Human and animal brucellosis in Jordan between 1996 and 1998: a study


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Summary

Between 1996 and 1998, a total of 2,494 samples of blood from humans and animals were collected and tested for brucellosis. This total included 1,594 samples of animal blood, collected from 1,050 sheep from 20 flocks, and 544 goats from eight herds. The serum samples were tested using the Rose Bengal test, the tube agglutination test, the complement fixation test and an enzyme-linked immunosorbent assay. Moreover, a complete history was compiled from each flock/herd. The rate of abortions in sheep due to brucellosis ranged from 0.5% to 56%, with a mean of 33.2%. The goats had a higher abortion rate. Thirty-four aborted sheep foetuses collected from these 20 flocks were bacteriologically and pathologically examined. A pure culture of *Brucella melitensis* biotype 3 was isolated from 21 of the aborted foetuses.

The human blood samples were collected from two groups: first, from 800 apparently healthy people who were reporting to community hospitals for routine health checks and secondly, from 100 people from groups with a high-risk of contracting brucellosis, such as veterinarians, sheep-herders and laboratory technicians. The *Brucella* antibody titres for the 900 human serum samples were obtained using the microtitre agglutination test. The cumulative percentage of the serum samples showing a titre reading greater than 1:80 was higher in the at-risk group than among the normal population (7% compared to 4.1%). Although these results were not statistically significant, the higher percentage of positive reactors among the high-risk group may indicate an increased risk factor among professional agricultural and veterinary personnel in Jordan.

It was concluded that brucellosis is common in sheep and goats in Jordan, subjecting the human population to high risks. *Brucella melitensis* Rev. 1 vaccination has been internationally recognised as the key to successfully controlling the disease. All animals in Jordan were repeatedly vaccinated between 1996 and 1998 on a trial basis, using a reduced dose of 1 × 10⁶ colony-forming units (CFU). Cumulative data on the annual rate of human cases of brucellosis indicate that fewer people are affected each year. The same is true for the rate of abortions in animals. Such evidence strongly suggests that the vaccination programme has been successful. However, as wild strains of *Brucella* have also been isolated from vaccinated animals, the authors recommend increasing the amount of vaccine to a full dose of 1 to 2 × 10⁹ CFU and vaccinating young female animals between the ages of three and eight months. To avoid brucellosis in humans, people should be educated about the dangers of contact with infected animals and the consumption of raw milk and milk products.

Keywords

Introduction

Brucellosis, also known as Mediterranean fever, remittent fever, Malta fever and undulant fever, is a zoonotic disease caused by *Brucella* species. It is a worldwide problem, with significant public health and economic implications (2, 14). The causative agent, a Gram-negative, facultative, intracellular bacterial pathogen, can cause serious infections in people and animals (16). The main *Brucella* species found in sheep and goats in the Middle East is *Brucella melitensis* (4, 7, 21, 22, 27, 31). The principal symptoms in sheep and goats are, as follows:
- abortion, typically in the third or fourth month of pregnancy
- the birth of weak lambs which do not thrive
- infertility (3).

This zoonosis is easily transmitted from one animal to another and from animals to humans (6). The epidemiological evidence indicates that at least 90% of human *Brucella* infections can be attributed to direct contact with infected livestock and to the consumption of contaminated raw milk and raw milk products (8). In the Middle East, brucellosis has long been recognised as a problem for humans and animals with a high economic impact throughout the region. The disease has been reported in Jordan, Saudi Arabia, Iraq and Syria, with varying incidences (1, 4, 7, 21, 27, 30).

Jordan has a total human population of approximately 4.8 million (25). According to the Annual Report of the Ministry of Agriculture, 2000, Jordan has approximately 1.9 million sheep and 461,000 goats (24). It is a developing country where brucellosis is still occurring. The number of human brucellosis cases is directly related to the prevalence of *Brucella* infections among sheep, goats and other animals.

