

SUB-UNGUAL SPLINTER HÆMORRHAGES

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SUB-UNGUAL "splinter" hæmorrhages have been described in standard medical textbooks for many years as one of the diagnostic features of bacterial endocarditis (Hunter and Bomford, Noble Chamberlain, Davidson, Hunter, Price, Cecil and Loeb, Beaumont, etc.). Pankey (1961) in a series of 167 patients with 186 attacks of subacute bacterial endocarditis found one quarter with splinter hæmorrhages and 70 per cent with conjunctival petechiæ. However, C.K. Friedberg and others (1961) suggest that splinter hæmorrhages should not be regarded as a diagnostic criterion in bacterial endocarditis, and Wood (1956) supports this view saying that such lesions are non-specific.

Untreated bacterial endocarditis carries a high mortality. Thus, the finding of "splinter" hæmorrhages in a patient with established rheumatic valvular disease who has a pyrexial illness or a sudden deterioration in the state of cardiac compensation not due to rhythm change, makes denial of treatment for endocarditis a difficult choice. The difficulty in obtaining positive blood cultures of the elusive *Streptococcus viridans* and the unavoidable time delay before such laboratory results are available, adds to the problem.

Splinter hæmorrhages are known to exist in other conditions. Platts and Greaves (1958) found them in patients with mitral stenosis. They are described in cases of glomerulonephritis (approximately 5 per cent), scurvy, anæmia and recently in a case of juvenile cirrhosis (Read, Sherlock and Harrison, 1963). However, the finding of such lesions more frequently than might be expected in unrelated conditions prompted this study to ascertain the frequency of splinter hæmorrhages in a general hospital population.

Method

Two hundred consecutive in-patients were examined in the wards of a teaching hospital providing the usual cross section of cases to

be found where both acute emergency and waiting list admission cases were housed together. One hundred patients (50 male and 50 female) from medical wards, and one hundred from surgical units were seen in the study.

Any sub-ungual splinter hæmorrhage which was visible to the naked eye on careful scrutiny of the finger nails was included in the survey. Suspect lesions were examined with the +20 lens of an ophthalmoscope under good lighting, i.e., conditions normally available in routine clinical practice without the use of special apparatus. From the ward chart, the patient's age, occupation, clinical diagnosis and hæmoglobin levels were noted. The patients were questioned about the possibility of trauma, however trivial, to the hands and finger nails. The colour, length in millimeters and shape of each hæmorrhage was noted, together with the number of lesions present. Where splinter hæmorrhages were found, the position on the nail was noted and the affected finger recorded. For this purpose the nail was arbitrarily divided into proximal, mid and distal thirds, and where the lesion was in the latter area it was noted whether or not the hæmorrhage extended distally across the line of the nail bed attachment.

Results

1. *The Incidence of Sub-Ungual Hæmorrhages*

132 patients of the 200 studied in the series were found to have sub-ungual hæmorrhages, i.e., an overall incidence of 66 per cent. 70 per cent of medical cases and 62 per cent of surgical cases proved to have splinter hæmorrhages. More detailed figures are shown in Table 1. Applying the chi-squared test, there is no

TABLE 1
NUMBERS OF PATIENTS SHOWING SPLINTER
HÆMORRHAGES

	Medical (100 cases)	Surgical (100 cases)	Total
Male	36 (72%)	36 (72%)	72 (72%)
Female	34 (68%)	26 (52%)	60 (60%)
Total	70 (70%)	62 (62%)	132 (66%)

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TABLE II
DISTRIBUTION OF SPLINTER HÆMORRHAGES ON INDIVIDUAL DIGITS WITH PERCENTAGES
IN PARENTHESIS

	Hand	Thumb	Fore	Mid	Ring	Little	Total
Medical	Right	35(10.7)	22(6.7)	14(4.3)	19(5.8)	9(2.7)	99(30.3)
	Left	21(6.4)	18(5.5)	15(4.6)	17(5.2)	11(3.4)	82(25.1)
Surgical	Right	16(4.9)	23(7.0)	18(5.5)	12(3.7)	5(1.5)	74(22.6)
	Left	19(5.8)	20(6.1)	18(5.5)	6(1.8)	9(2.8)	72(22.0)
	Total	91(27.8)	83(25.4)	65(19.9)	54(16.5)	34(10.4)	327

statistically significant difference between medical and surgical groups, nor between males and females in each group. This incidence is in marked contrast to the findings of Gross and Tall (1963) who report (since the completion of this study), an incidence of 19 per cent in a series of 267 hospital in-patients.

