SYNOVIOMA (SYNOVIALOMA) OF THE FOOT

REPORT OF A CASE

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The unique clinical and pathological features of synovial tumors were first recognized by Lejars and Rubens-Duval in 1910 (1). Smith, in 1927 (2), reported three cases and introduced the term synovioma. Within recent years reviews with additional case reports have been contributed by Sabrazès et al (3–5), Geschickter and Lewis (6), Zwahlen (7), Knox (8), Coley and Pierson (9), Fehr (10), and Berger (11). Comprehensive references are given by these authors. Berger finds the terms synovialoma most appropriate for the benign, and synovialosarcoma for the malignant tumors. He proposes a classification based upon histologic relationship to the tissue of origin.

Nearly all of the recorded examples of synovioma have proved to be malignant, with a strong tendency to recur, sometimes after a long interval. Pulmonary metastasis is prone to occur terminally. The outcome in any given instance is determined in part by the inherent growth capacity of the tumor cells, and in part by adventitious factors such as location and surgical accessibility. Articular and tendon sheath tumors are not likely to be fully encapsulated and therefore cannot be completely removed by conservative surgical procedures, so that recurrence is common, often with augmented growth rate and metastasis. Sabrazès has emphasized the necessity for the early use of radical surgical measures in tumors of this type. Synovial tumors of bursae might be expected to remain encapsulated within the fibrous tissue layer for some time, being thus more amenable to conservative surgical treatment. No support, however, is to be found for such an assumption in the reported cases.

Very few synoviomas of bursae, omitting tumors of other types, such as xanthomas, giant-cell tumors, osteochondromas and myxomas, have been recorded, and of these several are inadequately described. Ranke (12), in 1886, published an account of two bursal tumors, the second of which may have been a true synovioma. It occurred in a twenty-year-old man, in the left bursa extensorum, and was of one year’s duration. It was treated by excision but subsequently recurred. Extirpation of the recurrent tumor was followed by healing. This tumor measured 7 × 5 cm. and is described histologically as being composed of large round, ovoid, or spindle-shaped cells with huge nuclei and delicate intercellular substance, in some regions mucinous. The tumor was rich in blood vessels, many being merely endothelial lined tubes. It contained many fresh and old hemorrhages. Its significance lies in its content of mucin and in the pleomorphism of the cells, both features suggesting a synovial derivation.

Adrian (13) collected from the literature, up to 1903, reports of 17 bursal tumors and added 2 more. Of these, 3 may have been synoviomas. The first
was reported by Dollinger (14) in 1878. A white woman of fifty-eight years had a hazelnut-sized tumor of the prepatellar bursa present for ten years, which finally reached the size of a hen's egg, burst, discharged serous fluid, and continued to grow from the point of rupture. Dollinger thought that the tumor was a papilloma.

The second case in Adrian's series is especially remarkable. It was reported by Duret (15) in 1899. A girl of seventeen had bilaterally symmetrical subtricipital and trochanteric bursal tumors and a unilateral subdeltoid bursal tumor. One of the elbow tumors developed four or five months after an injury to the elbow. The others appeared in the course of the next five years. The patient's brother, aged sixteen, had a similar growth. The tumors were spongy, with cavities containing viscous or mucoid, yellow or brown fluid resembling pus. They were thought by Cornil to be endotheliomas. The outcome in this case and in that of Dollinger is not stated.

The third case in Adrian's series is that of an eight-year-old boy with a tumor on the plantar surface of the foot. It probably arose from the bursa of Lewis and according to Milian and Morestin (16), the authors, was possibly of tuberculous origin.

