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The flora of renal haemodialysis shunt sites

M. H. REBEL, R. VAN FURTH, P. STEVENS, LUCY BOSSCHER-ZONDERMAN, AND W. C. NOBLE

From the University Hospital, Leiden, The Netherlands, and St John's Hospital for Diseases of the Skin, London

SYNOPSIS During investigations of the microbial flora of the skin over haemodialysis shunt sites it has not proved possible to predict clinical infection by a preceding colonization of the shunt site with a pathogenic organism. The normal non-pathogenic flora of the sites is not specifically related to the flora of other sites on the body though *Staphylococcus aureus* on a shunt site appeared to be acquired principally from the nose when the shunt was in the arm or from the perineum when the shunt was in the leg. Cimino shunt sites had a greater density of organisms than did Scribner shunt sites; this may be related to the disinfection procedures.

Shunt site infections occurring in patients on routine haemodialysis are frequently due to *Staphylococcus aureus* or '*Staph. albus*' and such infection may necessitate revision of the shunt or, occasionally, result in septicaemia, pulmonary embolism, or endocarditis (Public Health Laboratory Service, 1968; Goodman, Crews, Ginn, and Koenig, 1969; McIntosh, Petrie, and MacLeod, 1969; Levi, Robson, and Rosenfeld, 1970; Rao, Webster, Sunderland, Smith, Ampalam, and Lee, 1972). The question as to whether shunt site colonization precedes infection, seems not to have been asked; such colonization, if detected, might enable infection to be prevented. This paper records observations and investigations in a dialysis unit of the University Hospital of Leiden.

Methods

Patients undergoing routine, twice weekly dialysis were studied. Investigations were carried out in two phases.

In phase I (1970), patients were examined once a week. The nose, perineum, and skin around the shunt site were sampled using cotton-tipped swabs moistened with broth. Staff members were swabbed in the nose only. When it was not possible to inoculate the swabs directly onto growth media, they were stored overnight in Stuart's transport medium. Swabs were inoculated onto blood agar and examined principally for *Staph. aureus* and other common pathogens such as *Pseudomonas* and *Proteus* species. All *Staph. aureus* strains from this phase were phage typed.

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In phase II (1972), the nose, gums, chest, perineum, axillae, toe webs, and shunt site were examined once only. Swabs were inoculated directly onto blood agar (aerobic and anaerobic incubation), McConkey, CLED, and Sabouraud agar. All except the Sabouraud plates were incubated at 37°C for 24 hr and then at bench temperature for a further 24 hours. One Sabouraud plate was incubated at 37°C for one week, the other at about 30°C for two weeks or more. All organisms were identified to the generic level; coagulase-negative cocci were identified using the scheme reported by Baird-Parker (1963) and diphtheroids by the scheme reported by Somerville (1973).

Clinical notes were used to compile a record of infections from 1968 to 1972.

Results

Table I shows the number of patients diagnosed clinically during 1968 to 1972 as having a shunt infection and the principal infecting organism was recorded. Some patients suffered no apparent infection and another had repeated episodes of infection. Frequently one organism predominated in swabs from patients with repeated infection though others yielded a variety of organisms; table II shows illustrative histories from two patients in 1972.

During the phase I investigations, 32 patients were sampled each week for a period of four months; at this period most of the patients had Scribner shunts. A total of 442 samples was collected, a mean of about 14 samples per patient. On a few occasions the shunt site was not examined by us as infection had been diagnosed by the clinician in charge of the

	Principal Infecting Organisms				Not Swabbed	Total Patients Dialysed
	Staph. aureus	*Staph. albus*	'Other'	'Sterile'		
1968	8	2	5	5	0	26
1969	8	2	1	3	4	34
1970	10	1	0	0	1	32
1971	4	3	1	2	0	26
1972	4	4	2	1	0	28

Table I *Number of patients with infected shunt sites*

'Other' infecting organism included enterococci, *Enterobacter* sp., and *Klebsiella* sp.

patient and a swab already sent to the routine bacteriology laboratory.

The figure shows the results from phase I. There were 18 occasions when colonization of the skin around the shunt by *Staph. aureus* was found. Nine of these weekly colonizations were with strains carried in the nose of the patient and one further strain was carried in the perineum. In the remaining eight the strain could not be traced to the index patient or any other patient, although three might have been acquired from a member of the nursing staff who carried a similar strain in her nose.

In addition to the episodes of colonization, there were nine occasions when the clinician diagnosed infection (all due to *Staph. aureus*) on the appearance of the skin and the presence of pus around the shunt. One infection was with a *Staph. aureus* strain of the same phage type as carried in the patient's nose; four infections were with *Staph. aureus* strains not carried by the patient although three might have been acquired from a staff member. Regrettably the remaining four strains of *Staph. aureus* processed in the routine laboratory were not available for phage typing.

Ten of these 32 patients were frequent nasal carriers of *Staph. aureus* and suffered 15 of the colonizations and five of the infections. Shunt colonization or infection appeared to be sporadic.

