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STAPHYLOCOCCUS EPIDEMIC WITH A STRAIN OF THE LYSIS FORM 81
AT A SURGICAL WARD

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STAPHYLOCOCCUS EPIDEMIC WITH A STRAIN OF THE LYSIS FORM 81 AT A SURGICAL WARD

(Following is the translation of an article by Annelore Guenter-Knaack and Martin Sprossig, Institute for Medical Microbiology of the Medical Academy of Erfurt, published in the German language periodical, Zent. Bakt. 194: pages 49-58, 1964. Translation performed by Constance L. Lust.)

In a modern hospital many infections of the staphylococcus aureus strain appear. This infection especially "hits" women's clinics, the surgical clinics and the children's clinics. The strains that appear, mainly isolated from patient's specimens, may be an individual strain appearing alone, or may be a recurring strain present in the hospital for longer periods. If the strains are present during the time of an epidemic then they are designated epidemic strains. It is of interest to prove that the same strain, with similar epidemiological behavior, caused infections. This was facilitated by biochemical and serological reactions, the antibiograms and especially the lysotypical behavior of bacteriophages. If a minimum of three infections appear at a ward, then according to Williams (1959) one can speak of an epidemic. It is necessary to obtain specimens of smears from the nose and throat, as well as the bed materials and air samples in order to trace the origin of an epidemic strain. If the epidemic strain is found in these specimens then the epidemiological conclusion must still be critically evaluated (Meyer 1962). Only in isolated (few) cases is it possible to designate the origins of Staphylococci. The sources found thus far are variable (Williams 1959) determined them for the known epidemics. He, as well as Hegenann et al (1961) showed that epidemics may start from patients with suppurate processes. It may be assumed that these Staphylococci are actually involved in the pathogenicity. The present report concerns itself with such an epidemic which was seen in our ward.

Materials and Methods

All strains isolated from wounds of patients, nose and throat smears of the personnel were differentiated by known methods. The specimens of nose and throat smears, bed smear and air were also characterized by biochemical tests and by antibiograms. Only if these reactions lead to a conclusion that the strain was the one that determined the epidemic, then the strains were typed with bacteriophages. In this way the lysotype was broadly characterized.

1. Biochemical Tests

The egg-yolk reaction and the crystal violet test were particularly useful for differentiating. The phosphatase test and fibrinolyses test

were in agreement with the plasma coagulase procedure. Plasma coagulase test: The samples from the patients were tested with the Roesch method (rabbit plasma), the other strains were checked by the precipitation test (clumping) to Birch-Hirschfeld (1934) Phosphatase was assayed with broth-agar 0.01% phenolphthalein phosphate, 24 hours at 37°C. Fibrinolysis assay: Broth-agar containing 12% human plasma and 6% 1/20m CaCl₂, 24 hours at 37°C. Egg-yolk-reaction: broth-agar containing 5% egg yolk 24 hours at 37°C and another 24 hours at room temperature. Crystal-Violet Test; Broth agar with added crystal violet at a final concentration of 1:300,000, 24 hours at 37°, and a further 24 hours at room temperature. Inoculation of the strains was according to Meyer (personal communication) with enough bacteria in a circular area of 1cm². After incubation the strains showed different colors. Different colors were white, yellow, blue, violet, white-violet, yellow-violet. Mercury chloride test: According to Moore (1966). Peptone-agar with HgCl₂ at a concentration of 1:27,000. Difco-Bacto-Peptone was used in place of Oxoid peptone.

2. Antibigrams

Herrmann (1954) method proved to be useful and very exact for epidemiological investigations. Penicillin, streptomycin, chloramphenicol and oxytetracyclin were employed. The use of Hemmhof diameter were:

0.5 cm R resistant; 0.5-1.0 cm e (weakly sensitive)
1.0 cm E (sensitive)

3. Lysotype

The international Staphylococci phage basis was used with 22 phages (29, 52, 52A, 79, 80, 3A, 3B, 3C, 55, 71, 6, 7, 42E, 43, 53, 54, 75, 77, 83A, 42D, 187, 81, Blair and Williams (1961) method was used to type. We used the 100-1000 routine test dilution (RTD) to type.

Results

Infections of the patients with the epidermic-germ.

