LOCAL INFECTION WITH PASTEURELLA SEPTICA
AFTER A DOG BITE

BY

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Pasteurella septica is a common pathogen of animals and birds, generally causing a haemorrhagic septicaemia, and it has been described as an upper respiratory tract commensal organism in cats, rats, and dogs. Human infection has been reported on several occasions following the bites of cats, the first recorded case being that of Kapel and Holm (1930), and occasionally from the bites of other animals, but only four cases following dog bites have been recorded (Allott, Cruickshank, Cyrlas-Williams, Glass, Meyer, Straker, and Tee, 1944; Brunsdon and Mallett, 1953). This is remarkable in view of the fact that the organism can be isolated from the tonsils of 50% of healthy dogs (Smith, 1955). A further case of local infection after a dog bite is reported here.

Clinical History

Mrs. E. R., aged 59, was bitten by a dog which had been frightened by fireworks on November 5, 1955. Seen 30 minutes after the accident, there were two ragged wounds on the dorsum of the right wrist, neither of which penetrated deeper than the subcutaneous fat. The wounds were trimmed and sutured under local anaesthesia, the arm fixed in a plaster slab and sling, and 1,500 units of anti-tetanus serum given after a test dose.

On November 16, 1955, the centre of the wound was noted to be sodden; the sutures were removed, and the area cleaned with CTAB and redressed. By November 19 the centre of the wound had broken down over an area $3 \times 1$ cm., and the patient was admitted for excision and grafting. A swab was taken from the wound, and on culture it yielded a mixed growth of coagulase-positive Staphylococcus aureus and an organism subsequently identified as Pasteurella septica. At operation on November 21 the area was excised and a Thiersch graft from the forearm applied. On December 3 about 60% of the graft had taken, and the area was swabbed and redressed with penicillin cream. Culture of the swab grew Staph. aureus only. By December 10 healing was complete except for a small, raw donor area, and this too had healed by December 14. Flexion of the two middle fingers was incomplete and remedial exercises were started but improvement was slow. The area was radiographed on January 14, 1956, but no abnormal bony appearances were seen. Blood for serological investigation was taken on the same day.

Bacteriology

The organism isolated on November 19, 1955, was a small Gram-negative cocco-bacillus. It was suspected to be Pasteurella septica because of its morphology, its failure to grow on MacConkey medium, and the source of the infection. Its cultural and biochemical characteristics confirmed the suspicion, and identification was corroborated by demonstrating cross agglutination between an antiserum prepared against the organism and known strains of P. septica and vice versa.

The organism was basically cocco-bacillary in form, but pleomorphic when grown on solid media with some filamentous forms. It was Gram-negative, and with methylene blue showed bipolar staining. Growth occurred on unenriched nutrient agar, but was very slow. On blood agar good growth was present after 24 hours; the colonies were low, convex, grey, and translucent with an entire edge, and 1.0–1.5 mm. in diameter. After three days’ incubation they became opaque and whitish grey, with a raised central area and a low periphery. Horse blood was not haemolysed but became slightly browned and cleared after three days. Additional CO$_2$ had no effect on the growth, and the organism also grew under anaerobic conditions, though more slowly. The organism did not grow on MacConkey medium incubated for seven days at 37°C, but grew well in broth and after 48 hours gave a diffuse turbidity. After four days a deposit was present which resuspended incompletely on shaking, giving ropy strands and floccules, but there was no surface ring or pellicle. The organism was non-motile after 18 hours’ incubation in fresh culture at 22°C and 37°C. In gelatin at 22°C a stab culture gave
a fine filiform growth without liquefaction. Growth in peptone water with or without added "sugars" was good after 24 hours.

Biochemical Reactions

These are presented in tabular form and are compared with two strains of *P. septica* from cat bites made available by the National Collection of Type Cultures (NCTC 8489 and 8771) and with the published reactions of certain other strains previously described by other workers. All these strains were similar in morphology and cultural characteristics to the one now reported (now referred to as strain ER) with the exception of Bartley and Hunter (1947). These workers describe growth on MacConkey medium, a finding not confirmed by any other worker.

It will be noted that strain ER differs from all others in that mannitol is not fermented. This sugar has been constantly attacked by all strains isolated from human infections, though Bergey (1948) only states that mannitol is "usually" fermented. Smith (personal communication) states that failure to ferment mannitol is characteristic of canine strains of *P. septica*, only 15% of such strains attacking this sugar. However, of the four strains previously isolated from dog bites, three did ferment mannitol and the ability of the fourth was not recorded. Strain ER also fails to ferment xylose, but fermentation of this sugar is a less constant characteristic. Sorbitol is not attacked by strain ER or by certain other strains, though Bergey states that this sugar is always attacked and uses fermentation of sorbitol as a characteristic to differentiate between *P. septica* and *P. pestis*. Production of H₂S and reduction of methylene blue by the strain ER were both very slow.