Patient	Date	Clinical Infection Present	Principal Infecting Organism	Antibiotic Therapy[1]	Other Observations
Mr A Scribner shunt in arm	1972				
	Jan. 3	+	*Staph. aureus*[1]	A	—
	13	+	*Staph. aureus*	A	—
	21	+	*Staph. aureus*	B	—
	Feb. 9	+	*Staph. aureus*	B	—
	16	+	No bacterial growth	B	—
	22	+ +	*Staph. aureus*	B	High fever, much pus
	29	+	*Staph. aureus*	B	—
	Mar. 15	−	*Staph. aureus*	C	—
	21	+	*Staph. aureus*	C	Clot necessitates revision to Cimino
	27	−	*Staph. aureus*	C	—
Mrs B Scribner shunt	1972				
	Feb. 3	+	*Staph. albus*	—	Fever
	23	−	*Staph. albus*	—	—
	Apr. 29	−	No bacterial growth	—	—
	May 3	−	*Staph. aureus*	C	—
	Sept. 16	−	*Staph. aureus*	C	—
	27	−	No bacterial growth	C	—
	Oct. 11	+ −	Klebsiella	D	Fever
	23	+	Klebsiella	D	Clot necessitates revision to new Scribner
	29	−	No bacterial growth	D	—
	Nov. 2	−	*Staph. albus*	—	—
	19	−	Enterobacter	—	—
	25	−	*Staph. albus*	—	—
	Dec. 13	−	Klebsiella	D	—

Table II *Illustrative histories of two patients with clinically apparent shunt infection*

[1]All *Staphylococcus aureus* strains from Mr A were resistant to penicillin, tetracycline, streptomycin, and sulphonamide, but sensitive to chloramphenicol, kanamycin, gentamicin, and methicillin.

[2]A Doxycyclin 1 × 100 mg/day plus gentamicin 40 mg after dialysis
B Gentamicin 40 mg after dialysis
C Cloxacillin 4 × 1 g
D Doxycyclin 1 × 100 mg/day

