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# Spindle cell haemangioendothelioma: probably a benign vascular lesion not a low-grade angiosarcoma

## A clinicopathological, ultrastructural and immunohistochemical study

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**Summary.** Ten cases of spindle cell haemangioendothelioma (SCH) were analysed clinicopathologically, including an immunohistochemical survey of seven cases and ultrastructural observations on one. There were seven females and three males, ranging from 16 to 76 years of age. All but one lesion developed on the extremities, predominantly on the hands and feet. Six of the ten patients presented multiple nodules or papules which gradually increased in size and number over a long duration. Among them, four patients had undergone operations twice or more, but no metastatic foci were recognized. Histologically, the lesions were composed of dilated vascular spaces and a proliferation of bland-appearing spindle cells and interspersed epithelioid endothelial cells. Ultrastructural and immunohistochemical studies demonstrated that the spindle cells were mainly made up of fibroblastic cells admixed with pericyte-like cells and macrophages. Smooth muscle cells and primitive mesenchymal cells were also present. The clinical and microscopic features suggest that SCH may be a benign vasoformative lesion of a heterochronological multicentric origin.

**Key words:** Vascular lesion – Haemangioma – Haemangioendothelioma – Spindle cell haemangioendothelioma – Soft tissue tumour

## Introduction

Spindle cell haemangioendothelioma (SCH) was newly recognized by Weiss and Enzinger (1986) as a low-grade angiosarcoma resembling both cavernous haemangioma and Kaposi's sarcoma. It was categorized as a vascular tumour of intermediate malignancy by Enzinger and Weiss (1988), on the basis of the presence of recurrent and/or additional lesions in two-thirds of patients and regional lymph node metastasis in one (Enzinger and Weiss 1988; Weiss and Enzinger 1986). However, the patient with lymph node metastasis had a history of radiation therapy, and the indolent clinical course of other patients and the bland-appearing histological features are in conflict with a malignant nature of SCH. On the other hand, Fletcher et al. (1991) recently suggested that SCH is a non-neoplastic lesion and that its development correlates with malformed vasculatures at the affected site. In any case, the biological behaviour of SCH has still to be clearly elucidated, mostly because the number of published cases is quite small. Since Weiss and Enzinger (1986) presented their initial findings in a study of 26 cases, only 30 additional cases have subsequantly been reported (Fletcher et al. 1991; Lessard and Barnhill 1988; Scott and Rosai 1988; Shimokobe et al. 1990; Zoltie and Roberts 1989).

We herein present our observations on ten patients with SCH in order to further delineate the clinicopathological features of this rare neoplasm and analyse the spindle cells (SCs) in SCH using both immunohistochemistry and electron microscopy in order better to elucidate their nature.

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## Materials and methods

Ten cases of SCH were obtained between 1977 and 1991, retrieved from the soft tissue registry of the Second Department of Pathology, Kyushu University Faculty of Medicine, Japan. Six cases were received in consultation. The cases were coded or submitted under the following diagnoses: haemangioma (4 cases), unclassified vasoformative lesion (1 case), vascular tumour of borderline malignancy (1 case), cutaneous angiosarcoma (1 case), and spindle cell haemangioendothelioma (3 cases). All the patients were Japanese.

For light microscopic observation, all paraffin blocks were recut and stained with haematoxylin and eosin (H&E), periodic acid-Schiff (PAS), alcian blue, Masson's trichrome and silver impregnation for reticulin. For the immunohistochemical study, 5-μm sections of 10% formalin-fixed, paraffin-embedded material from seven of the ten cases were stained using the avidin-biotin-peroxidase complex (ABC) technique (Hsu et al. 1981). After deparaffinization and rehydration, all sections were applied to 0.3% hydrogen peroxide in absolute methanol for endogenous peroxidase activity block-

**Table 1.** Primary antibodies and lectin used in the present study

| Antibody and lectin specificity | Source | Type | Dilution | Enzymatic predigestion |
|---|---|---|---|---|
| Vimentin | Dakopatts, Glostrup, Denmark | Mouse (mab) | 1:10 | No |
| Factor VIII RA | Dakopatts | Rabbit (pAb) | 1:1000 | No |
| *Ulex europaeus I* (UEA-I) | Vector, Burlingame, CA | Biotinylated | 1:50 | No |
| Desmin | Dakopatts | Mouse (mAb) | 1:100 | No |
| Alpha-smooth muscle actin | Sigma, St. Louis, Mo. | Mouse (mAb) | 1:5000 | No |
| Muscle-specific actin (HHF35) | Enzo, New York, NY | Mouse (mAb) | 1:16000 | Yes |
| S-100 protein | Dakopatts | Rabbit (pAb) | 1:400 | Yes |
| Lysozyme | Dakopatts | Rabbit (pAb) | 1:400 | No |
| Alpha-l-antitrypsin (AAT) | Dakopatts | Rabbit (pAb) | 1:400 | Yes |
| Type IV collagen | Advance, Tokyo, Japan | Rabbit (pAb) | 1:1000 | Yes |
| Cathepsin B | The Binding Site, Birmingham, England | Sheep (pAb) | 1:500 | No |
| Factor XIII subunit A | Behringwerke, Marburg, FRG | Rabbit (pAb) | 1:800 | Yes |
| MAC387 | Dakopatts | Mouse (mAb) | 1:100 | Yes |
| HAM56 (EAB935) | Enzo | Mouse (mAb) | 1:800 | No |
| EAB902 | Enzo | Mouse (mAb) | 1:4000 | Yes |
| CAM5.2 | Becton Dickinson, Mountain View, CA | Mouse (mAb) | 1:20 | Yes |
| AE1/AE3 | Hybritech, San Diego, CA | Mouse (mAb) | 1:500 | Yes |
| Epithelial membrane antigen (EMA) | Dakopatts | Mouse (mAb) | 1:200 | No |

