Case Reports

Primary Sternal Osteomyelitis

EDWARD A. GILL, Jr, MD
DENNIS L. STEVENS, MD, PhD
Boise, Idaho

STERNAL OSTEOMYELITIS has become more common in the past two decades largely related to the increased frequency of coronary artery bypass grafting and intravenous drug abuse. Sternal osteomyelitis as a complication of sternotomy is referred to as secondary sternal osteomyelitis; primary sternal osteomyelitis has no contiguous focus of infection. Contemporary cases of primary sternal osteomyelitis occur most commonly in intravenous drug abusers.[1] Primary sternal osteomyelitis remains a rarity with only 55 cases reported in the literature.[2] We report two cases of primary sternal osteomyelitis in patients with no apparent risk factors.

Report of Cases

Case 1

The patient, a 72-year-old man with non-insulin-dependent diabetes mellitus, was admitted for evaluation of an enlarging anterior chest wall mass. The patient had noted fullness in the left chest wall for a year before admission. Three weeks before admission, he had had sharp anterior chest pain that was precipitated when he arose from a sitting position or coughed. He also noted night sweats and dampness over the sternum. He said he did not have hemoptysis, dyspnea, dysphagia, anorexia, fevers, chills, or weight loss. He had not recently had an operation or trauma to the chest but did recall that a splinter of wood had lodged in the area near the lesion ten years previously.

On physical examination, the patient was afebrile but had a large—12 by 8 cm—wedge-shaped, erythematous, indurated mass over the anterior chest wall that protruded to the left of the midline. A chest roentgenogram revealed an osteolytic lesion of the sternum (Figure 1). On computed tomography there was destruction of the manubrium and adjacent ribs with soft tissue swelling extending into the anterior mediastinum (Figure 2). The results of laboratory tests included a leukocyte count of 12.4×10^9 per liter (12,400 per μl) and an erythrocyte sedimentation rate of 120 mm per hour.

An incisional biopsy of the sternum was done and a histopathologic examination showed chronic inflammation. Culture of the biopsy grew *Staphylococcus aureus* sensitive to vancomycin hydrochloride, oxacillin sodium, and cephalothin sodium. A regimen of nafcillin sodium, 8 to 10 grams per day given intravenously, was initiated but stopped after 14 days due to a skin rash. The suspicion for carcinoma or sarcoma was high, and because the initial biopsy did not show malignancy, a second biopsy was done. Further local debridement was done at the time of biopsy, but no costal cartilages were removed. The biopsy specimen again did not show a neoplasm. A Penrose drain was placed, but the wound was closed with mattress sutures. A Hickman catheter was placed, and intravenous cefazolin sodium was administered at home for a period of three months. The erythrocyte sedimentation rate dropped to 15 mm per hour after four months, and a repeat computed tomography examination eight months later revealed a decrease in the size of the chest mass (Figure 2). Currently, two years later, the patient remains asymptomatic.

Case 2

Our second patient, a 59-year-old man with peripheral vascular disease, had been placed on sodium warfarin therapy following a femoral-to-popliteal artery bypass operation. In mid-November 1983, he had chest wall pain that had developed during a hospital admission for a right lower lobe pneumonia. The patient was treated as an outpatient with ibuprofen and acetaminophen given for presumed costochondritis. A month later, itching and redness developed over the sternal area directly beneath a nickel-plated necklace recently given to him to monitor the warfarin therapy. An erythematous skin rash was noted in the sternal area, and radiographs revealed the persistence of congenital ossified centers of the sternum (Figure 3). In January of 1984, an area of fluctuance was noted beneath the erythema, and a percutaneous aspirate from this area grew *S aureus.* Tomograms were suggestive of an osteolytic lesion (Figure 4). Surgical exploration was done for the purpose of biopsy, culture, and debridement. Under general anesthesia, the body of the sternum underwent curettement, leaving the posterior plate intact. The wound was then packed with iodoform gauze. Three months later the patient was noted to have a sinus tract at the site of the old surgical scar, and this was explored under general anesthesia. The sternum again was curetted and packed with iodoform gauze. Because of allergic reactions to multiple antibiotics, the patient received several different drug regimens including neomycin, nafcillin, and cephapirin sodium over a period of six weeks. An eight-week course of erythromycin followed the parenteral use of antibiotics. *Staphylococcus aureus* was grown from the biopsy specimens of both surgical procedures. Four years later the patient remains infection free.