Serology

Blood was taken from Mrs. E. R. on January 14, 1956, 71 days after the injury and 35 days after healing was complete. The serum agglutinated strain ER to a titre of 1 in 32, NCTC 8771 to a titre of 1 in 8, and NCTC 8489 not at all. The serum from Mrs. E. R. did not agglutinate randomly chosen strains of *Bact. coli* and staphylococci, and the three strains of *P. septica* were not agglutinated by randomly chosen human sera. There was some difficulty in making smooth suspensions of all strains, which showed a tendency for some cultures to autoagglutinate in saline.

Two sera numbered 0704 and 4307, prepared against strains of *P. septica* obtained from the throats of healthy dogs, were kindly supplied by

### Table 1

| Sugar       | Reduction | Methylene Blue | NH₃ Production | H₂S Production | Nitrate | Voges-Proskauer | Methy] Red | Indole | Limu Milk | Trehalose | Rhamnose | Arabinose | Dextrose | Salicin | Mannitol |
|-------------|-----------|---------------|---------------|----------------|---------|-----------------|------------|-------|-----------|-----------|----------|----------|----------|---------|--------|----------|
| Strain ER   | ++        | +++           | ++            | ++             | ++      | ++              | ++         | ++    | ++        | ++        | ++       | ++       | ++       | ++      | ++      |
| NCTC 8489   | ++        | +++           | ++            | ++             | ++      | ++              | ++         | ++    | ++        | ++        | ++       | ++       | ++       | ++      | ++      |
| NCTC 8771   | ++        | +++           | ++            | ++             | ++      | ++              | ++         | ++    | ++        | ++        | ++       | ++       | ++       | ++      | ++      |
| tolerance   | 8         | 8             | 8             | 8              | 8       | 8               | 8          | 8     | 8         | 8         | 8        | 8        | 8        | 8       | 8       |
| agglutination| ++        | ++            | ++            | ++             | ++      | ++              | ++         | ++    | ++        | ++        | ++       | ++       | ++       | ++      | ++      |

Mr. J. E. Smith of the Royal Veterinary College. Their reactions are set out in Table II. An anti-
serum to strain ER was prepared in a rabbit using a suspension of the organism in 0.5% phenol-
saline as antigen. A course of four intravenous injections at weekly intervals raised the serum
titre, originally 0, to 1 in 60 against strain ER and 1 in 30 against NCTC 8771 and 8489. A further
series of injections of the antigen did not succeed in raising the titre against strain ER, but that
against NCTC 8771 and 8489 rose to 1 in 120.

### Mouse Inoculation

On November 24, 1955, two mice were inoculated with 0.2 ml. each of an overnight broth
culture of strain ER. One mouse injected intra-
peritoneally was found dead next morning, and a
carcass showed pulmonary congestion. A Gram-
negative cocco-bacillus identical with strain ER
was recovered from peritoneal washings, heart
blood, liver, spleen, and lung. The other mouse, injected intramuscularly, remained alive and
well for 14 days. On November 28 two further mice
were injected intraperitoneally, one with 0.1 ml. of
a 1 in 10 dilution of an overnight broth culture,
and one with 0.2 ml. of a 1 in 100 dilution. Both
mice remained alive and well for 14 days.

### Discussion

The literature on human infections with
*P. septica* up to 1947 is summarized by Schipper
(1947), who records among other cases 18 infec-
tions from cat bites, three from dog bites (those of Allott *et al.*), and one each from rabbit and
panther bites. Since this date human infections in
Great Britain have been recorded by Bartley and
Hunter (1947), sinusitis; Brunsdon and Mallett
(1953), dog bite; Pizy (1953), multiple arthritis in
an infant; and Cawson and Talbot (1955), bronchiectasis. Bezjak and Mimica (1952) report
two cases of upper respiratory tract infection from
Jugoslovia, and refer to three other recent Euro-
pean reports.

Human infections were divided by Regamey
(1939) into those following trauma, those follow-
ing animal bites, and those of obscure origin. Bezjak and Mimica give figures of 50%, 10%, and
40% for these three groups, and point out that
of the last group many infections involve or are
related to the upper respiratory tract. *P. septica*
has been reported as an upper respiratory com-
mensal in cats (Schenk, quoted by Allin, 1942 ;
Hansmann and Tully, 1945), rats (Schipper, 1947),
and dogs (Smith, 1955; carrier rate of 50% in
healthy animals). Topley and Wilson (1955) men-
tion an animal-house keeper who carried *P. septica*
in his nose for several months without ill effect,
and Needham is reported by Bezjak and Mimica
as stating that he had isolated *P. septica* from 28
patients, nearly all with bronchiectasis. Several
of the cases mentioned by Regamey are of trauma
to the face or head followed by sinusitis or
meningitis, and it seems not improbable that
*P. septica* may occur as a human upper respira-
tr tract commensal. In two cases of sinusitis the
organism was pathogenic and pyogenic, but in
bronchiectasis its pathogenicity is in doubt, and
Cawson and Talbot (1955) consider that it is prob-
ably only the colonizer of an already damaged
bronchial tree.