2. Distribution of Lesions

The total number of hæmorrhages counted was 327. Of these, 181 were found in medical (henceforth M), and 146 in surgical (henceforth S) patients. The maximum number of lesions found in one patient was 10, and in those patients with positive findings the average number of splinters per patient was 2.5.

3. Distribution of Lesions in Individual Fingers

Details of distribution are shown in Table 2 and the histogram (Fig. 1). As may be seen from the latter, the thumb and forefinger are the most common sites for location of these lesions.

4. Position of Lesions on the Nail

The majority of splinter hæmorrhages occurred in the distal one-third of the nail (303 or 92.7 per cent), as is shown in Table 3. This section of the nail has been further subdivided in the table. Most lesions extended at least as far as, and in some cases across, the junction between the vascular and avascular or free distal portion of the nail. Only 59 (19.5 per cent) were found at the junction of the mid and distal one-thirds of the nail—a site which has been suggested as the usual origin of splinter hæmorrhages. This area corresponds to the limit of balancing which is found on pressing the pulp of the finger from below.

In some cases the lesion had grown out with the nail and trimmings showed the blood streak incorporated in the underside of the nail. Staining of these trimmings with Prussian Blue was positive for iron confirming the presence of blood.

5. Description of Lesions

By definition splinter hæmorrhages are linear

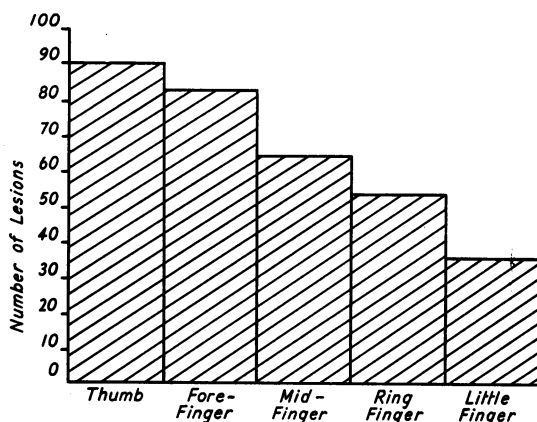


FIG. 1.—Histogram showing the number of lesions on individual digits.

and needle-shaped and the common diffuse sub-ungual hæmatoma, due to trauma, were excluded. Typical lesions are shown in the photographic plates. For purposes of reproduction the photographs show fairly large and obvious splinter hæmorrhages. Many of the lesions included in the survey were smaller, but all were visible beneath the nail or naked-eye examination. The smaller lesions tend to be more guttate, like a pin head, than splinter shaped.

Colour varied from bright red to black, but the majority were reddish brown or dark brown in colour, typical of changed blood. It was uncommon to find several "generations" of lesions in one patient as judged by colour gradations. Thus, when more than one hæmorrhage was present in an individual, all the lesions tended to be the same colour, and this was particularly marked when the hæmorrhages were black.

Length was measured with the aid of dividers, observing the lesion through the +20 lens. The hæmorrhages varied from half to three-and-a-half millimeters, but the majority were one to one-and-a-half millimeters long. No attempt was made to measure breadth.

TABLE 3

POSITION OF INDIVIDUAL LESIONS ON THE NAIL AFTER ARBITRARY DIVISION INTO PROXIMAL, MID AND DISTAL ONE-THIRDS. PERCENTAGES OF TOTAL LESIONS SHOWN IN PARENTHESIS

Division of Nail	Sub-Divisions	Medical	Surgical	Total
Distal Third	Extending to Edge	73(22.3)	77(23.6)	150(45.9)
	Not extending to Edge	70(21.4)	24(7.3)	94(28.7)
	Junction mid-distal	25(7.6)	34(10.4)	59(18.0)
	Total	168(51.4)	135(41.3)	303(92.7)
Mid Third		7(2.1)	10(10.4)	17(5.2)
Proximal Third		6(1.8)	1(0.3)	7(2.1)
Total		181(55.4)	146(44.6)	327