At the end of March, beginning April 1963 many staphylococcal infections appeared at a surgical ward. It was observed that the strain of six patients showed identical reactions. A strain of the seventh patient behaved differently in the antibiogram and had a different lysis picture. It was obvious that an epidemic was at hand. In June the germ could still be determined in a patient with furunculosis. Table 1 presents a general picture of the individual cases and of the isolated strains. It may be seen which biochemical reactions characterize the epidemic pathogen. The lysotype showed, with the RTD, the lysis form 81. The resistance to antibiotics did not increase during the period of observation (8 months).

Table 1

General picture of Staph. aureus-Infection

Patient	Diagnosis	evidence for St. aureus		Type of Materials	Biochem. Test										Lysis form (RTD)	
		1st.	later		Plasmacocagulase	Phosphatase	Fibrinolysin	Egg Yellow	Crystal violet	H ₂ O ₂	Penicillin	Streptomycin	Chloramphenicol	Oxytetracycline		
H.M.	Boneosteomyelitis	24.3	2.4 4.4 24.5 29.5 4.6 6.6	wound smear	+	+	+	-	GV	R	R	R	R	E	•	81
B.W.	Decubitalabscess	26.3	-	abcess smear												
O.Be	Decubitalabscess	26.3	4.4	abcess smear												
E.B.	"Fussy" meningitis died 17.6.1963	30.3	31.3 2.4 4.4 7.5 16.5 17.5 24.5 4.6 5.6 6.6 17.6	wound smear liquid wound smear liquid meninges smear												
H.G.	Facial boil	4.4	5.4	boil smear												
F.L.	Woundsuppuratation	4.4		wound smear											E	83A
M.S.	Furunculosis	4.4	5.4	boil smear											•	81
O.Be.	Furunculosis	11.6		boil smear												

Explanation of symbols: GV=yellow violet R: resistant
 E: sensitive e: weakly sensitive

Patients E.B. and M.S. E.B. a 13 year old girl was admitted into the clinic 2 February with sinusitis. The liquid remained sterile, but the smears during the frontal sinus operation on 4 March showed some hemolytic streptococci. During an operation on 14 March and two days later the puss again contained only hemolytic streptococci. Only on the 31 March did massive quantities of Staphylococci appear in wound smears and in fluid. In all instances it involved the epidermic strain. E.B. died on 17 June. During autopsy a meninges smear also showed the epidemic pathogen.

Patient M.S., a 25 year old man, arrived at the ward on 1 March with a furunculosis. An operation was performed on his right arm on 25 March, and on 1 April more symptoms appeared in his leg. On 5 April a boil appeared on his temple. The staphylococci from all boils corresponded to the epidemic germ.

Nose-and Throat-smears of the patients

During the first investigation 9-15 Staph. aureus-carriers of the epidemic germ became evident. Of the six patients with the germ in the smear we also found the germ in nose and throat smears. Patient B.W. had been released already. In F.L. the germ was demonstrated in the nose culture, but a different germ was found in wound smears. During the second and third series of trials the number of "germ"-carriers decreased (Table 2). None of the carriers of the epidemic germ were infected with this strain.

Table 2

Nose and Throat specimens of the Patients

Date	# of patients	# of Staph. aureus-carriers	# of epidemic germ-carriers
8 April	29	15	9
27 June	31	18	4
3 September	34	18	1

Nose-and throat-swabs of the ward-personnall.

On 8 April the epidemic germ was found in a ward helper, a second smear on this person on 7 June was negative. Later it was found in a nurse. Since she was originally negative, she probably contracted the germ on the ward. In further nose specimens on 28 August and 12 November and in other smears the epidemic-germ was always present.

Of all ward personnel about 50% were Staph aureus-carriers in all three investigations. Only one smear was taken from the operating-room personnel. Five of six persons were Staph. aureus carriers; none were carriers of the epidemic strain.

Smears of bed materials

Smears were made of every bed, especially pillows and upper bed material using the sweep-plate technique of Blowers and Wallace (1955). The samples were placed on selective agar containing 7.5% NaCl.

Table 3

Date	# of Rooms	# of Beds	# of beds with reference with Staph. aureus	Evidence of epidemic germ	
				rooms	beds
25 May	7	30	15	5	8
22 June	7	32	19	1	1
24 Aug.	7	31	11	-	-

From table 3 it may be seen that the germ was found on 8 on 30 beds during the first trial. Subsequently, after 4 weeks, only 1 bed contained the germ. Eight weeks later it was absent completely.

Of the seven patients who had the epidemic strain during the infection, two were still in the ward at the time of the first trial. The pathogen was found in both their beds. During the second trial only one of those patients remained on the ward and no epidemic germ was found.

