

THE EVIDENCE OF *BRUCELLA ABORTUS* INFECTION IN SLAUGHTERHOUSE MEN.

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OF recent years much attention has been paid to the incidence of *abortus* infection in various classes of persons as shown by the agglutination test. Numerous observers have shown that in the sera from febrile subjects the incidence of *abortus* agglutinins is such as to indicate a prevalence of this infection formerly unsuspected. A second type of investigation has been concerned with the inquiry into the incidence of such agglutinins in the sera of healthy persons, or those suffering from diseases other than undulant fever, who have furnished controls to the results obtained in febrile subjects. The inherent difficulty in obtaining proper controls lies in the frequency of the infection in cow's milk, and hence the difficulty in deciding whether such agglutinins as occur in "normal" persons have or have not been acquired, and whether or not they indicate some degree of infection at some period of life. Certain of these enquiries have furnished very suggestive evidence of infection with *Brucella* in those who might, by occupation or diet, be especially exposed to this organism. We may illustrate the various investigations referred to by quoting from the results of a number of workers as set out in Tables I and II.

It is evident that in a certain small percentage of "normal" subjects some agglutinins for *Brucella* are commonly to be found; the incidence of these depending upon the titre accepted as significant, which varies widely with different workers. It is not at present possible to say what extent, if at all, agglutination in low titres may be considered "normal" in view of the wide prevalence of the infection. It is clear, however, that there is a notable association between occupation, and the chances of infection, with the incidence and strength of these agglutinins. For example, where a titre of 1 in 100 is accepted as significant, the results of McAlpine and Mickle, and Cornell and de Young, with Wassermann sera and the sera of pregnant women, and those of Darsin with sera obtained mainly for the Wassermann test, indicate that the incidence of agglutinins is below 1 per cent. On the other hand, at the same titre, Huddleson and Johnstone obtain an incidence of agglutinins of 26 per cent. in the case of veterinary surgeons.

At lower titres correspondingly higher figures are obtained, but the results of Parry Morgan, and Welsh, indicate that this may be lowered to between 1 in 25 and 1 in 40 without any very notable increase in the incidence of evidence of infection in the same class of subjects. The titre of 1 in 10 adopted

by Harrison and Wilson, on the other hand, results in a very definite increase in incidence. It is of course arguable that even low titres indicate active infection at some time. The evidence from the observations in the latter part of Table II seems to indicate clearly, however, that both the incidence and concentration of agglutinins in persons especially exposed to the infection are notably in excess of those found in persons not specially exposed. The figures of Lentze, and of Carpenter, Boak and Chapman, for possible milk infection,

Table I. *Febrile cases. Sera derived from patients suffering from febrile disease.*

Author	Country	Period	No. of sera examined	Titre accepted as positive	No. of positives	%
Kristensen	Denmark	1927-8	4600	1 in 100	500	10.9
Hardy	U.S.A.	1927	783	1 in 80	38	4.9
Harrison and Wilson	England	1928	42	1 in 10	11	23
Meisel	Poland	1929-30	687	1 in 50	18	2.6
Parry-Morgan	Wales	1929	46	1 in 250	2	4.4

Table II. *Sera from normal subjects or persons not suspected of Brucella infection.*

Author	Country	Period	No. of sera examined	Titre accepted as positive	No. of positives	%	Remarks
Evans	U.S.A.	1923	500	1 in 5	59	11.8	Wassermann sera
Welsh	U.S.A.	1926-7	2433	1 in 25	60	2.5	"
McAlpine and Mickle	U.S.A.	1927	10137	1 in 100	63	0.6	"
Harrison and Wilson	England	1928	998	1 in 10	54	5.4	"
Parry-Morgan	Wales	1929	1325	1 in 40	5	0.4	"
Darsin	Latvia	1928-9	1100	1 in 100	18	1.6	Wassermann and Widal sera
Cornell and de Young	U.S.A.	1929	1015	1 in 100	Nil	Nil	Pregnant women (4 reacted at 1 in 10 and 2 at 1 in 40)
Carpenter, Boak and Chapman	U.S.A.	1928	4050	1 in 15	296	7.3	Wassermann sera
Carpenter, Boak and Chapman	U.S.A.	1928	955	1 in 15	24	2.4	As above, but in a population supplied with pasteurised milk
Larson and Sedgwick	U.S.A.	1913	425	Complement fixation	73	17.4	Children fed on raw milk
Fici	Italy	1922	98	—	11	11.2	Tuberculous patients
King and Caldwell	U.S.A.	1927	1007	1 in 15	91	9	Inmates of sanatoria
Lentze	Germany	1930	54	1 in 120	13	24	Milkers, etc.
Hardy, Hudson and Jordan	U.S.A.	1929	167	1 in 80	29	17	Killers and dressers of pork
Hardy, Hudson and Jordan	U.S.A.	1929	50	1 in 80	1	2	Controls to above
Huddleson and Johnstone	U.S.A.	1930	49	1 in 100	13	26	Veterinary surgeons

and Hardy, Hudson and Jordan for persons engaged in slaughtering and the dressing of pork are especially suggestive.

The observations which we ourselves have made concern the presence of *Brucella* agglutinins in slaughterhouse men in Liverpool. The sera from these have been tested against both *Br. abortus* and *Br. melitensis*, the Oxford standard suspensions being used. Unheated sera have been employed and agglutination carried out in a water bath at 37° C. In a majority of the cases the test has been repeated with heated sera. The results were essentially the

same as with the sera unheated: if anything, heating seemed slightly to intensify the reaction. Controls have been made with the sera of male subjects of the same age groups. The results are given in gross, in the first instance (see Table III), and thereafter analysed according to occupation. The actual gross

Table III.