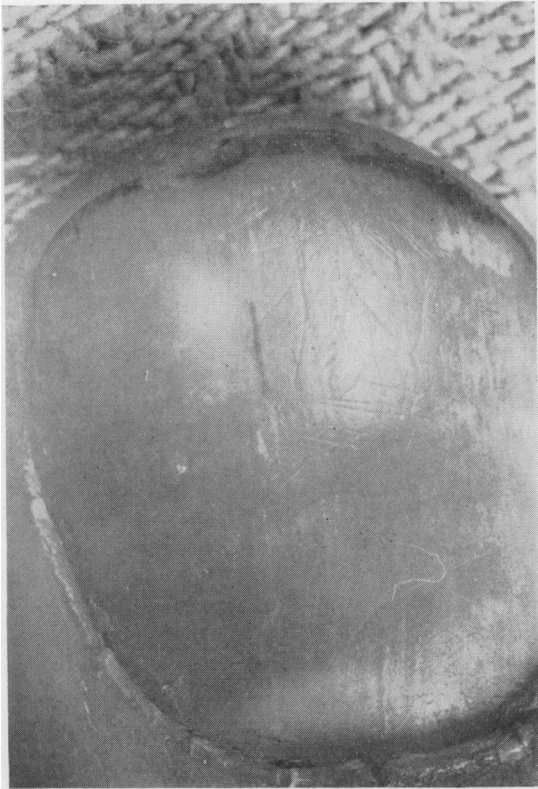


FIG. 2.—An obvious splinter hæmorrhage is seen at the junction of mid and distal one thirds of the nail. Near the top left of the nail is a smaller lesion extending to the nail edge.

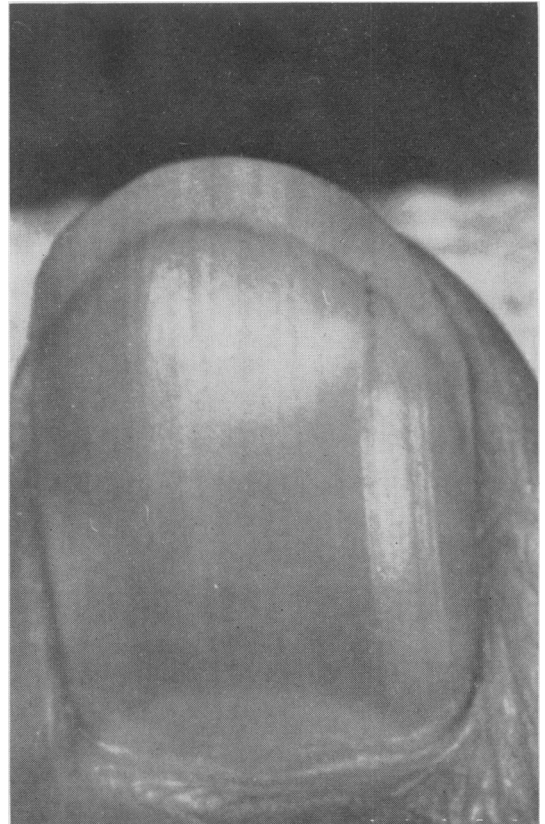


FIG. 3.—Typical long standing lesion, black in colour, showing fragmentation.

Difficulties in observing lesions were found:
 (1) with hands exposed to dirt and trauma, e.g., garage mechanics and manual labourers;
 (2) in the elderly, where minor degrees of nail opacity and onychophytosis were found

particularly affecting the thumb nails;
 (3) where the finger nails were the seat of old trauma, producing distortion in nail growth, and where the nails were bitten;
 (4) in nails which had longitudinal ridges,