Air investigations

were performed with the slit sampler of Hosel and Steininger. This was done on the ward as well as in the operating room from 29 April - 19 September. 61 strains of Staphylococci were isolated from blood-agar plates, and in no case did they correspond to the epidemic germ. Of the 61 strains, 30 had the lysis form 3A. This was apparently a germ present in the hospital. This strain did not cause any illnesses. During the second trial this germ was completely absent.

Discussion of the Results

The investigations described yielded the answer as to the source of the staphylococci of this infection.

On surgical wards, the infections arising in the operation rooms play

an important role. As sources personnel with skin irritations (Blowers et al 1955, McDonald and Timbury, 1957) must be considered, healthy persons as Staph. carriers (Devonish and Miles 1939; Sompolinsky 1957; Lautermann and Gruen 1958; Penikett 1958) as well as the air in the operating room (Blowers 1955, Shooter 1956). We thought we could differentiate these possibilities since the germs causing the epidemic was not to be found in personnel or in the air of the operating room. Also in wound infections did not play a role. Patient B.W. was never in the operating room and still contracted a decubital abscess.

The germ with lysis form 61 was found in nose- and throat cultures in the personnel of the ward and patients, as well as bed material samples.

The germ was found in a helper, but was later not found again. Also a nurse was positive at about 8 weeks after trials started, but she was negative at the time of the epidemic. Therefore she cannot be a source of the epidemic germ. This nurse was a carrier. She was only transferred (6 Mo.) from the ward after the beginning of the epidemic. Even Williams (1955) observed in several cases that epidemic terminate even though carriers of the germ were still on the ward.

It was of interest that several patients who had the epidemic germ in their smears also carried some in their noses and throats. This observation has been reported previously. Williams (1963) reviewed them and added his own results. He noticed that in a postoperative sepsis in Staph. carriers the organism appears more frequently in the nose than in patients that have no Staph. aureus in the nose or throat area. Carriers with the epidemic strain had an even higher rate of sepsis. In William's report only one case had no clear connection between the germs of the nose and those of the infected wound.

The first bed-material analysis was only started two months after the outbreak of the epidemic, but even then the germs were present in large numbers. This lead to an important example. That, since the Staph. outbreak, it is justified that the same hygienic procedures be carried out in a surgical ward as in an infectious ward. Also bed materials must be "disinfected" after release of patients (Gruen 1962b).

This epidemic was probably started by the germ spreading from one patient. Patient M.S., for example, was admitted with a furunculosis. In typing of the strains we only had "furunculi" of legs and of the temple available. But it may be assumed that Staph. of form 81 would have been present in other boils also.

Hegeman et al (1961) put forth the view that most infections on a surgical division arose from ill patients with infectious centers. Those germs can subsequently enter into a wound caused by the operation. Williams (1963) claimed that patients became infected on a surgical ward not

so much from personnel but rather from other patients. The actual pathogenicity of Staph. is therefore more important than merely knowing the frequency of appearance and its antibiotic resistance. It is important to isolate patients with puss centers. Williams claims (1962) that the rate of sepsis can be halved if an isolation policy controls the Staphylococcus on the ward. In general the infections in surgery may be drastically reduced in basic procedures for safety are thoroughly carried out (Aschenbrenner and Caselitz 1958; Gruen 1962a).

Williams (1959) summarized the phage-type of the known epidemics. It became apparent that only about 6 types are responsible for hospital epidemics. A special significance becomes apparent for type 80/81 (80/81 complex) (Nahmias *et al.* 1961), which appeared in women's clinics as well as on surgical wards. The present epidemic was caused by a germ that was lysed only by phage 81 (1000 X RTD: Lysis form 52/81). Of seven patients 5 received abscesses or "furunculi". Bynoe *et al.* (1956) already pointed out that Staphylococci of lysis form 81 were frequently found in abscesses or boils. Bynoe *et al.* first described phage 81.

We are unaware of another epidemic caused by a germ of lysis type 81. Nahmias *et al.* (1961) found in Atlanta that a strain of lysis form 81 seldom had a relation to illness. For this reason it was especially important to demonstrate that the germ of lysis form 81 was involved here. Further observations will have to tell whether this is as important for epidemics as William's (1959) germs.

Summary

A staphylococcus epidemic which concerned seven patients is described, which occurred at a surgical ward. A Staph. aureus with the lysis form 81 (RTD) was discovered to be the source of the epidemic. The epidemic had been started, almost certainly, by a patient who came to the ward with a furunculosis.

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