Discussion

Primary sternal osteomyelitis, once a rare disorder, has become more common today with the increased prevalence of intravenous drug abuse. The most common bacterial cause of primary sternal osteomyelitis in intravenous drug abusers is *Pseudomonas aeruginosa,* although the most common overall is *S aureus.*[2-4] *S aureus* is also the most common pathogen in secondary sternal osteomyelitis. It is interesting that *Mycobacterium tuberculosis* has become a rare cause of sternal osteomyelitis since 1952.[5]

Vaughn's review of sternal osteomyelitis in 1918 indicated that only 13 cases had been reported before 1910,[6] and all were in the German literature.[7] Wilensky and Samuels (1926) reported 24 cases of primary sternal osteomyelitis,[8] but because several of the cases described were characterized by generalized sepsis, we have excluded these in our listing

(Gill EA Jr, Stevens DL: Primary sternal osteomyelitis. West J Med 1989 Aug; 151:199-203)

From the Departments of Medicine, Veterans Administration Medical Center (Drs Gill and Stevens), Boise, Idaho, and University of Washington School of Medicine (Dr Stevens), Seattle.

Reprint requests to Dennis L. Stevens, MD, PhD, Department of Medicine, VA Medical Center, Boise, ID 83702.

of the total number of cases with primary sternal osteomyelitis (Table 1).[1-13] In their series, the mortality rate was 27%, which is higher than in any other series.[8] Many of their patients died of septic shock. Since the 1926 review, an additional 30 cases have been reported in international medical journals, bringing the total to 55 cases.

Table 2 compares cases of primary and secondary osteomyelitis both in terms of treatment and complications. Note that secondary sternal osteomyelitis was not described in the preantibiotic era. Since the introduction of the coronary artery bypass procedure, however, secondary osteomyelitis has become a well-known complication. Culliford and coworkers defined predisposing risk factors for poststernotomy osteomyelitis[15]: a prolonged perfusion time, excessive postoperative bleeding, a depressed cardiac output, and reexploration for the control of hemorrhage. In addition, internal mammary artery bypass grafts have increased the risk of sternotomy infection as compared with vein grafts. In fact, the overall infection rate of 1.5% climbed to 2.3% with the use of one internal mammary artery bypass and to 8.5% with bilateral internal mammary artery grafts.

Primary sternal osteomyelitis presents with anterior sternal pain, redness, tenderness, and swelling. When evaluating a case of chest wall pain or a mass in the sternal area, it is most important to consider sternal osteomyelitis in the differential diagnosis. Delayed diagnosis and inappropriate treatment are common in this illness. The differential diagnosis of primary sternal osteomyelitis is broad and should include cellulitis, soft tissue abscess, benign soft tissue tumors, and soft tissue or bony sarcoma. Fibrosarcoma is the most common soft tissue sarcoma. Bone sarcomas are rare, the most common being osteosarcoma and Ewing's sarcoma,

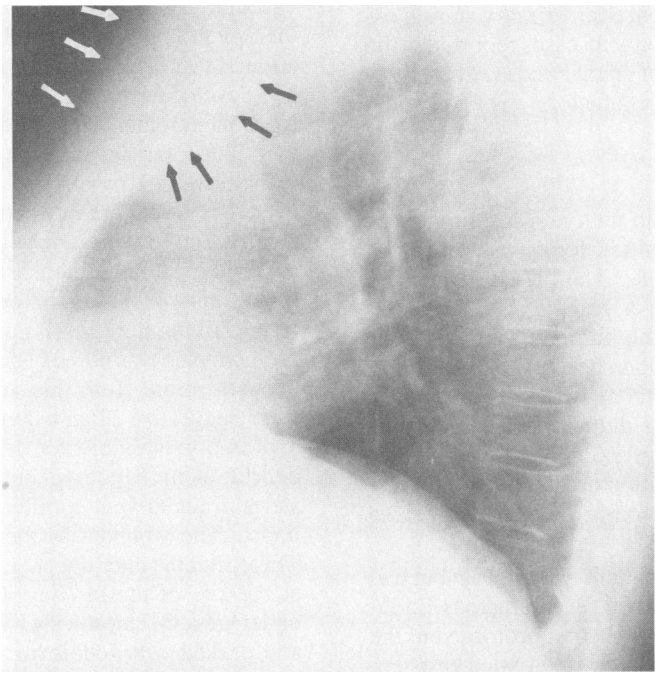

Figure 1.—A lateral chest x-ray film shows soft tissue swelling and destruction of the sternum **(arrows)** in patient 1.