In Jordan, sheep and goats are vaccinated with the *Brucella melitensis* Rev. 1 vaccine. This vaccine is injected subcutaneously, at a reduced dose of $1 \times 10^7$ colony-forming units (CFU) of *B. melitensis*. Animals are vaccinated at all ages, at any time during the year and annual revaccination is recommended. Each year, about 18% to 25% of the sheep and goats in Jordan are vaccinated (24). There are approximately 40 to 45 sheep or goats for every 1,000 families in the population, and an average of six people per family depend on animal husbandry. Jordan produces 61.4% of its milk requirements and the other 38.6% are imported as pasteurised powdered milk or milk products. Dairy products, such as soft cheese, cottage cheese, yoghurt and butter, are prepared from sheep and goat milk and many of these products are consumed fresh – in fact, as freshly as possible. It is customary in Jordan to drink raw milk and eat fresh cheeses; however, this habit has been found to be an important epidemiological factor in contracting brucellosis (15). *Brucella* species have been isolated not only from human brucellosis patients (32), but also from milk and other dairy products (4, 15).

The objective of this study is to examine the seroprevalence of human brucellosis in Jordan and the sero-epidemiology of brucellosis in sheep and goats. The authors also discuss the public health significance of brucellosis and the ways and means in which this disease might be prevented.

Materials and methods

Sheep and goats

To determine the seroprevalence of brucellosis in sheep and goats, a total of 1,050 sheep from 20 flocks and 544 goats from 8 herds were examined between 1996 and 1998. The flocks of sheep came from eight of the twelve provinces of Jordan, whereas the goats came from four provinces (Table I). Histories on the management, incidence of abortion, vaccination programme, time of lambing and number of infected sheep-herders were obtained for each group of animals. Four flocks of sheep and three herds of goats had known histories of brucellosis, with symptoms such as abortion, retention of the placenta and infertility. Flock/herd size ranged from 16 to 2,000 animals. Six flocks/herds were classified as small (16 to 100 animals), 18 flocks/herds as medium (101 to 400) and four flocks/herds as large (> 400).

Blood was sampled using a systematic random sampling method (23). The sera were separated and stored at – 40°C until used. Each animal was sampled only once during the study. The abortion rate was calculated as the percentage of pregnant ewes which aborted per gestation.

Data on the total sheep and goat populations in Jordan, the percentage of sheep vaccinated against brucellosis and the incidence of abortion in sheep and goats were obtained from the annual reports of the Ministry of Agriculture for the years 1989 to 2000 (24).

Serological testing

The following tests were conducted on all the animal sera:
- the Rose Bengal test (RBT)
- the tube agglutination test (TAT)
- the complement fixation test (CFT)
- an enzyme-linked immunosorbent assay (ELISA) (6, 29, 34).
The RBT was performed with standard Brucella antigen. A total of 40 infective units (IU) per millilitre (ml) by tube agglutination was considered a positive result, as recommended by the World Health Organization (WHO) (12). The CFT was conducted according to the method described previously (6). A titration of haemolysin and antigen was performed before the test. The minimum haemolytic dose was also estimated for each run. The end point titre was taken as the first well showing approximately 50% lysis of indicator cells. An absence of haemolysis at a serum dilution of 1:10 was regarded as a negative result. Sera giving a titre equivalent to 20 international complement fixation test units per ml or more were considered to be positive (30). The indirect ELISA method used anti-Brucella immunoglobulin G antibodies. Brucella abortus 1119-3 lipopolysaccharides were used as a coating antigen. Positive and negative control sera were taken from Brucella abortus strain 19 (S19) vaccinated and unvaccinated heifers, respectively, to standardise the test. The samples were measured photometrically in a light path at 405 nm. A reading of 0.32 or less was regarded as negative.

In regard to the human samples, the B. melitensis and B. abortus antibody titres of the tested sera were obtained by microtitre agglutination, which is one of the most widely accepted screening tests for human brucellosis (19, 26). Stained B. melitensis (M antigen) and B. abortus (A antigen) suspensions were obtained and the final dilutions of the tested sera ranged from 1:20 to 1:320, respectively. The titre was calculated as the highest dilution that showed clear agglutination.

**Pathological and bacteriological examination**

A total of 34 aborted foetuses were bacteriologically examined. Tissues from the lungs, liver, spleen and heart of three of the aborted foetuses which were shown to test positive for the presence of bacteria were fixed in 10% neutral buffered formalin for histopathological study. Sections five microns thick were prepared by standard methods and stained with haematoxylin and eosin. Stomach contents were aspirated by sterile syringes. Slide smears were prepared and stained using Stamp's method (33). For bacteriological isolation, parts of the stomach contents, liver, lungs and heart were streaked on potato-dextrose agar, trypticase-soy agar and blood agar. The plates were incubated at 37°C in a jar to which CO2 was supplied. Growth was examined macroscopically and microscopically. Brucella cultures were identified and typed by morphology, Gram stain and agglutination with A and M monospecific antisera, according to the method described by Corbel and Hendry (11).