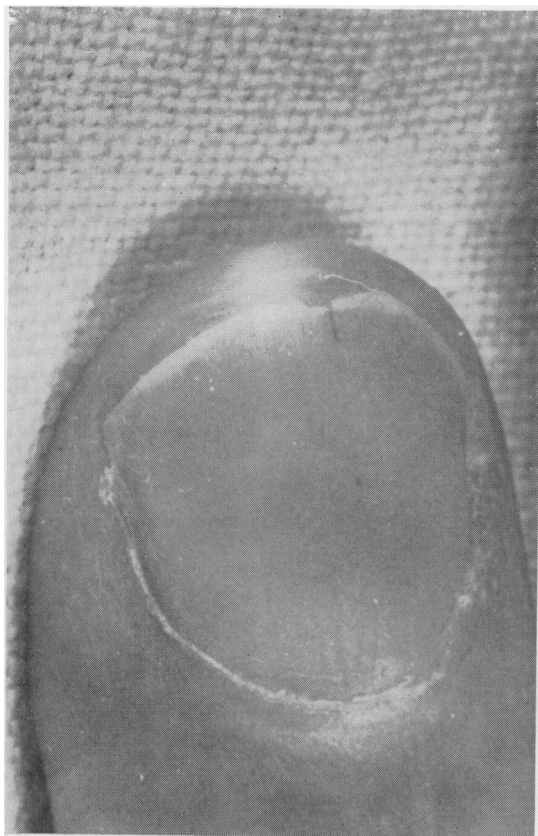


FIG. 4.—Patient with sub-acute bacterial endocarditis showing splinter hæmorrhage in the distal one third of the nail which was partially removed by the investigator for staining. Two other minute hæmorrhages lie in the middle third of the nail.

often ingrained with dirt which superficially resembled splinter hæmorrhages;

(5) in nails which were the subject of disease such as psoriasis and onycholysis.

These problems were overcome, where necessary, by cleaning the nail with clear oil, such as the immersion oil used in microscopy, and by scraping away superficial marks which may be confused with splinters. Blanching of the nail bed by pressure on the pulp of the finger from below was found of assistance in doubtful cases.

6. *The Effect of Trauma*

Approximately one-third of the patients who had splinter hæmorrhages claimed exposure to trauma. Details are shown in Table 4.

When the expected number of patients with splinter hæmorrhages who claimed trauma is compared with the observed number, the chi-squared test shows no significant difference. This is true considering the group as a whole,

and when men and women are considered separately. (The expected number was calculated by taking the overall incidence of 66 per cent of the total number of patients who claimed trauma).

However, a four cell comparison of patients with and without trauma and those with and without hæmorrhages was significant at the level $0.3 < P > 0.2$, and highly significant for males alone ($P < 0.0005$).

Trauma in Relation to Occupation. While the question of exposure to trauma was phrased in the same way for each patient, the results are purely subjective, and must be interpreted as such. It was found, for example, that brick layers, motor mechanics and plumbers' mates would deny knocks to their fingers, while bank managers and other sedentary workers were emphatic that they had often bruised and nipped their finger nails. Many factors were responsible for this apparent discrepancy, as labourers had often been unemployed or ill in hospitals for weeks or months, while office workers were involved in such after-hours activities as laying crazy paving in their gardens.

7. *Effect of Age*

Reference to Table 5 suggests that there is a higher incidence of splinter hæmorrhages occurring after middle life. Comparing the group of patients over 40 years of age with the under 40 group, the chi-squared test does show a significant difference ($0.05 > P < 0.025$). This finding of course parallels other vascular degenerations occurring past middle life.

8. *Effect of Anæmia*

Table 6 shows the numbers of patients with sub-ungual hæmorrhages in relation to hæmoglobin levels. For statistical comparison, the patients were divided into three groups:

- (i) normal or greater than normal level of hæmoglobin;
- (ii) Hæmoglobin 70 - 99%;
- (iii) Hæmoglobin $< 70\%$.

There was no significant difference between observed and expected results in each group.

9. *Effect of the Menstrual Cycle*

Female patients in groups were questioned about the phase of the menstrual cycle. Of the 26 women in this group who had splinter hæmorrhages, 14 were menopausal, four were menstruating, six were in the ovulatory, and one was in the secretory phase. One patient was pregnant at the time of examination. The numbers of patients are too small to permit analysis, but there is no obvious relationship.