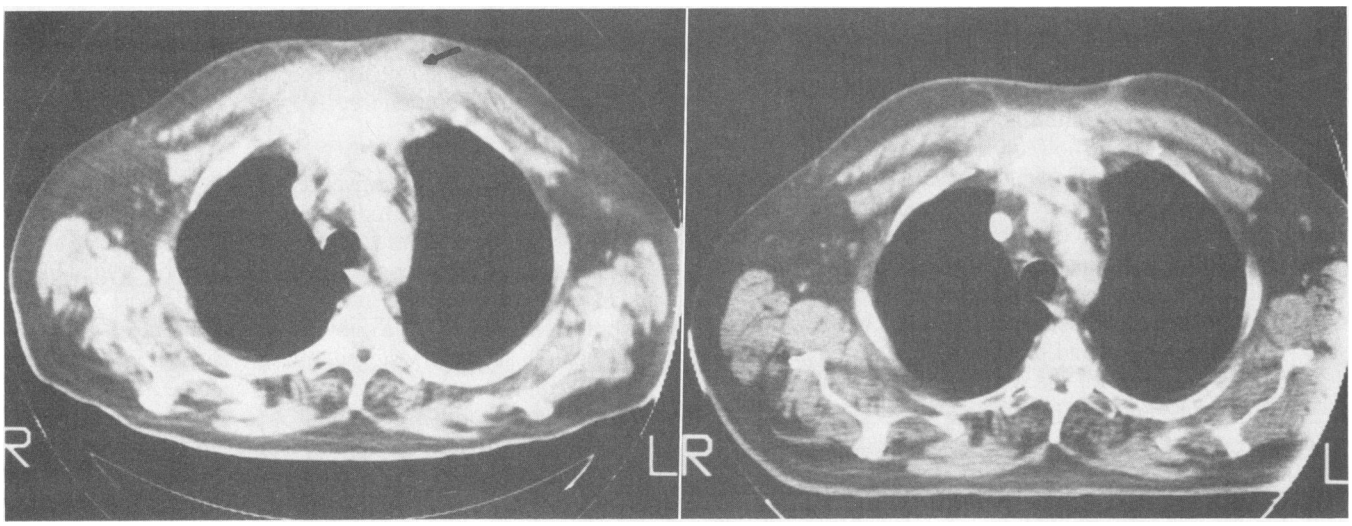

Figure 2.—Chest computed tomography in patient 1 shows, **left**, sternal destruction and inflammatory response extending through bone and soft tissue to the chest wall surface **(arrow). Right,** 9 months later, after surgical debridement and antibiotic therapy, the destructive process of the sternum is nearly absent.

