Relationship of Antigen k to *Staphylococcus aureus* Bacteriophage Type 187, of Human and of CanineOrigins

I. LIVE

Department of Microbiology, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, Pennsylvania 19104

Received for publication 5 October 1972

Similarities as well as differences have been observed between phage type 187 *Staphylococcus aureus* cultures of human and of canine origins. Thus, all strains susceptible to phage 187, regardless of their host specificity, were agglutinated by absorbed serum k. (Furthermore, agglutinability of the autoclaved bacteria indicated a reaction with the k1 component of the k-antigen complex.) On the other hand, the strains of canine biotype were in addition agglutinated by absorbed serum 61218, and they possessed biochemical features which distinguished them from human strains of *S. aureus.*

*Staphylococcus aureus* cultures of human and of canine origins have been found to differ in biochemical reactions (7, 8, 11). On that basis, it was ascertained that when *S. aureus* isolates from dogs were susceptible to the international set of phages they were of the human biotype (presumably acquired by contact with people), except for some which were lysed by phage 187 and which possessed characteristics of *S. aureus* of canine biotype (7, 8). Since a correlation has been found to exist between susceptibility to phage 187 and presence of k antigen in *S. aureus* cultures recovered from man (2, 12), the object of the present study was to determine whether *S. aureus* cultures of canine origin lysed by phage 187 likewise possessed k antigen in addition to antigen 61218, peculiar to canine *S. aureus* (13), despite the biochemical differences between *S. aureus* of human and of canine biotypes.

**MATERIALS AND METHODS**

 Cultures. The following groups of cultures were used: (i) *S. aureus* of phage type 187 isolated from anterior nares of dogs at the veterinary hospital of the University of Pennsylvania, (ii) *S. aureus* of phage type 187 isolated from human nasal carriers and from human lesions made available through the courtesy of P. B. Smith and Gary A. Hancock of the Center for Disease Control, Biological Reagents Section, Atlanta, Ga.; H. Morton of the University Hospital, University of Pennsylvania; and L. Blouse, Brooks Air Force Base, Tex.), and (iii) phage-untypable *S. aureus* cultures and cultures of the 80/81 phage complex recovered from hospitalised canine carriers, which were included as controls (the cultures of the 80/81 phage complex were of the human biotype, and the phage-untypable cultures were of canine biotype).

The coagulase test with human and with canine plasma, the fibrinolysin test, and the procedure for preparation of absorbed immune serum 61218 were carried out as previously described (7).

**Preparation of absorbed immune serum k.** The absorbed serum against k antigen of *S. aureus* was prepared according to the procedure outlined by Cohen and Oeding (1).

**Agglutination test.** The slide agglutination technique was employed as previously described (7). When testing for agglutinability by absorbed serum 61218, growth from 18-h Trypticase soy agar slant cultures was used. In tests with absorbed serum k, growth from 18-h mannitol salt agar cultures was employed as recommended by Haukenes (5). In addition, autoclaved bacteria grown on Trypticase soy agar (agar slant growth washed off in a small quantity of saline and heated at 120 C for 30 min) were tested with absorbed serum k to determine whether agglutination reactions took place with the heat-stable antigen k, of the k-antigen complex (5, 9). With all positive reactions, bacterial suspensions were prepared in 0.85% NaCl to test for spontaneous agglutination.

**RESULTS**

The results of the coagulate, fibrinolysin, and agglutination tests are presented in Table 1.

Of the 57 cultures, the 9 canine isolates represented *S. aureus* of canine biotype on the basis of criteria (coagulation of canine plasma only, lack of fibrinolytic activity, agglutination with serum...
TABLE 1. Coagulate, fibrinolysin, and agglutination tests on Staphylococcus aureus of phage type 187, from human and canine sources

<table>
<thead>
<tr>
<th>Source of isolates</th>
<th>No. of cultures</th>
<th>Positive test results (no. of isolates)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Coagulate test</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Human plasma</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Canine plasma</td>
<td></td>
</tr>
<tr>
<td>Canine</td>
<td>9</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Human</td>
<td>48</td>
<td>48</td>
<td>8</td>
</tr>
</tbody>
</table>

* In each instance, the same results were obtained with the live as with the autoclaved bacteria.

Previously described (7), and the 48 cultures recovered from people possessed characteristics of S. aureus of human origin (coagulation of human plasma with or without coagulation of canine plasma, no agglutination with serum 61218, predominantly fibrinolysin-positive reaction). All 57 cultures, in the live as well as in the autoclaved form, were agglutinated by absorbed serum k. On the other hand, of the cultures included as controls (see Materials and Methods), none of those of the 80/81 phage complex and only one of the phage-untypable cultures were agglutinated by absorbed serum k.

**DISCUSSION**

Random finding of antigens peculiar to human S. aureus in phage-untypable staphylococci of canine biotype has previously been reported (11). In the present study, antigen k, a component of human S. aureus of phage type 187 (2, 12), was found to be present also in all examined canine cultures of this phage type (phage 187 being the only one of the international set of phages to which some canine strains of the bacteria have been found susceptible), whereas only 1 of 10 phage-untypable cultures of canine biotype was agglutinated by absorbed serum k. The fact that this serum agglutinated the live as well as the autoclaved organisms in all instances of a positive agglutination reaction indicated a reaction with the heat-stable k1 component of the k-antigen complex (5, 9). The canine strains of the bacteria, however, possessed in addition antigen 61218, not represented in human S. aureus, and there were also biochemical differences between the cultures possessing affinity for the two host species. Strains of S. aureus of phage type 187, therefore, of the two biotypes showed similarity in some respects, and they differed in others, depending on whether they were of human or of canine origin. The observed differences in biochemical properties, which seem subject to change (4), may be due to alteration resulting from adaptation of S. aureus to different host species. The antigenic makeup of staphylococci, on the other hand, has been reported to be a stable characteristic (3, 6, 10). Consequently, the serological evidence of k1 in all of the S. aureus cultures of phage type 187 studied indicated an intimate relationship between this antigen and strains of phage type 187 regardless of their host specificity (the more so since the isolates were from different geographical areas). Thus, the data indicated consistent sharing of an antigen by a phage-defined group of S. aureus of human and of canine origins concomitant with the finding of differential features specifically associated with S. aureus of one or the other of the two biotypes.

**ACKNOWLEDGMENT**

This investigation was supported by a research grant from the World Health Organization.

**LITERATURE CITED**


