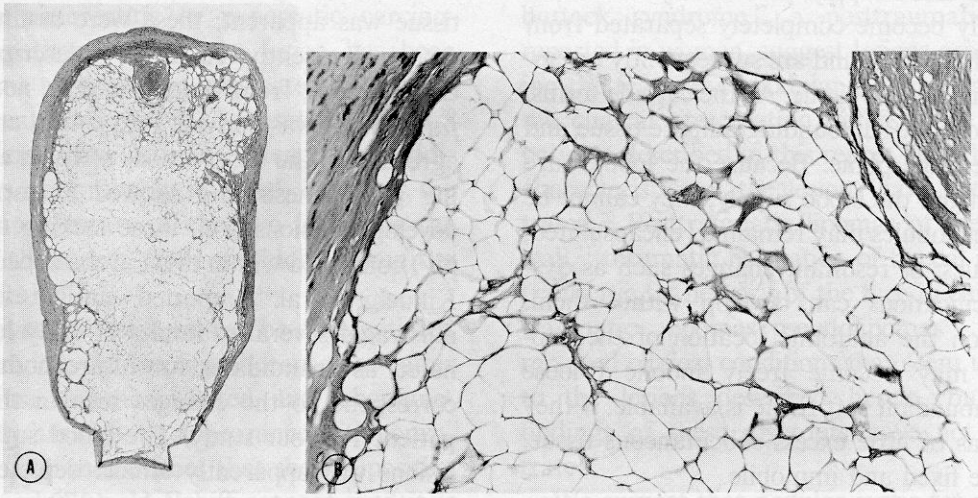

Fig. 2. Patient 2. **A,** Clinically mobile lesion in subcutis is completely encapsulated. (×18.) **B,** A few viable fibroblasts are seen in capsule; internal portion of lesion reveals only outlines of necrotic adipocytes. (×150.)