TABLE 1.—*Reported Cases of Primary Sternal Osteomyelitis (N=55)*

Reported Case	Author, Year	Age, yr	Sex	Source of Bacteria	Organism	Surgical Therapy	Underlying Disease	Trauma	Outcome
1	Wilensky and Samuels, 1926[8]	24	♂	Typhoid	Unknown	Debridement	...	No	Survived
2		35	♀	Sternum	*Salmonella paratyphi*	Debridement	...	No	Survived
3		24	♂	Sternum	Unknown	Radical resection*	...	Yes	Survived
4		8	♂	Sternum	*Staph aureus*	Debridement	...	Yes	Survived
5	Drews, 1910[7]	Young†	..	Sternum	*Staph aureus*	Debridement	...	No	Survived
6-18	Drews, 1910[7]‡								
19	Solomon, 1926§	Young†	..	Pneumonia	Unknown	Debridement	...	No	Died
20	Sick, 1926§	40	♂	Pneumonia	Unknown	Debridement	...	No	Died
21		16	♂	General infection‖	...	...	...	No	Died
22		15	♀	Sternum	Unknown	...	...	No	Survived
23		21	♂	Sternum	Unknown	...	...	No	Survived
24	Muhlein, 1926§	..	..	Lung	Unknown	...	Splenic tumor	...	Died
25	Batut, 1926§	22	♂	Sternum	*Salmonella typhi*	Debridement	Unknown	...	Survived
26	Vaughn, 1918[6]	26	♂	Sternum	Unknown	Debridement	...	Yes	Survived
27	Peloquin, 1926§	..	..	Sternum	...	4 operations	...	No	Died
28	Bidwell, 1926§	..	..	Liver	Unknown	Debridement	Liver abscess	No	Died
29	Koch, 1926§	30	♂	Pneumonia	...	Radical resection	...	No	Survived
30	Janz, 1926§	21	♂	Pneumonia	Unknown	Debridement	...	No	Survived
31	Busch, 1926§	18	♂	Sternum	Unknown	Radical resection	...	No	Survived
32	Maier, 1947[9]	19	♀	Pneumonia	*Streptococcus* sp	Debridement	...	No	Died
33	Brown, 1952[10]	19	♂	Sternum	?*Mycobacterium tuberculosis*	Debridement	...	No	Survived
34		41	♂	Sternum	*M tuberculosis*	Debridement	...	No	Survived
35		28	♂	Sternum	*M tuberculosis*	Several	...	No	Survived
36	Vellacott, 1952[11]	26	♂	Sternum	*Staph aureus*	Debridement	Unknown	Yes	Survived
37	Biesecker, 1973[12]	21	♂	Sternum	*Staph aureus*	Debridement	...	No	Survived
38		2½	♂	Sternum	Gram-negative	Debridement	...	No	Survived
39	Mir-Sepasi et al, 1975[1]	22	♂	Sternum	*Pseudomonas aeruginosa*	Radical resection	IV drug abuse	No	Survived
40		24	♂	Sternum	*P aeruginosa*	Debridement	IV drug abuse	No	Survived
41		21	♂	Sternum	*P aeruginosa*	Debridement	IV drug abuse	No	Survived
42		24	♀	Sternum	*P aeruginosa*	Debridement	IV drug abuse	No	Survived
43	Enat et al, 1979[13]	47	♂	Sternum	*Staph aureus*	...	...	CPR	Survived
44-50	Jara et al, 1979[4]¶								
51	Sant, 1979[3]	28	♀	Sternum	*Staph aureus*	...	...	...	Survived
52	Kelly and Chetty, 1985[2]	40	♀	GI tract	Gram-negative	...	...	...	Survived
53	Richter, 1983[14]	..	..	Sternum	*M tuberculosis*	...	...	...	Survived
54	Watts et al, 1987[5]	40	♂	Sternum	*M tuberculosis*	Debridement	...	No	Survived
55		49	♂	Sternum	*M tuberculosis*	...	...	No	Survived

CPR=cardiopulmonary resuscitation, GI=gastrointestinal, IV=intravenous, *Staph=Staphylococcus*

*Radical resection was defined as complete resection of the sternum with additional reconstruction.
†A minimal description of patients was given, with age described only as young.
‡Cases 6-18: Drews cited 13 cases from the German language literature.
§All of these cases were described by Wilensky and Samuels, 1926.[8]
‖This may well have been a case of generalized sepsis.
¶Cases 44-50: 7 patients (1 woman, 6 men), all intravenous drug abusers, were treated with debridement and all survived. The causal organism in 4 was *Pseudomonas aeruginosa*, in 2 was *Staphylococcus aureus*, and in the 7th was undetermined. The ages and sources of bacteria were not given.

TABLE 2.—*Primary Versus Secondary Sternal Osteomyelitis*

Feature	Sternal Osteomyelitis	
	Primary	Secondary
Risk factors	Trauma; ?pneumonia; ?diabetes	Internal mammary artery bypass grafting; prolonged time on heart-lung bypass; sternal massage for CPR after an operation; prolonged low cardiac output state after a bypass procedure; excessive bleeding; history of reexploration for control of bleeding
Complications	Sepsis	Wire, saphenous vein bypass valve, and mediastinal infection; sepsis; sternal erosion
Mortality rate	Preantibiotic era, 19% Postantibiotic era, 3%	10% all cases in postantibiotic era
Management	Antibiotics with or without surgical therapy	Antibiotics plus reconstructive operations in most cases—left to heal open
Organism	*Staphylococcus aureus, Pseudomonas aeruginosa*	*Staphylococcus aureus, Klebsiella pneumoniae, Candida albicans*