**Human data**

A total of 900 human serum samples were collected from two distinct groups of the population in Jordan. The first group was composed of 800 apparently healthy volunteers, including blood donors and individuals reporting to hospital laboratories for routine health checks (excluding testing for brucellosis). The number of samples collected from each region of Jordan was representative of the size of the population in that area. Thus, 200 samples were obtained from the northern region of Jordan, 400 from the central areas, and 200 from the south.

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**Table I**

Design of a study of the sero-epidemiology of brucellosis in sheep and goats from eight provinces of Jordan between 1996 and 1998

<table>
<thead>
<tr>
<th>Governor provinces</th>
<th>Number of flocks/herds examined</th>
<th>Number of aborted foetuses collected</th>
<th>Bacteriological isolations from foetus (number of flocks experiencing abortions)</th>
<th>Positive serology results by RBT</th>
<th>ELISA</th>
<th>Number of shepherds infected</th>
<th>Number of flocks vaccinated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mafrak 3 (sheep)</td>
<td>290</td>
<td>4</td>
<td>+ 3 (3)</td>
<td>46</td>
<td>37</td>
<td>5 (one family)</td>
<td>1</td>
</tr>
<tr>
<td>Irbid 3 (sheep)</td>
<td>105</td>
<td>2</td>
<td>+ 1 (2)</td>
<td>9</td>
<td>7</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Ramtha 3 (sheep)</td>
<td>160</td>
<td>3</td>
<td>+ 2 (2)</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Jarash 3 (sheep)</td>
<td>85</td>
<td>5</td>
<td>+ 3 (3)</td>
<td>14</td>
<td>9</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Ajloon 3 (sheep)</td>
<td>140</td>
<td>4</td>
<td>+ 3 (3)</td>
<td>27</td>
<td>14</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Safawi 3 (sheep)</td>
<td>100</td>
<td>1</td>
<td>+ 1 (2)</td>
<td>11</td>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Amman 1 (sheep)</td>
<td>70</td>
<td>2</td>
<td>+ 1 (1)</td>
<td>15</td>
<td>12</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Karak 1 (sheep)</td>
<td>100</td>
<td>3</td>
<td>+ 2 (1)</td>
<td>8</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ajloon 2 (goat)</td>
<td>115</td>
<td>2</td>
<td>+ 1 (1)</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Irbid 2 (goat)</td>
<td>135</td>
<td>3</td>
<td>+ 1 (1)</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ramtha 2 (goat)</td>
<td>130</td>
<td>2</td>
<td>+ 1 (1)</td>
<td>7</td>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Jarash 2 (goat)</td>
<td>164</td>
<td>3</td>
<td>+ 2 (2)</td>
<td>67</td>
<td>49</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

RBT: Rose Bengal test
ELISA: enzyme-linked immunosorbent assay
Another group of 100 serum samples were collected from people who were known to be at high risk for brucellosis (i.e. veterinarians, sheep-herders and laboratory technicians). These people had been in contact with animals and/or animal products and were showing clinical signs of brucellosis. They had been referred to their community hospital for further investigation and clinical diagnosis.

The authors also obtained relevant data from the Ministry of Health (25) on the incidence of human brucellosis in Jordan between 1988 and 2000. These data have been included in the discussion of the results of this study.

Statistical analysis

The chi-square ($\chi^2$) and Pearson’s correlation coefficient were used. The data are presented as mean values. Differences among groups are considered statistically significant for ($P < 0.05$), where $P$ = significant differences.

Results

The design of the study is summarised in Table I. The study included sheep flocks from eight different provinces of Jordan and eight goat herds from four provinces. Twenty flocks of sheep (1,050 animals) and eight herds of goats (544 animals) were studied, of which eight flocks and three herds were vaccinated against brucellosis. Abortions occurred in 20 of the 28 flocks/herds, more specifically, in 17 sheep flocks and 5 goat herds.