mAb, Monoclonal antibody; pAb, polyclonal antibody

**Table 2.** Clinical data on patients with spindle cell haemangioendothelioma

| Case no. | Patient Age (years)/Sex | Location of tumour | Depth | Number and size (cm) of tumour | Pre-operative duration (years) | Follow-up (years) |
|---|---|---|---|---|---|---|
| 1. | 22/F | Rt. palm | Dermis to subcutis | Multiple, two small nodules | 7 | NED, 11.5 |
| 2. | 38/M | Lt. foot, lower leg and thigh | Dermis to subcutis | Multiple, more than ten small nodules | 20 | NA |
| 3. | 70/F | Lt. foot, lower leg and thigh | Subcutis | Multiple, more than ten small nodules | 50 | AWD, 2.5 |
| 4. | 26/F | Lt. hand | Dermis to subcutis | Multiple, more than ten small nodules | 2 | AWD, 26 |
| 5. | 24/F | Lt. foot | Dermis | Multiple | 15 | AWD, 1.5 |
| 6. | 16/M | Upper back | Dermis | Single, $0.5 \times 0.5$ | 1 | NED, 1.5 |
| 7. | 43/F | Rt. thigh | Intramuscular | Single, $1.5 \times 1.1$ | 1 | NED, 3 |
| 8. | 76/F | Lt. foot | Intramuscular | Single, $2.5 \times 2$ | 0.5 | Recent case |
| 9. | 58/M | Bilat. palm | Dermis to subcutis | Multiple | 20 | Recent case |
| 10. | 20/F | Lt. foot | Dermis to subcutis | Single, $0.9 \times 0.2$ | 0.5 | Recent case |

NED, No evidence of disease; NA, information not available; AWD, alive with disease

ing and then prepared both with and without enzymatic predigestion by phosphate-buffered 0.1% trypsin (type II, No. T-8003; Sigma, St. Louis, Mo.) for 10–30 min at 37° C. Sequential incubations in 1% normal goat serum (10 min), primary antibodies (see Table 1, 90 min at room temperature), secondary biotinylated antibody (Vectastain ABC kit, Vector Laboratories, Burlingame, Calif.; 40 min), and avidin and biotin reagents (Vectastain ABC kit, 40 min) were followed. Chromogen diaminobenzidine was used to visualize peroxidase deposition at the antigenic sites. These sections were counterstained with methyl green. Appropriate positive and negative controls were used in each staining run.

An ultrastructural study was performed on the lesions of case 4. Fresh tissue was fixed in 2.5% buffered glutaraldehyde, rinsed in phosphate buffer, post-fixed in 1% osmium tetroxide, dehydrated, embedded in Epon 812 and cut with the use of a Reichert ultramicrotome. The ultrathin sections were stained with uranyl acetate and lead citrate, and then examined using a JEM 100CX transmission electron microscope (Jeol, Tokyo).

## Results

A summary of the clinicopathological data for the ten patients with SCH is given in Table 2. The patients included seven women and three men, ranging in age from 16 to 76 years, with a median of 32 years and a mean of 39. Seven of the 10 patients perceived the lesions before the age of 24 years. All but one lesion on the upper back were located on the extremities, especially in the hands (3 cases) and the feet (5 cases).

Clinically, most patients had a history of superficial, slowly growing lesions with a long interval between onset and surgical excision, and four patients (cases 1, 6–8) suffered from occasional pain. Six of the ten patients presented multiple nodules or papules which gradually increased in both size and number over a duration from

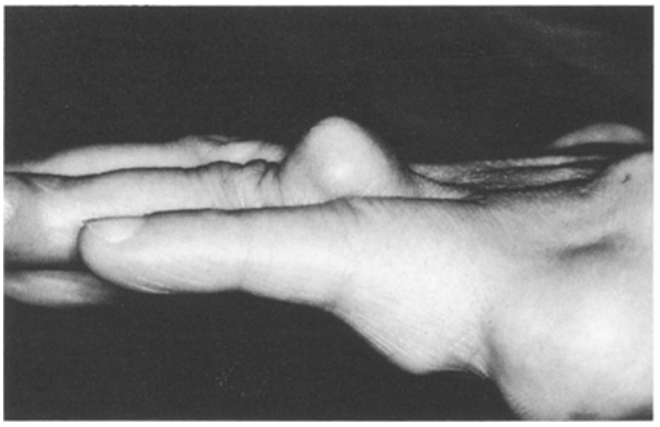

**Fig. 1.** Spindle cell haemangioendothelioma (SCH) involving the left hand of a woman with multiple small nodules. These nodules had gradually increased in number and size over 25 years (case 4)

several years to decades (Fig. 1). Multiple lesions were often situated in the same area, and two involved the entire lower extremities and one both hands.

Common clinical diagnoses were either haemangioma or cavernous haemangioma. Other preoperative diagnoses included angioleiomyoma, fibroma, neurofibromatosis, epidermal cyst, and rhabdomyoma. Only one of the recent cases was diagnosed as SCH prior to the pathological examination, since the clinician had experienced one example of SCH before and had a good knowledge of the clinical characteristics of SCH. No other vascular lesions, such as epithelioid haemangioendothelioma and vascular malformation or abnormality, accompanied the lesion in any of the cases.

Follow-up data was available for six patients, ranging from 1.5 to 26 years with an average period of 7.5 years. Of six patients with multiple lesions, four (cases 2–5) had undergone two or more surgical excisions. None of the lesions had metastasized. At the time of writing, all patients are alive and doing well either with or without the disease.

Macroscopically most of the lesions affected the dermis and the subcutis, except for two cases in which they were solitary, intramuscular nodules. An adhesion to a digital nerve was noted in one of the deeply located lesions (case 8). The majority of the lesions appeared to be relatively well damarcated with or without a pseudocapsule, and were small, rubbery soft, purple or bluish, single or multiple nodules or papules, approximately 0.5–2.5 cm in diameter. Neither necrosis nor ulceration was evident in any lesion.