CPR=cardiopulmonary resuscitation

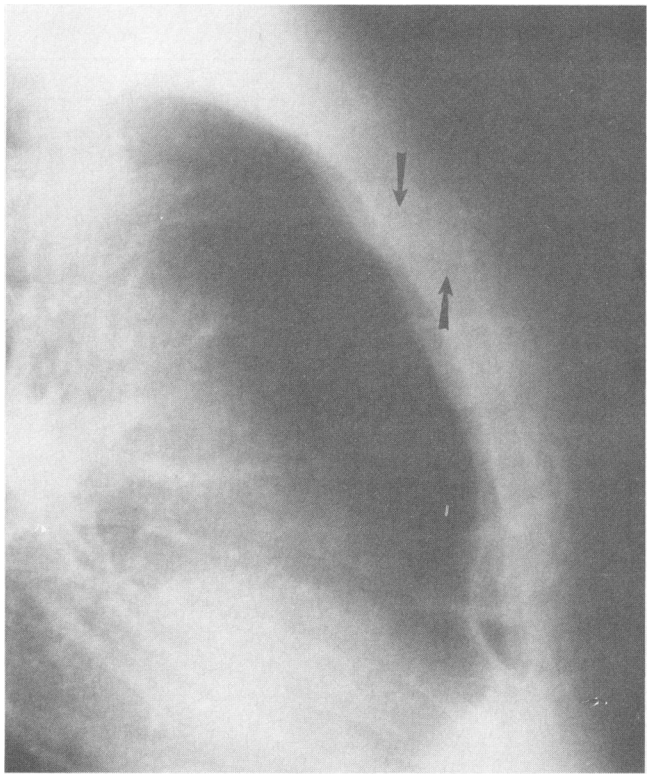

Figure 3.—A plain lateral chest film of patient 2 shows midsternal hypertrophy and a questionable accessory joint **(arrows).**

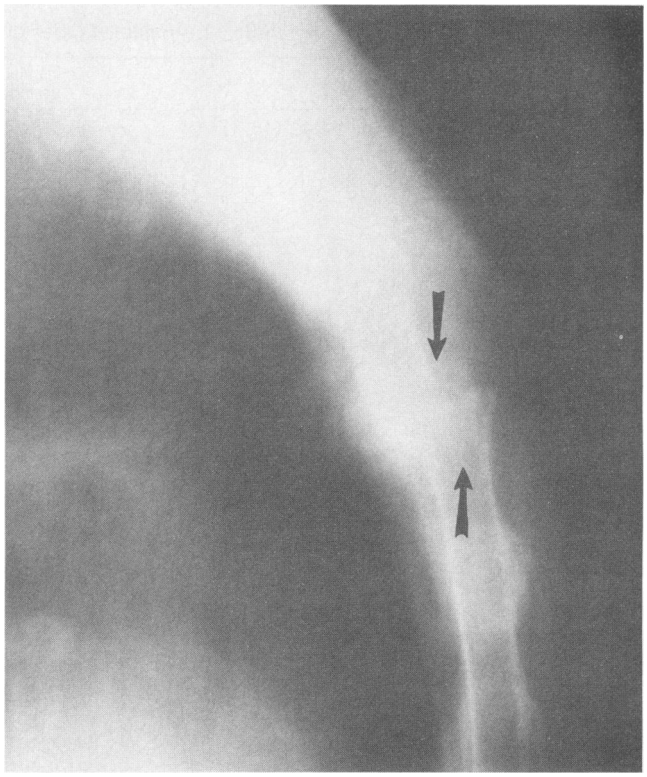

Figure 4.—A tomogram of the sternum shows the destructive process of the sternal osteomyelitis **(arrows).**

both mainly pediatric tumors. Sarcoma is important to consider because a biopsy may facilitate a contiguous spread, and a complete surgical resection is necessary for cure in many cases.