Case ref.	SLAUGHTERERS. Total 100.					SLAUGHTERERS. Total 100.				
	<i>Abortus</i>					<i>Melitensis</i>				
	1/10	1/20	1/40	1/80	1/160	1/10	1/20	1/40	1/80	1/160
2	±	+	+	+	+	+	+	+	-	-
12	+	+	+	-	-	±	-	-	-	-
24	+	+	-	-	-	±	-	-	-	-
32	+	+	+	+	±	+	+	+	-	-
43	+	±	±	±	-	+	±	-	-	-
44	±	-	-	-	-	±	-	-	-	-
47	+	+	±	-	-	-	-	-	-	-
68	+	-	-	-	-	±	-	-	-	-
72	+	-	-	-	-	-	-	-	-	-
73	+	+	+	+	±	+	+	+	-	-
76	+	+	±	-	-	+	+	+	-	-
79	+	+	±	-	-	+	+	-	-	-
81	±	±	+	+	+	±	+	+	-	+
83	+	+	+	-	-	+	-	-	-	-
90	+	+	+	±	-	+	+	-	-	-
100	+	+	+	-	-	+	+	-	-	-
Total positives	16	13	12	6	4					

Case ref.	CONTROLS. Total 100.					CONTROLS. Total 100.				
	<i>Abortus</i>					<i>Melitensis</i>				
	1/10	1/20	1/40	1/80	1/160	1/10	1/20	1/40	1/80	1/160
4 a	+	±	-	-	-	+	±	-	-	-
9 b	±	±	-	-	-	0	±	-	-	-
12 b	+	-	-	-	-	-	-	-	-	-
3 c	±	-	-	-	-	-	-	-	-	-
11 c	+	+	-	-	-	0	-	-	-	-
12 c	+	±	-	-	-	+	±	-	-	-
18 c	±	-	-	-	-	±	-	-	-	-
19 c	0	±	-	-	-	0	-	-	-	-
20 c	+	±	-	-	-	0	±	-	-	-
29 c	±	-	-	-	-	-	-	-	-	-
30 c	+	-	-	-	-	+	±	-	-	-
47 c	±	-	-	-	-	±	-	-	-	-
48 c	-	-	-	-	-	±	-	-	-	-
63 c	+	-	-	-	-	-	-	-	-	-
64 c	±	-	-	-	-	-	-	-	-	-
66 c	+	±	-	-	-	-	-	-	-	-
70 c	-	+	+	+	+	+	+	+	+	+
73 c	+	+	±	-	-	±	+	±	-	-
76 c	+	-	-	-	-	+	-	-	-	-
Total positives	18	9	2	1	7					

0 = test not done in this dilution. + = definite agglutination.
 - = negative. ± = partial agglutination.

NOTE. In general the *abortus* suspensions were agglutinated to a higher titre than the *melitensis*; especially in the group of slaughterhouse workers.

incidence of *abortus* agglutinins at a titre of 1 in 10 is greater in the control series than in the slaughterhouse men, but it is evident that this only applies to low titres—at a titre of 1 in 40 or more the figures are only 12 per cent. for the slaughterhouse men as against only 2 per cent. for the controls.

AGE.

If the presence of *abortus* agglutinins in the sera of individuals in a population, not exposed to other risks of infection, is determined by milk consumption, then in the control group there may well be evidence of the disappearance of these agglutinins as age advances. On the other hand, if the *abortus* agglutinins in the slaughterhouse workers are due to infection associated with their trade, no such age distribution would be expected. Table IV affords an analysis in this respect.

Table IV.

Age	No. of subjects	% showing agglutinins	
		Slaughterhousemen	Controls
16-25	80	12.5	20
26-35	14	20	14
Over 35	6	50	16.5

The numbers in these groups are too small for conclusions to be drawn from them, but the indications are suggestive.

OCCUPATION.

In the Liverpool district it is usual for a man to work entirely with one class of animal. A man who slaughters sheep does this continually and with few exceptions is not also employed in killing oxen or pigs, and *vice versa*. It is therefore possible and interesting to examine the relationship of *abortus* agglutinins to occupation.

Table V.

	No. in group	Titre	Total positive	% positive
Sheep slaughterers	47	1/10	7	15
		1/40	5	10.5
Pig „	22	1/10	*1	4.5
		1/40	0	0
Cattle „	34	1/10	9	26
		1/40	7	20.5

* Also sheep

The figures in Table V again refer to only small series, but as far as they go they indicate a maximum likelihood of infection from association with cattle. On the other hand, it is interesting to note that only one of the twenty-two men engaged in slaughtering swine showed any agglutinins, and this individual, whose serum agglutinated *Br. abortus* at a titre of 1 in 20, was also at times engaged in dealing with sheep. The lack of evidence of infection in the group concerned with swine is contradictory to the general conclusion in America (Hardy, Hudson and Jordan), where this animal is considered an important vector of *abortus* infection. It accords well, however, with clinical opinion in this country which lays no stress on the pig as a source of infection. The relatively high incidence of agglutinins in the killers of sheep is worth further

investigation and suggests a greater importance for this animal as a source of infection than has been generally admitted in Great Britain, although its rôle is well recognised in Southern Europe (Favilli).

SUMMARY.

Men engaged in slaughtering and dressing meat show a higher incidence of *Brucella abortus* agglutinins than those in similar age and sex groups who are otherwise employed, where titres of 1 in 20 and upwards are observed.

This applies especially to men who deal with cattle and sheep; no such increased incidence has been noted in men dealing with pigs.

It would seem that a titre in the vicinity of 1 in 40 serves to indicate evidence of *Brucella* infection definitely greater than that likely to be found in the generality of the community.

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