Microscopically the tumours consisted of two predominant elments in all cases: irregularly dilated blood channels either filled with erythrocytes or containing

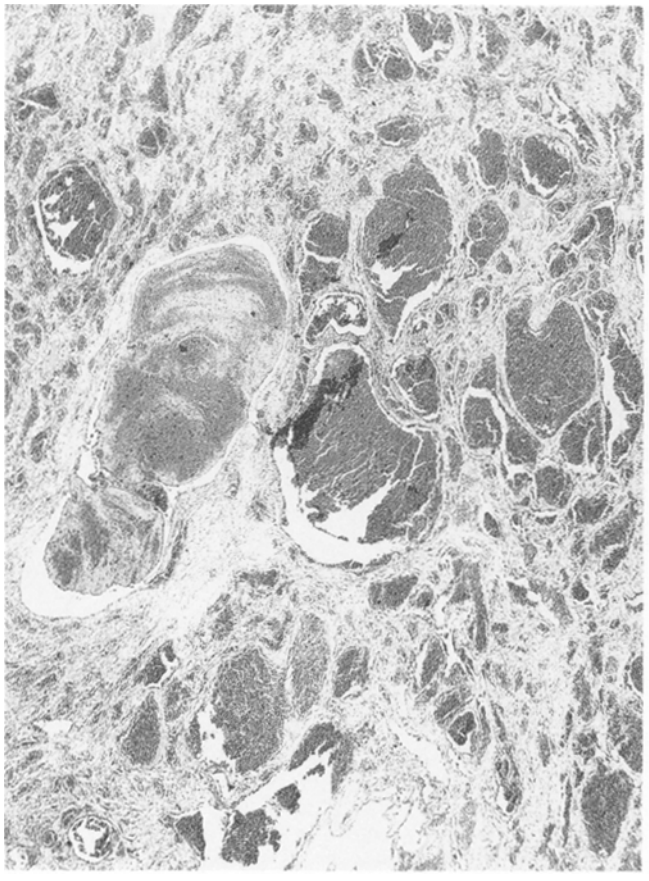

**Fig. 2.** Typical microscopic appearance of the SCH. A combination of cavernous vascular spaces filled with either blood or thrombi and spindle cell areas. H&E, ×30

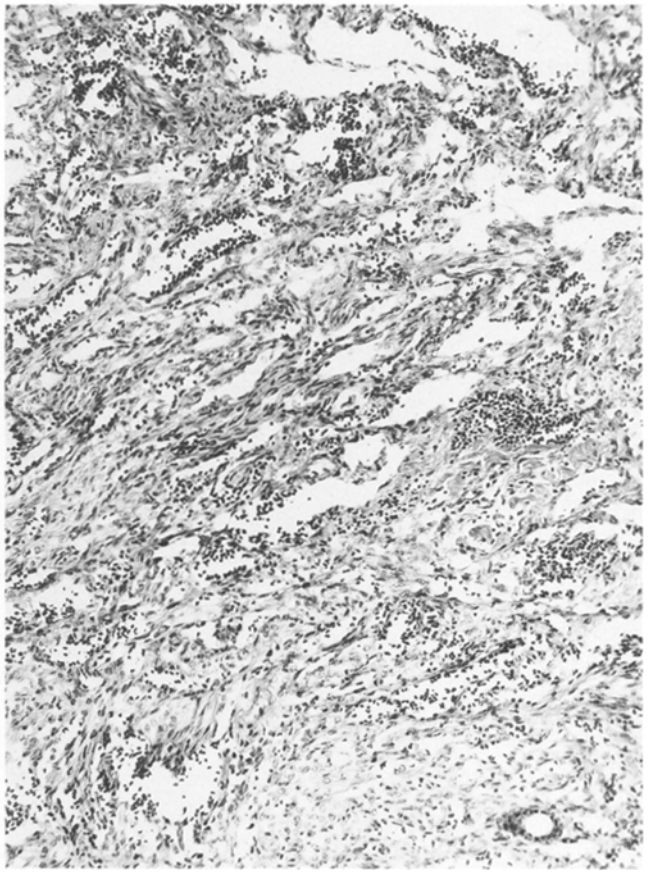

**Fig. 3.** A Kaposi's sarcoma-like area. A proliferation of spindle cells admixed with irregular clefts or slit-like vascular spaces. H&E, ×124