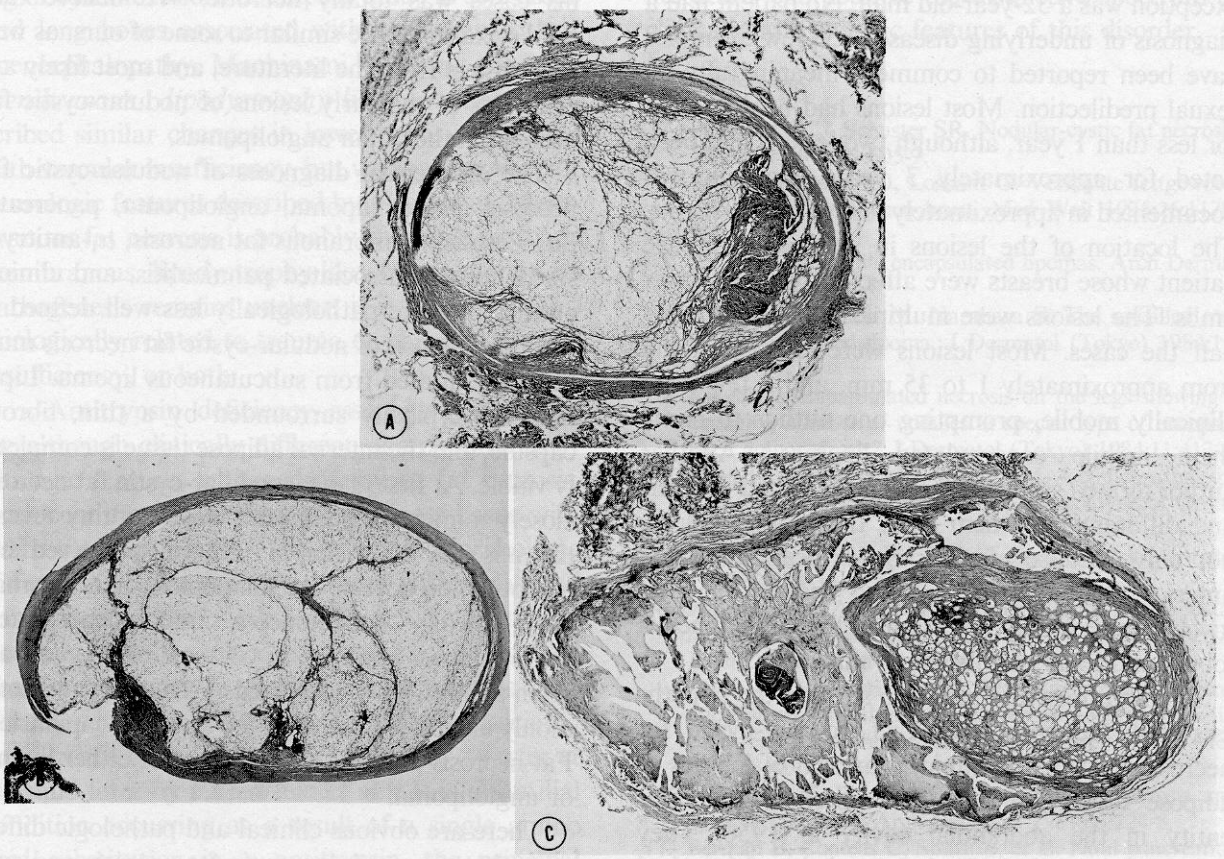

Fig. 3. Patient 4. **A,** Nonmobile lesion is almost entirely necrotic but shows a few areas containing nuclei. Fibrous septa course throughout lesion, suggesting incorporation of multiple lobules into one lesion. **B,** Patient 5. Lesion is clinically nonmobile and shows extensive dystrophic calcification. We suspect that this represents an end-stage lesion. Fenestrated areas of fat necrosis and fibrosis are seen within smaller circumscribed area. (**A,** ×12; **B,** ×32.)

compromised blood supply, presumably from trauma, gradually become completely separated from the surrounding tissue and are subsequently encapsulated by thin fibrous tissue. As the capsule forms, it retracts from the surrounding adipose tissue and creates a cleavage plane. Because the lobules are sequestered from the blood supply, they cannot be resorbed. The lobules may remain as encapsulated, necrotic tissues, or resultant changes such as dystrophic calcifications can develop within them. Depending on the anatomic location of the capsules, they may become freely mobile ("loose bodies") if abundant soft tissue is available; if they form in areas of little excess subcutaneous tissue, they become fixed and immobile.

Review of the literature also sheds light on the subject, and at least 10 cases with a similar spectrum of changes have been reported.[1-5] The lesions usually occurred in two distinct populations: adolescent boys and middle-aged women. An exception was a 32-year-old man. No patient had a diagnosis of underlying disease. Too few examples have been reported to comment meaningfully on sexual predilection. Most lesions had been present for less than 1 year, although two lesions had been noted for approximately 3 years. Trauma was documented in approximately one third of patients. The location of the lesions in all (except in one patient whose breasts were affected) was the lower limbs. The lesions were multiple in approximately half the cases. Most lesions were small, ranging from approximately 1 to 35 mm, and a few were clinically mobile, prompting one author to name them mobile encapsulated lipomas.[3] Another author termed similar lesions encapsulated necrosis and differentiated them from the mobile lesions, not only because of their fixed location on the anterior tibial regions, but also because of their involvement of only a portion of the subcutaneous lobule and focal membranous changes.[5]

The literature also seems to support the hypothesis that the pathogenesis of nodular-cystic fat necrosis is related to rapid infarction of lobules of adipose tissue. Lynn et al.[6] described a similar entity in the abdominal cavity in 1956. They discussed the pathologic characteristics of detached asymptomatic epiploic appendages, which they called "loose bodies," found floating freely within the abdominal cavity. In many cases the histologic changes involved cysts or solid nodules with fat necrosis, calcification, or both. Some specimens were described in which the preservation of the tissue was apparent; these were assumed to have detached recently. In a 1977 description of soft tissue lesions, from which the term *nodular-cystic fat necrosis* was derived, Przyjemski and Schuster[1] agreed with the observations of Lynn et al. regarding pathogenesis and showed examples of fully developed lesions (i.e., those lacking a blood supply) contained within cysts in the subcutis. In 1984 Kikuchi et al.[14] reported similar findings and illustrated several examples of early lesions designated as "candidates for future nodules," which correspond to the changes seen in the lesions of patient 1 in our study. The blood supply to these lesions was apparently almost depleted. Sahl[3] related the cases he reported in 1978 to angiolipomas because, according to his descriptions, capillaries and eosinophilic thrombi were found within the lesions. It is somewhat unclear from his report and photographs whether or not the adipose tissue in his cases was totally necrotic. We believe that Sahl's examples are similar to some of ours, as well as to others from the literature, and most likely are examples of the early lesions of nodular-cystic fat necrosis rather than angiolipomas.