Schwamm (17), in 1930, published the case of a thirteen-year-old girl who complained of a feeling of cold, with tenderness and progressive limitation of motion of the right shoulder. After five years, during which time she was treated for rheumatism and for articular tuberculosis, a tumor appeared. Atrophy of the shoulder was apparent. X-ray examination revealed decalcification of the head of the humerus, with flattening and subluxation. Between it and the acromion an ovoid shadow was visible. Disarticulation for a malignant tumor was proposed, but was not performed. At operation it was possible to remove a bursa the size of an egg, which was firmly adherent beneath the apex of the acromion. In removal, the sac was torn at this point. It was smooth and contained in a gray-white, soft, moist lobular tissue.

Schwamm's tumor was studied histologically by Maresch, who describes it as having a fibrous capsule containing groups of lymphocytes, with septal extensions throughout the tumor, from which there was proliferation of fusiform cells, in places cuboidal or cylindrical with numerous mitoses, forming irregular papillae. Invasion of blood vessels was not evident. The cells enclosed irregularly sized spaces resembling synovial spaces, filled with a finely granular or thready coagulum, staining with eosin, but more deeply with hematoxylin. From the histology of the tumor and its site, Maresch believed it to be a neoplasm, with both the synovial lining and fibrous tissue participating in its formation.

Schwamm did not reach a definite conclusion about the nature and genesis of this process. The patient was well four months after operation. As the whole course of the case corresponded to that of chronic bursitis he favored the diagnosis of bursitis papillomatosa.

From Maresch's study it seems very probable that this is a synovial tumor, and confirmation is supplied by Fehr (10), who reports that after two operations for recurrence, and in spite of radium treatment, the patient died two years later with lung metastasis. Examination of the slides by Zwahlen left no doubt that the tumor was a synovioma.
Bonne and Collet (18) report a case of synovioma in a twenty-five-year-old Javanese woman. As a translation of the original paper was not available the following abstract (from Am. J. Cancer) is quoted. “The tumor arose from a bursa on the outer side of the left knee and was 20 cm. in diameter, having attained this size in ten months. Grossly it consisted of solid and cystic areas, the cysts being filled with a gelatinous substance after formalin fixation. Microscopically there were both sarcomatous and pseudo-epithelial elements, the latter lining the cysts and clefts. In both types of cells localized areas of fatty and myxomatous degeneration were seen. There were many mitoses and necrotic areas. The patient showed no signs of metastasis.” As the case had been followed only three months, the outcome was unknown.

Black (19) reported a case of synovioma removed from the hand of a thirty-six-year-old man. The tumor developed in the web of the thumb at the site of a crushing injury. It was painless, and grew to a diameter of 2.5 cm. in three years. It was encapsulated, with solid gray-white cut surfaces which exuded clear mucoid fluid after formalin fixation. Microscopic examination showed a thick fibrous capsule with coarse trabeculae having finer divisions which branched within the tumor, supporting groups of concentrically arranged fusiform or irregularly polyhedral cells. These cells lined the septa in multiple layers. There was a large quantity of intercellular, thready, basophilic, mucoid substance, in which many cells lay free. In these there was often an accumulation of hyalin acidophilic material. Differential stains for mucin were of no value in identification of this intracellular material.

This tumor is considered to be a benign synovioma in which the dual potentialities of synovial tissue, i.e. mucin production and synovial membrane formation, are retained by the tumor cells. It is thought to have originated from a tendon sheath or bursa, following injury. Recent inquiry reveals that the patient is well, with no sign of recurrence, four years after operation.

Berger reports 5 cases of synovialosarcoma, in the first 3 of which the tumors originated in serous bursae. In his first and second cases the tumor was shown to be in continuity with synovial membrane, thus furnishing conclusive proof of its origin. In the third case a bursal origin is probable, though the tumor may have arisen from a tendon sheath.

All three of Berger’s patients were males between twenty-six and thirty-eight years of age. The tumors were histologically similar to one another, and each recurred within a few months. Two led to death within two years after onset, probably from pulmonary metastasis. In the third case the prognosis was regarded as poor.