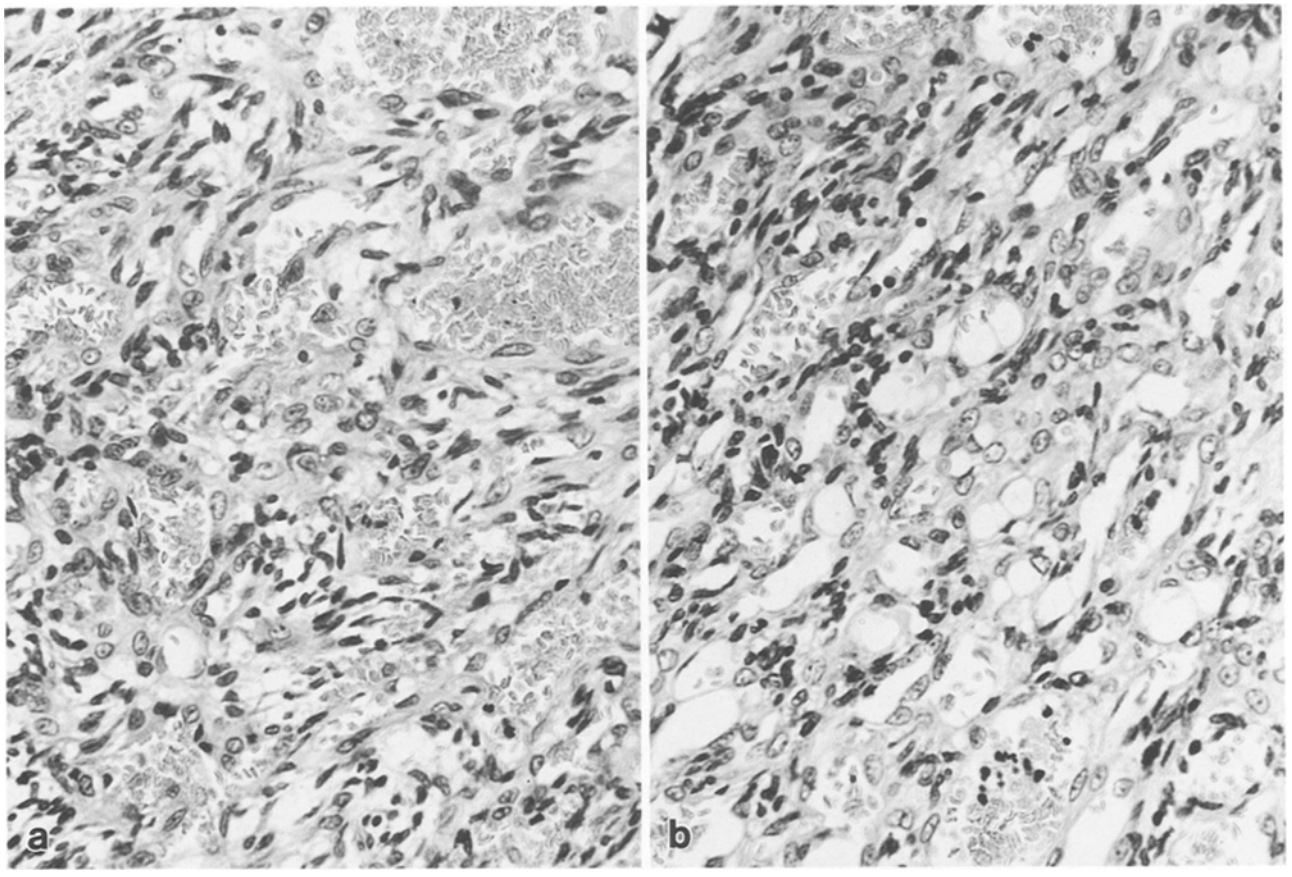


**Fig. 4a, b.** High power view of the spindle cell area. **a** Area with predominant spindle cells presenting a bland look without cellular atypia. H&E, ×350. **b** Area with many epithelioid endothelial cells showing cytoplasmic vacuolization. H&E, ×350

**Table 3.** Immunohistochemical and lectin histochemical results on seven cases of spindle cell haemangioendothelioma

| Antibody and lectin | VC | | | | EC[a] | | | | SC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | − | + | ++ | +++ | − | + | ++ | +++ | − | + | ++ | +++ |
| Vimentin | 0 | 1 | 1 | 5 | 0 | 1 | 3 | 1 | 1 | 1 | 2 | 3 |
| Factor VIII RA | 1 | 1 | 3 | 2 | 1 | 2 | 2 | 0 | 7 | 0 | 0 | 0 |
| UEA-I | 0 | 1 | 2 | 4 | 0 | 1 | 4 | 0 | 7 | 0 | 0 | 0 |
| Desmin | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 3 | 2 | 2 | 0 |
| Alpha-smooth muscle actin | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 3 | 2 | 2 | 0 |
| HHF 35 | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 3 | 2 | 2 | 0 |
| S-100 | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 7 | 0 | 0 | 0 |
| Lysozyme | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 6 | 1 | 0 | 0 |
| AAT | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 6 | 1 | 0 | 0 |
| Type IV collagen | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 7 | 0 | 0 | 0 |
| Cathepsin B | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 7 | 0 | 0 | 0 |
| Factor XIII a | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 2 | 1 | 4 | 0 |
| MAC387 | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 4 | 2 | 1 | 0 |
| HAM56 | 0 | 1 | 2 | 4 | 1 | 3 | 1 | 0 | 4 | 2 | 1 | 0 |
| EAB902 | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 7 | 0 | 0 | 0 |
| CAM5.2 | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 7 | 0 | 0 | 0 |
| AE1/AE3 | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 7 | 0 | 0 | 0 |
| EMA | 7 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 7 | 0 | 0 | 0 |

VC, Vascular lining cells; EC, epithelioid cells in spindle cell area; SC, spindle cells; −, negative staining; +, a few or scattered positive cells; ++, a moderate number of positive cells; +++, majority of cells stained

[a] Five cases available for determination

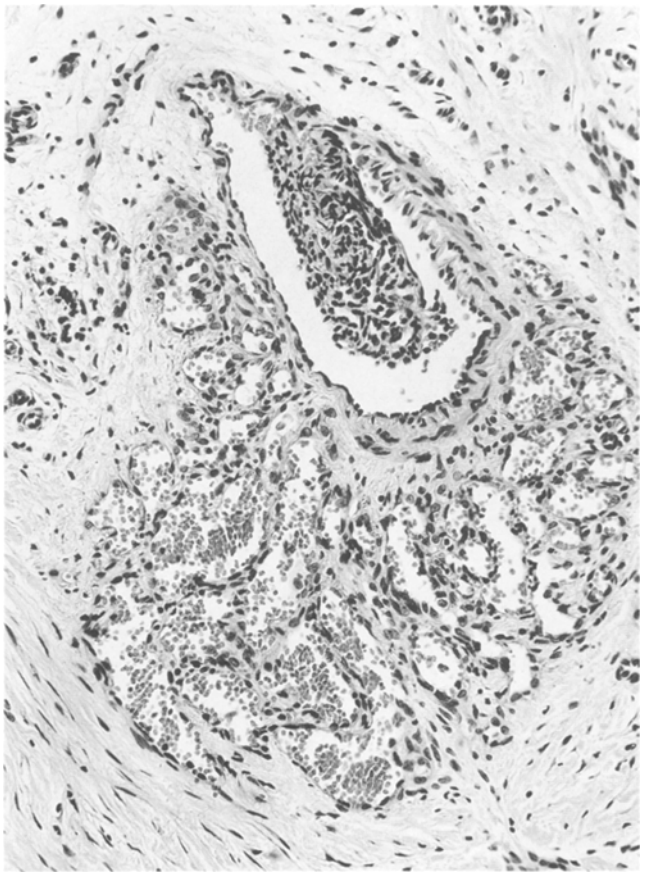

**Fig. 5.** Intravascular SCH tissue. A finding easily confused with a vascular metastasis. H&E, ×190

thrombi or phleboliths, as seen in cavernous haemangioma, and a proliferation of bland-appearing SCs between and surrounding the blood channels (Fig. 2). The walls of the vessels, lined by flattened entothelial cells, were usually thin. Although thick-walled blood vessels due to perivascular fibrosis were occasionally found at the periphery, there was no evidence of arteriovenous malformation. The SCs were usually arranged either in a haphazard fashion or in short fascicles, and irregular clefts or slit-like vascular spaces lined by flattened or plumped endothelial cells intervened in the SC areas. Such features closely simulated Kaposi's sarcoma (Fig. 3). Generally, the SCs lacked pleomorphism and mitotic figures were seldom or never found (Fig. 4). The number of SCs varied from case to case, and from portion to portion in the same lesion. In seven cases a large number of SCs constituted half or more of the entire lesion, whereas in other three cases only a small number of SCs were present around the walls of the vessels or at the periphery of the mass. In nine of the ten lesions, epithelioid endothelial cells with rounded or oval nuclei and pale eosinophilic cytoplasm, occasionally containing cytoplasmic vacuoles, were interspersed singly or in small clusters among the SCs (Fig. 4).