The diagnosis of sternal osteomyelitis requires a bone biopsy. Helpful radiologic studies include computed tomography, a technetium Tc 99m pyrophosphate bone scan, and scans using gallium citrate Ga 67 and indium In 111. All of the nuclear medicine scans lack specificity and are perhaps best suited for follow-up examinations. Smith and associates, however, have advocated the use of gallium ^{67}Ga scanning as more specific than technetium ^{99m}Tc scanning.[16] It is unclear from their report whether or not the ^{99m}Tc scans were multiphasic.[16] We found plain and computed tomography to be the most useful in the diagnosis and follow-up of our patients. Although no studies exist supporting its use in this illness, magnetic resonance imaging has been useful in some types of osteomyelitis, especially in patients with Pott's disease.[17]

The treatment of secondary sternal osteomyelitis requires more aggressive debridement than does the primary form. Hence, most cardiothoracic surgeons advocate extensive surgical intervention with some reconstruction in most cases. Johnson and colleagues have recommended total sternectomy and removal of associated cartilage, with reconstruction accomplished using bilateral pectoralis major myocutaneous flaps.[18]

While some debridement is often necessary in primary sternal osteomyelitis, a few cases ($< 10\%$) will resolve with antibiotic therapy alone. The extent of sternal debridement has been reviewed in a noncontrolled, nonprospective manner by two sets of authors. Mir-Sepasi and co-workers suggest removing most of the sternum but recommend leaving the posterior periosteum intact.[1] Such a conservative approach was curative in both of our cases, but each required a second operation.

Conclusions

We have presented two cases of primary sternal osteomyelitis, making the total of reported cases 57. Each patient had significant underlying illness: diabetes mellitus and peripheral vascular disease, respectively. Diabetes could certainly be postulated a risk factor for this disease. Case 1 also was unusual in that there was a preexisting history of a foreign body more than ten years before the patient was first seen. Our cases were more typical of the older cases in the literature in that there was no history of intravenous drug abuse. We also report what we think is the first case of this illness treated on an outpatient basis with intravenous antibiotics through a Hickman catheter. Hence, we have defined an approach to this illness combining appropriate diagnostic studies, limited surgical intervention, and appropriate antimicrobial therapy.

REFERENCES

1. Mir-Sepasi MH, Gazzaniga AB, Bartlett RH: Surgical treatment of primary sternal osteomyelitis. Ann Thorac Surg 1975; 19:698-703

2. Kelly CA, Chetty MN: Primary sternal osteomyelitis. Thorax 1985; 40:872-873

3. Sant GR: Primary sternal osteomyelitis. J R Coll Edinburgh 1979; 24:368-369

4. Jara FM, Yap A, Toledo-Pereyra LH: The role of surgery in primary osteomyelitis of the chest wall. J Thorac Cardiovasc Surg 1979; 77:148-150

5. Watts RA, Paice EW, White AG: Spontaneous fracture of the sternum and sternal tuberculosis. Thorax 1987; 42:984-985

6. Vaughn RT: Acute osteomyelitis of the sternum: Woody presternal phlegmon: Osteotomy and drainage. Surg Clin North Am 1918; 5:253-262

7. Drews H: Die akute Osteomyelitis des Brustbeins [Acute osteomyelitis of the sternum], *In* Inaugural Dissertation. Parchim, H Freise, 1910

8. Wilensky AO, Samuels SS: Osteomyelitis of the sternum. Ann Surg 1926; 83:206-216

9. Maier HC: Infections of the costal cartilages and sternum. Surg Gynecol Obstet 1947; 84:1038-1044

10. Brown RB: Chronic abscesses and sinuses of the chest wall. Ann Surg 1952; 135:44-51

11. Vellacott D: Sternal osteomyelitis. Lancet 1952; 1:749

12. Biesecker GL: Primary sternal osteomyelitis. Chest 1973; 63:236-238

13. Enat R, Pollack S, Wiener M, et al: Osteomyelitis in fractured sternum after cardiopulmonary resuscitation (Letter). N Engl J Med 1979; 301:108-109

14. Richter R: Die isolierte Brustbeintuberkulose [Isolated tuberculosis of the sternum]. ROFO 1983; 139:132-135 (Engl Abstr)

15. Culliford AT, Cunningham JN Jr, Zeff RH, et al: Sternal and costochondral infections following open-heart surgery—A review of 2,594 cases. J Thorac Cardiovasc Surg 1976; 72:714-726