The tumors consisted of dense cellular masses giving rise to pseudo-glandular cavities lined by cells which are described as “flat, cuboidal or approximately columnar, resting directly on elements of sarcomatous aspect.” There was an argyrophil reticulum of fine fibrils, in some places surrounding individual cells. The aspect of the cell masses suggests histiocytoma, and some of the cells contained lipoid or hemosiderin inclusions.

Some spaces contained mucin, which appeared to be extracellular in origin. The proportions of cellular forms varied between the tumors and in various portions of the same tumor. The amount of mucin present was also variable; in one case it was entirely lacking.
In Berger's fourth case, that of a woman seventy-five years of age, the tumor was of tendon sheath origin, grew much more slowly and, although the cellular structure did not closely resemble that of the others, it contained large quantities of mucin. In a fifth case the tumor arose from a subfascial serous bursa, and is believed to represent a hitherto undescribed type of xanthomatosus giant-cell tumor, which is truly malignant.

The purpose of the present report is to describe a synovial tumor of the foot, similar in many respects to the foregoing cases, but in addition containing chondroblastic elements. The author is indebted to Dr. G. M. Frumess for permission to report this case, and for the history.

A white woman, aged thirty-eight, complained of a growth on the sole of the left foot, of two years' duration. The lesion started between the bases of the fourth and fifth toes, on the plantar surface. It began as a painless lump under the skin, and was the size of a small pea when first noticed. It had grown slowly to a diameter of 2.0 cm. at the time of removal. It had remained painless, although when walking the patient was conscious of a sensation of pressure at the site. The skin over the lesion was not discolored or retracted, and was freely movable over the tumor, which in turn was not fixed to the deeper tissues. The growth did not fluctuate on pressure, but was soft and compressible, having the consistency of sponge rubber.

The tumor was excised under local infiltration anesthesia. "The tumor shelled out with gauze dissection, being very well encapsulated and not attached, as far as could be seen, by any structures to surrounding tissues or to the skin. Healing by primary union was complete in two weeks. No lymph nodes were palpable in the popliteal or inguinal areas either before or after operation. Roentgenological examination of the thorax performed nine days after operation revealed no evidence of pulmonary metastases."

Description of the Tumor: The bisected specimen consists of a flattened hemisphere of firm gray-white tissue 2 cm. in diameter and 0.8 cm. in thickness, with a tightly adherent,
thin fibrous capsule. The tissue appears to have bulged outward when previously cut. Freshly cut surfaces are solid, gray with faint yellow and brownish mottling, and do not bulge.

Microscopically the tumor is made up of coarse hyalinized fibrous septa which are continuous with fibrous strands forming the capsule. The septa enclose solid masses of plump, spindle-shaped or polyhedral, moderately basophilic cells with large reticular nuclei, in which a single nucleolus is often prominent. These cells are quite uniform in size and staining properties. Mitotic figures are rare. The cells are arranged in sheets, with a tendency to form concentric layers, or to line narrow irregularly shaped spaces following the course of fibrous septa (Fig. 1). In some areas the cells lie in contact with one another, while in others they are separated individually or in groups by a deposit of blue-staining mucinous substance in the form of thin strands or fine granules (Fig. 2). In several loca-

![Image](image-url)

**Fig. 2. Section showing relationship of mucinous to cartilaginous matrix with a space containing mucin and free tumor cells (lower left).** × 150

...tions there are large sheets of this material containing small circular or oval cavities within which lie tumor cells, singly or in small groups. In such zones a resemblance to cartilage is apparent, as indicated by the occasional presence of paired cells within the cavities, and more frequently by pairing of the spaces (Fig. 3). The matrix varies from a mucinous fibrillary substance to an eosinophilic hyalin material, showing bands of differential staining with marginal refractile zones and faint striations at the borders of the cell spaces.

The mucinous substance stains metachromatically with thionin by Hoyer's method, taking on a purplish color which fades on exposure to light, in the course of several days. It also stains differentially, but faintly, with Mayer's mucicarmine stain. With Van Gieson's stain for collagen the fibrous strands of the septa and capsule stain red and delicate red staining fibrils appear to merge with the intercellular mucinous substance. The Foot modification of Bielschowsky's reticulum stain demonstrates a coarse reticulum which branches from the septa to form a more delicate network, which in some locations can be seen to separate the individual tumor cells.