Infections from animal bites have been charac-
terized by prolonged course, slow healing, and a
tendency to bone involvement. Antibodies to the
organism are not commonly formed during such
infections, and only Allott *et al.* (1944) record that
in one case of dog bite infection the serum of the
patient contained agglutinins for the infecting
organism to a titre of 1 in 80, and to a strain of
*P. septica* from another dog bite infection to a
titre of 1 in 20. In systemic infection a high level
of antibodies may be produced, as in Ludlam's
(1944) case of appendix abscess.

### Classification

When members of the group *P. septica* were
first isolated from various animals they were
named in terms of the infected animal; e.g.,
*P. suiseptica*, *P. lepiseptica*, etc. Further investiga-
tions emphasized the homogeneity of the group
and the specific prefix was in general omitted, all
being described as *P. septica* (*P. multocida*). Sub-
sequent attempts have been made to subdivide the
group again, either on the basis of fermentative
capabilities or on serological relationships.

Rosenbusch and Merchant (1939) excluded *P.
pestis* and *P. pseudotuberculosis* and divided the
other members of the *Pasteurellae* from animals
as follows:

### Table II

<table>
<thead>
<tr>
<th>Organism</th>
<th>Antiserum</th>
<th>Rabbit Immunized with ER</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER</td>
<td>1 32</td>
<td>&lt;1 30</td>
</tr>
<tr>
<td>NCTC 8489</td>
<td>Nil</td>
<td>&lt;1 30</td>
</tr>
<tr>
<td>NCTC 8771</td>
<td>1 8</td>
<td>&lt;1 30</td>
</tr>
</tbody>
</table>

Local Infection with *Pasteurella Septica* After a Dog Bite
Atypical strains, which haemolyosed rabbit blood and fermented lactose, maltose, trehalose, raffinose, and inositol, were grouped as *P. haemolytica*. The remaining strains were grouped as *P. septica* and subdivided according to fermentation reactions:

**Group I**: Fermented arabinose and dulcitol, but not xylose.

**Group II**: Fermented xylose, but not arabinose or dulcitol.

**Group III**: Fermented all three sugars.

All fermented glucose, mannose, laevulose, and galactose, and none fermented rhamnose, salicin, inulin, dextrin or starch. Of the strains used to establish this classification, one was from a cat and one from a rabbit, but no dog strains were included.

Bezjak and Mimitca quote Pestana and Rugai (1943) as stating that 97% of avian Pasteurella strains fermented arabinose, while mammalian strains failed to do so. They also quote Stamatin (personal communication) as stating that avian strains ferment arabinose but not xylose, while mammalian strains ferment xylose but not arabinose. Both strains described by these authors were of the avian type, but they proved non-pathogenic for pigeons and only one of their patients gave a history of contact with birds. Strains have been described from human infections which fermented neither of these sugars (ER, NCTC 8771, Cooper and Moore, 1945) while others fermented both (Bartley and Hunter, 1947). Of the strains recorded in Table I, not all the data are available, but by the classification of Rosenbusch and Merchant NCTC 8489, strains “Allin” and “Cawson and Talbot” fall into Group 2, and NCTC 8771, ER, “Ludlam” and “Cooper and Moore” are abnormal.

Serological subgrouping of *P. septica* was attempted by Cornelius (1929) working with 26 isolated animal strains, of which only one was from a cat and none of canine origin. He classified his strains into four groups; of the strains isolated from one species of animal, only those from mice fell together into the same group, and there was some suspicion that these strains were the same one isolated at different stages of an experimental epidemic. Cornelius makes no reference to classification based on fermentative capabilities.

It appears that a classification of the *P. septica* group based on strains isolated primarily from wild animals is inadequate to classify those isolated from human infections. The fermentative reactions of the group appear to be more diverse than has been appreciated, and this, the variable agglutinability and the rapid loss of virulence described by some workers as occurring in laboratory cultures, may be related phenomena. They may represent either distinct subdivisions of the group, or possibly a high endogenous mutation rate for these characteristics.

**Summary**

A case of localized human infection with *Pasteurella septica* resulting from a dog bite is described.

The identification and classification of *P. septica* from human infections are discussed.

I am indebted to Sir William Gissane for permission to utilize the clinical notes of the patient under his care, to Dr. S. Sevitt for help and encouragement, and to Mr. J. E. Smith, of the Royal Veterinary College, for unpublished data and the gift of sera.

**References**


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