TABLE 4

INCIDENCE OF PATIENTS SHOWING SPLINTER HÆMORRHAGES WHO CLAIMED EXPOSURE TO TRAUMA

	Patients with Splinter Hæmorrhages			Patients with no Splinter Hæmorrhages			Total
	Men	Women	Total	Men	Women	Total	
Trauma	31	12	43	8	9	17	60
No Trauma	41	48	89	20	31	51	140
Total	72	60	132	28	40	68	200

TABLE 5

THE EFFECT OF AGE ON THE INCIDENCE OF LESIONS

Age	Patients with Lesions	Patients without Lesions	Total
70+	19	6	25
60-69	25	17	42
50-59	30	10	40
40-49	29	11	40
30-39	16	10	26
20-29	5	7	12
10-19	8	7	15
Total	132	68	200

TABLE 6

THE EFFECT OF HÆMOGLOBIN LEVELS ON THE INCIDENCE OF LESIONS

Percentage Hb.	Patients with Lesions	Patients without Lesions	Total
100%	60	28	88
90-99%	23	16	39
80-89%	13	8	21
70-79%	17	8	25
60-69%	8	7	15
50-59%	6	0	6
<50%	5	1	6
Total	132	68	200

Discussion

From this study, where 66 per cent of patients in a general hospital population showed sub-ungual "splinter" hæmorrhages, it would appear that this sign has little value as a diagnostic pointer in bacterial endocarditis.

In this series, there were four cases (M) of subacute bacterial endocarditis and all of these had splinter hæmorrhages. In the case illustrated in Fig. 4, the patient had a classical Osler node in the pulp of the affected finger. Another of these patients, who had been the subject of several teaching ward-rounds, observed that fresh sub-ungual petechiæ developed during the course of his illness. The development of fresh splinter hæmorrhages in the absence of trauma in patients such as this, is probably the only justification for retaining this physical sign. This viewpoint has been supported by a recent annotation (*Brit. med. J.* 1963).

The pathogenesis of these lesions was not the prime function of this study but several possible factors have been examined. Landau and Davis (1960) studied the nail bed vasculature in diabetes mellitus using a slit lamp and microscope. They found an increase in venous congestion of nail bed capillaries and a rise in pressure of terminal digital vessels. Similar changes were found in conjunctival vessels causing "micro-pools" both in diabetes and in hypertension. The present study included nine patients with diabetes mellitus, five of whom had splinter hæmorrhages, the other four having no obvious nail pathology.

Other writers suggest that splinter hæmorrhages may be an embolic phenomenon. In the case of bacterial endocarditis, the development of fresh sub-ungual petechiæ coincident with the Osler node would tend to support this.

In the general population age and trauma

appear to be the most common predisposing factors. Several colleagues have observed independently that minor trauma, in which the nail tended to be avulsed from the nail bed, produced typical splinter hæmorrhages. These were in the distal portion of the nail and extended to the edge. While splinters tend to "grow out", 303 (92.7 per cent of the total) of the lesions were in the distal part of the nail.

This fact, together with the positive correlation with the patients' claim of trauma, and the distribution concentration in the finger and thumb (together containing 53.2 per cent of the total lesions), would tend to support trauma as a causative factor. Gross and Tall (1963) arrived at a similar conclusion.

No conclusion can be reached about the effect of the menstrual cycle on the incidence of splinter hæmorrhages in this series.

Summary

- (i) The frequency of sub-ungual "splinter" hæmorrhages occurring in a general hospital population was studied to test the hypothesis that this is a common

finding of little diagnostic value in bacterial endocarditis.

- (ii) Two hundred cases (100 medical and 100 surgical) were examined.
- (iii) The overall incidence of patients showing splinter hæmorrhages was 66 per cent. 72 per cent of these were male and 66 per cent female.
- (iv) Methods of examining the hæmorrhages, their characteristics, location and distribution are described.
- (v) Possible ætiological factors are discussed.
- (vi) Advancing age of the patient and exposure to trauma appear to be causative factors.
- (vii) It is concluded that as splinter hæmorrhages occur so frequently in unrelated conditions, they have little value as a physical sign in bacterial endocarditis.

I should like to thank Professor G. M. Bull for his help and advice, Mr. Merritt for assistance with statistics, and the physicians and surgeons of the Royal Victoria Hospital who permitted me to study patients under their care. I am grateful to Mr. R. Wood who took the photographs.

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