Extravasated erythrocytes and haemosiderin deposits were often seen, but no hyaline globules were observed. It was not uncommon to see focal aggregates of lymphocytes and plasma cells in the SC area. Small foci of myxoid change in SC areas were present in two cases. It was a notable finding that tumour tissue was observed within blood channels in three lesions (Fig. 5). The overlying epidermis usually displayed no remarkable changes.

The results of immunohistochemistry in the seven cases of SCH are summarized in Table 3. The cells which lined the vascular spaces (VCs) and epithelioid endothelial cells (ECs) exhibited a similar immunohistochemical staining pattern. They showed a variable intensity of reactivity for factor-VIII-related antigen (Fig. 6a) and an affinity for *Ulex europaeus* agglutinin-I (UEA-I) (Fig. 6b); the reactivity was often weaker in the lesions than in the control vascular endothelium, whereas SCs were non-reactive for these markers, in keeping with the previous reports (Fletcher et al. 1991; Scott and Rosai 1988; Weiss and Enzinger 1986). Three of the seven cases displayed SCs which were positive for two anti-macrophage monoclonal antibodies tested, MAC 387 (Fig. 7a) and HAM 56 (Fig. 7b), and were scattered among non-immunoreactive SCs. HAM 56 also reacted from moder-

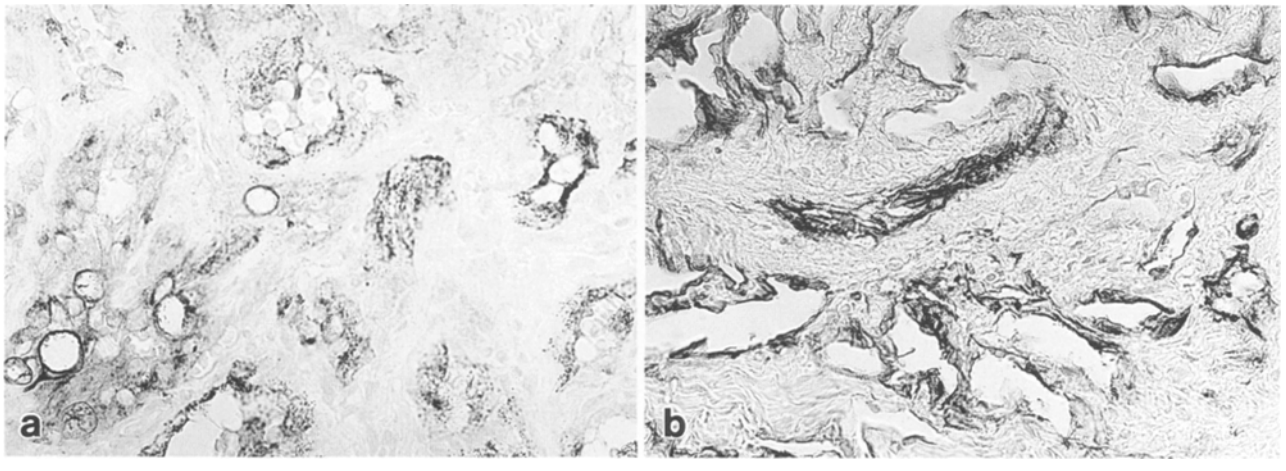


**Fig. 6a, b.** Factor VIII RA (**a**) immunoreactivity (×350) and *Ulex europaeus I* (**b**) lectin historeactivity (×350) are observed in the vascular endothelium and epithelioid endothelial cells, but not in spindle cells