The differential diagnoses of nodular-cystic fat necrosis include lipoma, angiolipoma, pancreatic fat necrosis, membranous fat necrosis, α_1-antitrypsin deficiency–associated panniculitis, and clinical entities that are pathologically less well defined.

The diagnosis of nodular-cystic fat necrosis must be differentiated from subcutaneous lipoma. Lipomas are typically surrounded by a thin, fibrous capsule, and the internal adipose tissue is completely viable. At first glance, nodular-cystic fat necrosis closely mimics a lipoma, but close scrutiny reveals the absence of nuclei in the well-preserved but necrotic adipocytes. Angiolipomas, like lipomas, are typically subcutaneous and encapsulated; angiolipomas, however, in contrast to lipomas, are often painful, show increased vascularity, and commonly exhibit microthrombi within the capillaries.[7] Fat necrosis per se is not a feature of either lipoma or angiolipoma.

There are obvious clinical and pathologic differences between nodular-cystic fat necrosis and subcutaneous pancreatic fat necrosis. Although pancreatic fat necrosis may show preserved andipocyte outlines, in addition to the underlying disease process, it is classically an inflammatory lesion with reactive foamy histiocytes and saponification. The

typical patient showing this type of fat necrosis has either acute pancreatitis or pancreatic carcinoma.[8,9] The pathogenesis of the lesion has been debated. Some authors have implicated circulating pancreatic enzymes as the causative factor,[10] whereas others[11] have offered evidence that additional factors are probably involved. Probably the most confusing feature of the two lesions is the similarity of the names, both of which contain the term *fat necrosis.*

Nodular-cystic fat necrosis can be differentiated from membranous fat necrosis because the latter entity is diffuse, nonencapsulated, and subcutaneous. It usually has a cystic appearance with convoluted or crenated membranes that show a positive reaction to periodic acid–Schiff reagent, and it is associated with foamy histiocytes and a few giant cells.[12] Membranous changes of adipose tissue were recognized by Nasu et al.[13] in 1973 under the term *membranous lipodystrophy,* a rare disease involving of cystlike lesions of adipose tissue in soft tissue and long bones associated with sudanophilic leukoencephalopathy. Machinami,[14,15] using the term *membranous lipodystrophy-like changes,* described similar changes in lower limbs of patients with vascular insufficiency, but without the bone or neurologic features described by Nasu et al. Membranous fat necrosis is probably the same entity as membranous lipodystrophy-like changes, but its pathogenesis remains unclear; it is possibly multietiologically related to trauma or chronic vascular insufficiency, or both.

α_1-Antitrypsin deficiency–associated panniculitis, although clinically different, shares some morphologic features with nodular-cystic fat necrosis. Both conditions show lobules of adipose tissue with sharp cleavage planes. The principal morphologic difference between the two lesions is the profound nonvasculitic neutrophilic infiltrate of α_1-antitrypsin deficiency–associated panniculitis. The unusual dermal collagenolysis and lobular panniculitis associated with α_1-antitrypsin deficiency–associated panniculitis were initially recognized by Warter et al.[16] and later by Rubinstein et al.[17] It is a familial condition occurring as a result of a single amino acid substitution in α_1-antitrypsin, the principal serum protease inhibitor. Both phenotypic homozygotes and heterozygotes can be affected.[18] The lesion can occur in children or adults; it frequently develops after trauma and may predate other lesions of the syndrome.[19]

A few clinical syndromes, such as the "battered buttock syndrome," a posttraumatic condition reported in women, suggest lesions grossly displaying the features of nodular-cystic fat necrosis, but the clinical presentation differs from that of the patients described in this report, and the histologic characteristics of the lesions have not been illustrated.[20] Posttraumatic lipomas of the abdominal wall,[21] traumatic herniation of buccal pad of fat,[22] traumatic fat necrosis of the face in children,[23] and traumatic lipomas/pseudolipomas[24] are other reported clinical conditions that seem to be similar to the lesions described herein, but histologic findings of these disorders have not been illustrated.

We suspect that nodular-cystic fat necrosis is a relatively common lesion that is often either diagnosed only descriptively or confused with other lesions, mainly lipomas. We believe the examples we have presented, as well as those from the literature, characterize the distinctive spectrum of clinical and histologic features of this disorder.

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NODULAR-CYSTIC FAT NECROSIS

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