16. Smith PW, Petersen RJ, Ferlic RM: Gallium scan in sternal osteomyelitis. AJR 1979; 132:840-841

17. Quinn SF, Murray WT, Prochaska J, et al: MRI appearance of disseminated osseous tuberculosis. Magn Reson Imaging 1987; 5:493-497

18. Johnson P, Frederiksen JW, Sanders JH: Management of chronic sternal osteomyelitis. Ann Thorac Surg 1985; 40:69-72

Metastatic Crohn's Disease

SUSAN TERI McGILLIS, MD
Cleveland

ARTHUR C. HUNTLEY, MD
Sacramento, California

GRANULOMATOUS LESIONS OF THE SKIN not attributable to a known foreign body reaction or infectious agents are often presumed to be sarcoidosis, a disease of exclusion. We report the case of a patient initially thought to have cutaneous sarcoidosis, who on further investigation was determined to have "metastatic" Crohn's disease.

Report of a Case

The patient, a 62-year-old man, first consulted our dermatology service for evaluation of an erythematous, scaly, nummular patch on his left lower leg that had been present for about two months.

Further history indicated that six months before he noted the lesion, he had been ill with malaise, diarrhea, vomiting, and a 9-kg (20-lb) weight loss. He was admitted to hospital and underwent an extensive evaluation, including radiographic studies that revealed tumors in the antrum of the stomach and terminal ileum (Figure 1). These were initially considered to be consistent with adenocarcinoma, but an endoscopic biopsy of the gastric lesion showed many noncaseating granulomata. No other systemic illnesses or abnormalities were identified at that time. A diagnosis of Crohn's disease was made after tuberculosis and other causes for the granulomata were ruled out. He was treated with a regimen of prednisone, 30 mg a day, with complete resolution of all gastrointestinal symptoms. The patient had been completely weaned off prednisone at the time of being seen by us.

About two months after the prednisone therapy was discontinued, he was examined in the dermatology clinic because of mild erythema and scaling that had developed on both legs. Several potassium hydroxide preparations were negative, and the patient was initially treated with mid-strength topical steroids with no apparent response. The lesions progressed, and eventually thickened, indurated plaques developed with sharply marginated ulcerations and crusting (Figure 2).

Several skin biopsies revealed sarcoidal granulomas with few giant cells and little coagulation necrosis (Figure 3). Special stains and cultures were negative for deep fungi, acid-fast bacteria, and spirochetes. No foreign body material was identified by polarization. A diagnosis of sarcoidosis was initially made, and a complete evaluation for systemic involvement was embarked on. All results were normal. The patient had no adenopathy. A chest x-ray film showed no hilar

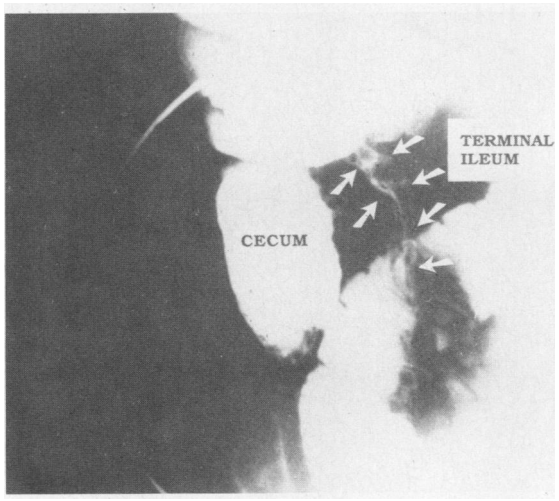

Figure 1.—A barium-enhanced radiographic examination of the intestine reveals cuffing of the terminal ileum (arrows) characteristic of Crohn's disease.

Figure 2.—The initial skin findings consisted of dermatitis and scaling of the legs within which there is ulceration and crusting.

(McGillis ST, Huntley AC: Metastatic Crohn's disease. West J Med 1989 Aug; 151:203-205)

From the Departments of Dermatology, Cleveland Clinic Foundation, Cleveland (Dr McGillis), and University of California, Davis, Medical Center, Sacramento (Dr Huntley).

Reprint requests to Arthur C. Huntley, MD, Department of Dermatology, University of California, Davis, Medical Center, 1605 Alhambra Blvd, Sacramento, CA 95816.