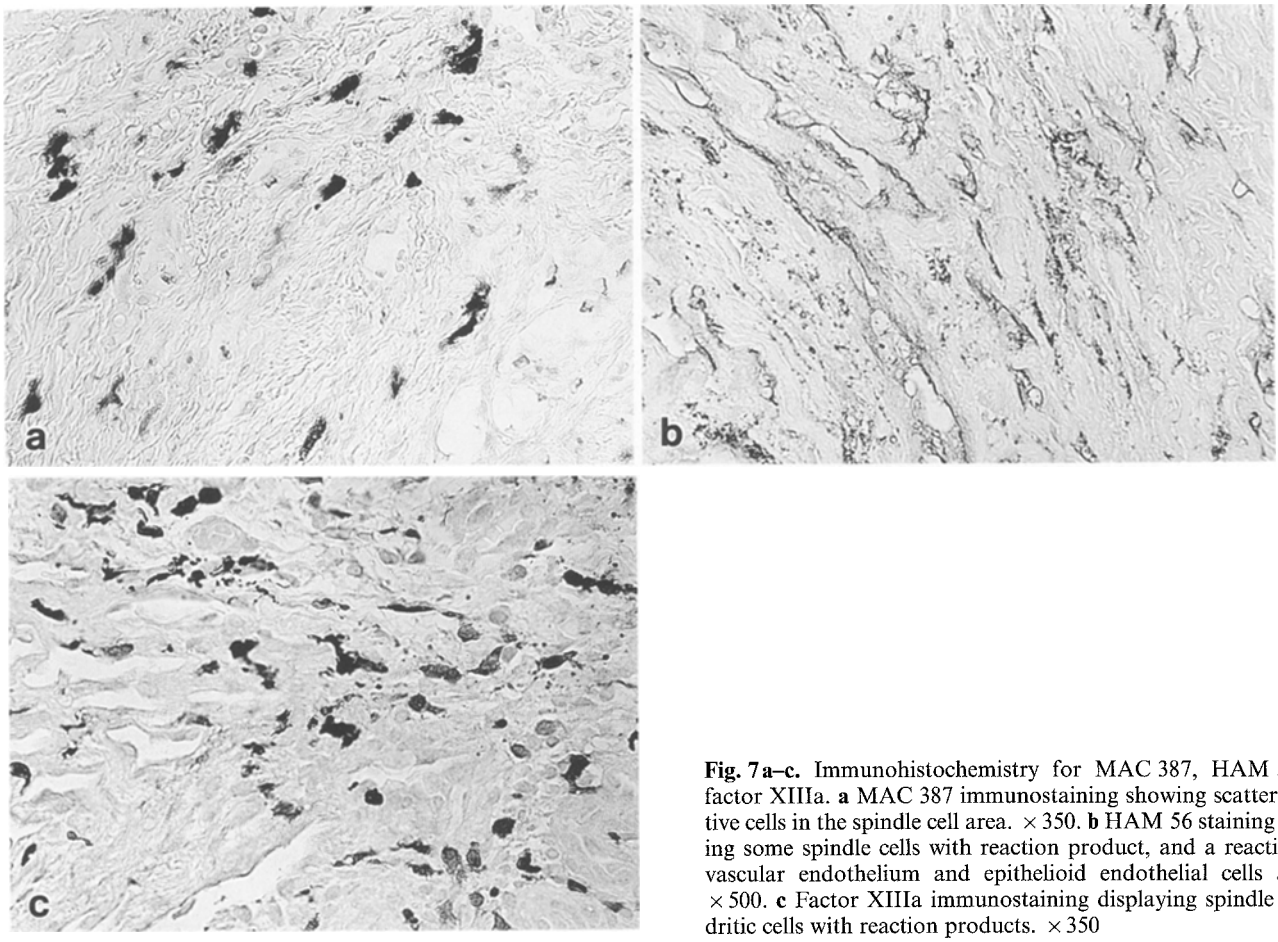


**Fig. 7a–c.** Immunohistochemistry for MAC 387, HAM 56, and factor XIIIa. **a** MAC 387 immunostaining showing scattered positive cells in the spindle cell area. ×350. **b** HAM 56 staining exhibiting some spindle cells with reaction product, and a reaction with vascular endothelium and epithelioid endothelial cells as well. ×500. **c** Factor XIIIa immunostaining displaying spindle or dendritic cells with reaction products. ×350

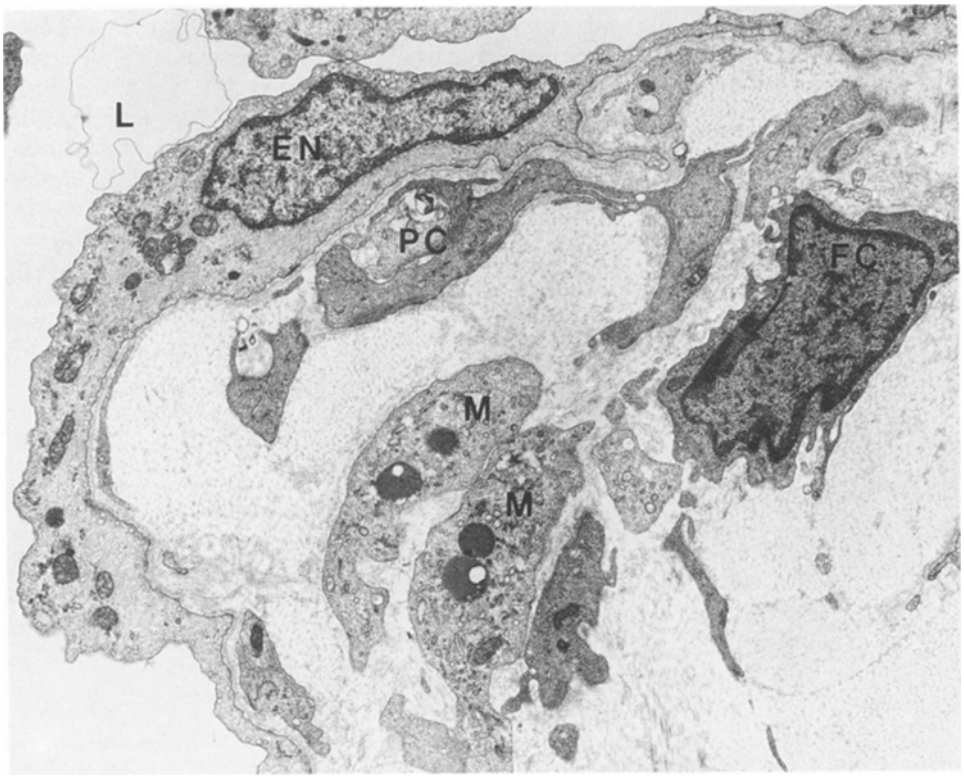


**Fig. 8.** Electron micrograph showing a normal-appearing vascular endothelium (EN) surrounded by elongated or irregularly shaped interstitial cells, including pericyte-like cell (*PC*), fibroblastic cell (*FC*) and macrophage (*M*). *L*, lumen. ×9800

ately to strongly with the VC component and weakly to moderately with the EC component (Fig. 7b). A few lysozyme-positive and alpha-1-antitrypsin-positive SCs were seen in one lesion. In five cases, a small or moderate number of SCs were stained positively for factor XIIIa (Fig. 7c), an antibody considered to be reactive to so-called dermal dendrocytes (Cerio et al. 1989a, b). Irregularly arranged fascicles of SCs positive for HHF 35, alpha-smooth muscle actin and desmin were observed in four lesions, and were located close to the blood vessels especially around the thick-walled cavernous channels.

The three cell components of SCH, in all cases except for the SCs in one case, were stained either focally or diffusely for vimentin. No reaction for S-100 protein, type IV collagen, cathepsin B, cytokeratins (EAB 902, CAM 5.2, AE1/AE3), or epithelial membrane antigen was detected in any lesion.

Ultrastructural examination on case 4 displayed vascular spaces lined by endothelial cells, individual or grouped endothelioid cells, and perivascular or interstitial cells.

The vascular endothelium showed a well-formed basal lamina, numerous pinocytotic vesicles, interdigitated short cytoplasmic processes overlying the luminar surface and intercellular attachments with neighbouring cells (Fig. 8). In addition, oval or rounded cells, which had features suggestive of an endothelial origin and seemed compatible with the epithelioid cells observed at the light microscopic level, were also seen (Fig. 9). These cells were often grouped in small nests and cohered to each other with tight junctions, and were constantly encircled by a discontinuous external lamina. They had a high nuclear cytoplasmic ratio and abundant cytoplasmic filaments in the cytoplasm. Rudimentary luminal structures were occasionally discerned.