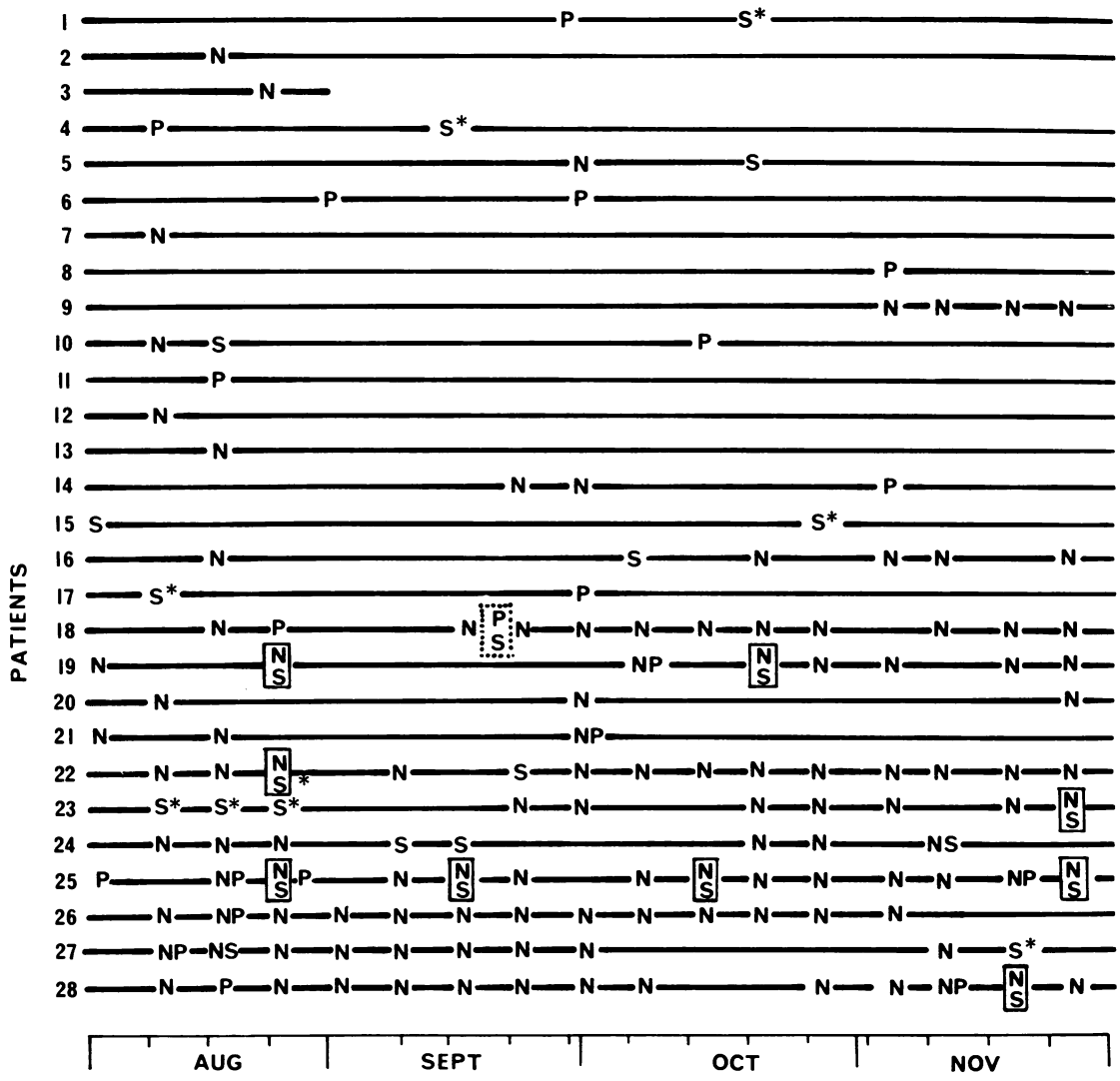

Fig *Colonization of the nose, perineum, and shunt during phase I. Four patients who apparently never carried* Staph. aureus *have been omitted from this chart.*

N = *nasal colonization with* Staph. aureus
P = *perineal colonization with* Staph. aureus
S = *shunt colonization with* Staph. aureus
S* = *clinical infection of the shunt with* Staph. aureus
[N S] = Staph. aureus *of same phagetype isolated*

and there was no evidence from this investigation that shunt colonization preceded clinically apparent infection.

During the phase II investigations, 23 patients were sampled once only. Five patients failed to yield any viable organisms from swabs around the shunt site (no other site failed to yield a reasonable number of organisms) and nine yielded fewer than five colonies of diphtheroids or coagulase-negative cocci (table III). Four of the remaining nine shunt sites yielded *Staph. aureus*; in two instances this was also found in the nose, in one instance in the perineum (scanty *Staph. aureus* round a Scribner shunt in the leg), and the remaining patient yielded *Staph. aureus*

Shunt	No Growth or Scanty Non-pathogens Only	Scanty Pathogens	Heavy Growth Non-pathogens	Heavy Growth Pathogens
Scribner	11	1	4	0
Cimino	3	0	0	4
Total	14	1	4	4

Table III *Distribution of organisms according to type of shunt in phase II*

'Pathogens' include *Staph. aureus* and *Citrobacter* sp. Non-pathogens are principally coagulase negative, Gram-positive cocci and diphtheroids.

from the nose, axilla, and perineum. One patient yielded large numbers of *Citrobacter* sp. from the skin over a Cimino shunt in the arm and this organism was also found in the patient's axilla. One of the four remaining patients yielded large numbers of coagulase-negative cocci (staphylococci of Baird-Parker (1963) type S5 and S6 and micrococci of type M2), organisms of the same type being found elsewhere on the body; two yielded predominantly diphtheroids and the last a mixture of cocci and diphtheroids. No relationship could be found between the non-pathogenic flora of the shunt sites and other sites on the body.

During phase II, 16 patients had Scribner shunts and seven Cimino shunts. Scribner shunt sites were routinely disinfected with an iodine compound, whilst the skin over Cimino shunts was treated with chlorhexidine in alcohol. This is probably reflected in the flora of the shunt sites for the only sites to carry large numbers of organisms were those over Cimino shunts (table III).

Discussion

Staphylococcus aureus is the most frequently reported pathogen of haemodialysis shunt sites (Eykyn, Phillips, and Evans, 1970; Levi *et al*, 1970; Sherrard, 1970; Rao *et al*, 1972) and was found to be endemic in the investigations reported here. There was no evidence from the phase I investigations that colonization of the shunt preceded clinical infection, at least within the limitations set by swabbing once a week. There was a suggestion that one staff member carried strain of *Staph. aureus* responsible for some of the infections, though the phage pattern (group III) was too broad and the antibiotic sensitivity pattern (resistant to penicillin only) too common to make this certain. Since these dialysis patients lived at home except for the two weekly visits to the Unit at night, it is probable that family contacts accounted for some of the untraced strains.

Patients who were nasal or perineal carriers of *Staph. aureus* seemed predisposed to colonization and infection of the shunt site, and in a situation of severe endemic shunt infection, suppression of the nasal or perineal flora might prove of value.

In phase II those patients with an apparently normal skin flora of cocci and diphtheroids at the shunt site carried the same organisms elsewhere on the body, often at multiple sites, and it was not possible to identify any special area as contributing to the organisms around the shunt. Banks, Yates, Cawdrey, Harries, and Kidner (1970) in a study of infection of intravenous catheters also failed to find a correlation between the normal skin flora and organisms infecting the catheter sites.

Patients whose skin over the shunt site was heavily colonized with potential pathogens were also nasal or axillary carriers of the strains; all had Cimino shunts in the arm. There were five patients with Scribner shunts in the arm, none of whom had heavily colonized skin around the shunt. The 11 Scribner shunts in the leg included four with a normal non-pathogenic flora of cocci and diphtheroids around the shunt. Differences in the degree of colonization can probably be attributed to differences in the disinfection technique, for the iodine compounds might be expected to persist on the skin and prevent any luxuriant growth of organisms. It remains possible, however, that the occurrence of an arteriovenous fistula results in higher temperature and humidity at the skin surface, thus favouring the growth of microorganisms.

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