Rather numerous thick-walled arteries, arterioles, and lymphatic channels are present in the capsule. An infiltrate of lymphoid cells is irregularly distributed throughout the
stroma (Fig. 4). Kling, who has studied sections of this tumor, believes that these cells are primitive marrow elements associated with osteoid matrix. This belief is logical in view of the evident multipotentiality of the tissue of origin. There are scattered small hemorrhagic zones, with scanty deposits of hemosiderin in the form of brown granules, most of which lie within the cytoplasm of mononuclear cells which cannot be distinguished from neighboring tumor cells. In several small areas the tumor cells are exceptionally large, with pale, finely granular cytoplasm suggesting xanthoma cells.

Although only one year has elapsed since operation, it seems unlikely from both clinical and histological evidence that there will be recurrence. The tumor is therefore considered to be benign.

**DISCUSSION**

The tumor described above has distinctive histologic features which strongly resemble those of synovial membrane. Its cells are thought to be of mesenchymal origin but tend to form layers and to line spaces within a fibrous stroma.

A mucinous substance is produced within the tumor which in part assumes the character of cartilage, but is also intimately related to argentophil fibrils which merge with the collagenous septa and capsule.

It seems evident that the tumor is formed by cells of common origin, having multiple developmental potentialities related to the formation of cartilage, mucin, and collagen. The tumor does not resemble a chondroma or osteochondroma nor does it appear to be teratogenous.

A similarity to salivary gland mixed tumors is suggested by the presence in the tumor of mucinous and cartilaginous substances. Some relationship may actually exist, but epithelial elements and myxomatous tissue of the type found in mixed tumors are not present.
An analogy has been drawn by Key (20) on histological grounds, and by Vaubel (21) on the basis of synovial tissue culture, between the formation of cartilage matrix and synovial mucin. Vaubel's work, however, indicates that synovioblasts are specifically differentiated autonomous cells. Kling (22) believes that the normal synovial lining cells differentiate from mesenchyme and are multipotential, and that the mucoid substance in synovial fluid is elaborated by these cells. Using a modified Metzner toluidine blue stain, he has found metachromatic intracytoplasmic granules in synovial cells. Cherry and Ghormley (23), from a study of 168 excised specimens of human tissue, believe that synovial mucin is a product of cellular disintegration and not a true secretion.

Berger's study (11), based on five synovial tumors and a review of reported cases, indicates that synovial membrane has reticulo-endothelio-histiocytic properties, a view first advanced by Franceschini (24). Superficial cells have endothelial potentialities and can form a continuous lining membrane. Synovial mucin is thought to be analogous to precartilaginous or preosseous matrix.

The findings in this case favor this belief but offer no evidence as to the site of mucin formation. No new evidence concerning the reticulo-endothelial character of synovial membrane is obtained, although certain of the cells appear xanthomatous.

The presence of osteoid and primitive marrow cells may be considered either as the result of differentiation from common ancestral cells, or from associated but independent mesenchyme. The close relationship between the
mucinous and cartilaginous matrix and the tumor cells indicates a common origin for these substances.

Although the great majority of synovial tumors so far reported have proved to be malignant, a relatively benign type of bursal synovioma is believed to exist, as illustrated by this case and the one previously reported by the author (19). It is possible that these tumors might ultimately have become malignant, if they had not been removed surgically. Both, however, grew slowly and remained encapsulated for long periods of time (two and three years, respectively) prior to operation.

**Conclusion**

A synovial tumor of the foot is described. It is thought to be benign and of bursal origin. The tumor cells exhibit divergent capacities for differentiation and are associated with a mucinous and cartilaginous matrix. The literature relative to synovial tumors of bursae is reviewed.

**References**