Three principal cell types were identified either around or between the vascular channels: fibroblastic cells, pericyte-like cells, and macrophages (Fig. 8). The most common cells were elongated or irregularly shaped fibroblastic cells containing a moderate amount of rough endoplasmic reticulum and free ribosomes, scattered mitochondria, and fusiform or convoluted nuclei (Fig. 10a). Intracytoplasmic filaments, approximately 10 nm in diameter, were also noted in some fibroblastic cells. Pericyte-like cells were always present close to the vascular spaces, which were enveloped by an incomplete basal lamina and contained a variable number of pinocytotic vesicles. Interspersed were macrophages characterized by numerous primary or secondary lysosomes and Golgi apparatus in the cytoplasm (Fig. 10b).

In addition to the above cell types, there were small numbers of smooth muscle cells, undifferentiated mesenchymal cells, mast cells, and inflammatory cells.

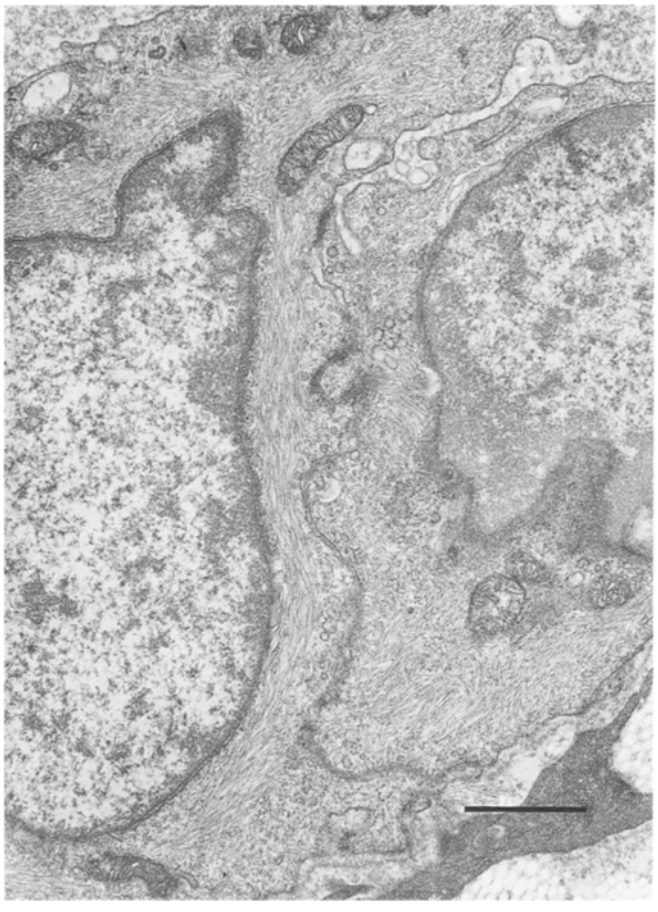

**Fig. 9.** Electron micrograph showing two rounded epithelioid cells which are partially encircled by basal lamina and attached to each other with tight junctions. Note abundant intracytoplasmic filaments in these cells. *Bar* = 1 μm. × 17000

## Discussion

The neoplasms herein described were consistent with the clinicopathological criteria illustrated by Weiss and Enzinger (1986) for SCH: slowly growing multiple nodules preferentially located in the distal extremities, and histological features characterized by dilated vascular channels with or without thrombi and phleboliths resembling cavernous haemangioma, interstitial bland-appearing SCs often with irregular clefts reminiscent of Kaposi's sarcoma, and single or grouped epithelioid endothelial cells with occasional cytoplasmic vacuolization. Although SCH can occur at any age, in many cases the initial lesion was noted either in childhood or young adult life. Occasionally related pain was experienced in four of the ten patients in the present series, a finding not previously described.

There has been debate over the nature of SCs in SCH. The immunohistochemical and ultrastructural findings in this study disclosed that the SCs did not exhibit a clonal phenotype but a mixture of heterogeneous cell types. They mainly consisted of fibroblastic cells admixed with pericyte-like cells and macrophages, and smooth muscle cells and primitive mesenchymal cells were also discerned. Such macrophages have been found in most tumours in several species (Evans 1982; Paradimitriou and Ashman 1989). In this study, factor XIIIa, a clotting proenzyme, was detected in some SCs of five lesions, and spindled macrophages positive for MAC 387 and HAM 56 were found. The factor-XIIIa-positive cells have been named "dermal dendrocytes" because

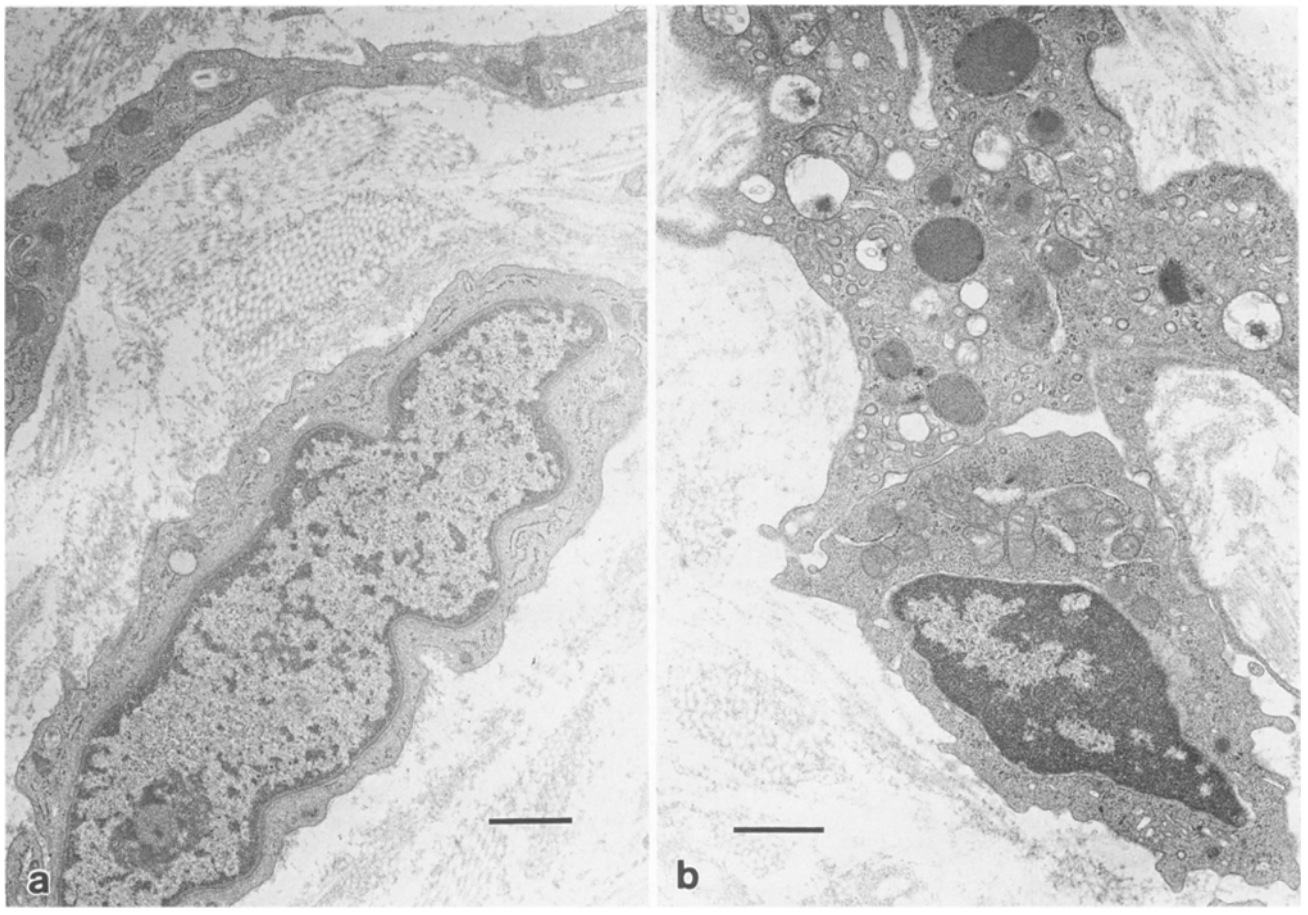


**Fig. 10a, b.** Two types of spindle cells. **a** Elongated fibroblastic cell as shown by moderate amounts of rough endoplasmic reticulum, mitochondria, and free ribosomes. *Bar* = 1 μm. ×11000. **b** Macrophage characterized by numerous primary and secondary lysozomes. *Bar* = 1 μm. ×13000

of their dendritic morphology, and are considered to be stem cells possibly developing fibroblastic or phagocytic activities under an appropriate stimulus (Headington 1986). The presence of factor-XIIIa-positive cells has been found in many inflammatory, reactive, and neoplastic dermatoses, including Kaposi's sarcoma (Nickoloff and Griffiths 1989) and varying types of soft tissue tumours (Arrese and Pierard 1990; Cerio et al. 1989a; Nickoloff and Griffiths 1989; Reid et al. 1986). Although the true nature of the factor-XIIIa-positive cells in SCH is uncertain, a widespread presence of factor-XIIIa-positive cells in a variety of cutaneous lesions seems to represent a host response to a diverse array of stimuli.

Weiss and Enzinger (1986) regarded SCH as a low-grade angiosarcoma or a vascular tumour of intermediate malignancy on the basis of their data that among the 14 patients with follow-up information, 9 experienced "recurrence" and one finally developed a regional lymph node "metastasis". However, the "metastasis" developed after 19 recurrences over a 40-year period and radiotherapy to the lesion, while the last recurrent tumour had areas resembling a conventional high-grade angiosarcoma. Thus, the metastasizing tumour in question may have been a radiation-induced or post-radiation angiosarcoma rather than a true metastatic SCH. There were no metastatic lesions encountered afterwards by other investigators, nor by us, including several long-term follow-up cases of over 25 years.

The clinical course of SCH is typically indolent, with some patients having lesions for more than 20 years before consulting a doctor. There have also been some lesions that were present either at or shortly after birth (Fletcher et al. 1991; Weiss and Enzinger 1986). Moreover, multiple lesions which gradually increased in size and number over a long interval were observed in more than half of the published patients (Fletcher et al. 1991; Scott and Rosai 1988; Weiss and Enzinger 1991) and in six of ten of ours, some of which involved different regions of the body. By careful examination, the "recurrent" lesions were generally found to share only a rough localization and were sometimes far from the original sites. They were seldom or never at the original site; a phenomenon that was observed by both previous authors (Fletcher et al. 1991; Weiss and Enzinger et al. 1991) and us. The anatomical distribution, the rather circumscribed lesion, the cell components without atypia, and dilated vascular spaces containing thrombi or phleboliths such as in benign vascular lesions argue against a malignant potential for SCH. In addition, clas-

sical ultrastructural studies have established a continuum between the pericytes and the smooth muscle cells forming the structural layer external to the endothelium of differing vessels of normal adult mammalian tissues (Dardick et al. 1989; Rhodin 1968). The ultrastructures of vasculature in SCH also contain integral pericyte-like and smooth muscle cells, in contrast to conventional angiosarcoma lacking these structures (Holden et al. 1987; Mackay et al. 1989). The findings, we believe, indicate that SCH is a heterochronologically multicentric benign vasoformative lesion.

Fletcher et al. (1991) hypothesized that SCH is a non-neoplastic, possibly reactive vascular lesion which arises in association with a local abnormality of blood flow at the affected site, in light of the presence of variably malformed vasculature in almost every lesion in their group. Although slightly excessive numbers of thick- or thin-walled blood vessels could be seen in the peripheral regions in some lesions of our series, there was no convincing evidence of arteriovenous malformation, and no cases in our series had any clinical association with vascular malformations or any other vascular tumours. Further studies must still be performed to clarify whether SCH is a true vascular neoplasm or represents a multicentric reactive vascular proliferation, as suggested for Kaposi's sarcoma and some other multiple vasoformative lesions (Auerbach and Brooks 1989; Bayley and Lucas 1990; Ruszczak et al. 1989).

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