Of 34 aborted foetuses that were bacteriologically examined, $B. \text{melitensis}$ biotype 3 was isolated from 21 foetuses. $B. \text{melitensis}$ biotype 3, which is regarded as the main $Brucella$ strain in the field in Jordan, was the sole biotype isolated from 14 of the 20 flocks of sheep and from 5 of the 8 goat herds. The abortion rate among sheep varied from flock to flock, ranging from 0.5% to 56%.

Table I also summarises the history of human infection associated with 11 flocks.

Culture and serological findings

As shown in Table II, there was a significant correlation between bacteriological isolation, serological tests and the abortion rate. The test results, from each of the serological tests employed, are shown in Table III. The RBT produced the highest number of positive responses: 136 out of 1,050 sheep sera (12.9%) and 82 out of 544 goat sera (15.07%). The ELISA demonstrated higher numbers of positive sera than the CFT and TAT, proving to be twice as sensitive in detecting positive sera in sheep as the TAT.

Clinical signs of disease

The main clinical sign of brucellosis in sheep and goats during this study was abortion during the last month of pregnancy or premature expulsion of the foetus. Retention of the placenta, metritis and even death of the ewe were also observed.

Pathological findings

The gross lesions primarily affected the placenta and foetus. Most of the aborted foetuses examined were full-term. The foetuses were somewhat oedematous, with blood-tinged fluid in the subcutaneous tissues and body cavities. The abomasal contents were clear, translucent and viscid. From these contents, a pure culture of $B. \text{melitensis}$ was isolated. Histopathologically, there were scattered microscopic lesions of bronchopneumonia with infiltration of leukocytes.
Brucellosis in humans

The percentages of the serum samples from the ‘healthy volunteers’ which, upon testing, demonstrated a titre > 1.80 were compared to the percentages of the samples showing the same titre from the high-risk group. The results of serological testing showed that the cumulative percentage of the serum samples showing a titre reading of > 1.80 was higher among the high-risk group than among the normal population (7% as opposed to 4.1%, respectively). Although the figure was not significantly different (χ² = 1.73, P < 0.19), it may indicate that brucellosis is more endemic among workers at high risk of infection. It was noted that the majority of cases occurred in people who tended sheep and goats, and came into contact with their excretions (25).

Complete epidemiological investigations were performed on many of the cases of human brucellosis to study the modes of transmission of the infection from animals to humans. These investigations revealed that the majority of cases were due to the ingestion of raw milk and its products, namely, cottage cheese and yoghurt. Table IV summarises the cumulative data obtained from the annual reports of both the Ministry of Health and Ministry of Agriculture. These reports show a continuous fluctuation in the annual incidence of human brucellosis in Jordan, from between 20 and 26 cases per 100,000 head of population at the beginning of the 1990s to 5 cases per 100,000 in recent years. A similar trend was observed in the abortion rates of sheep and goats.

Twelve sheep-herders from the farms in the study developed clinical signs of fever, weakness, malaise, abdominal pain, headache and backache, as did five veterinarians and three students at the Faculty of Veterinary Medicine, Jordan University of Science and Technology. Ministry of Health laboratories confirmed that these patients had contracted brucellosis due to B. melitensis biotype 3.

Discussion

Jordan has approximately 1.9 million sheep and 461,000 goats. The breeding season is from July to October, and the lambing and kid seasons are between November and February. The traditional grazing management system of sheep and goats is still in use, with the animals being allowed to graze more or less freely during the daytime. Moreover, several flocks belonging to different owners may graze the same pasture on the same day or on different occasions. Most of the animals either lamb or abort on the pasture. Thus, if the cause of the abortion is Brucella, the pasture becomes contaminated and other susceptible flocks that graze the same pasture will also be liable to infection.

Animal brucellosis in Jordan was first reported in 1971, in two herds of goats imported from neighbouring countries. Between 1983 and 1998 a high prevalence was recorded in small ruminants, mostly in the northern provinces, and over the same period the incidence of human brucellosis in Jordan rose dramatically, an increase directly related to the increase in Brucella infections among sheep and goats. It is remarkable to note that, although only 29 cases of human brucellosis were reported between the years 1975 and 1985, the number of reported cases reached 531 (17.7 per 100,000) in 1986; 503 (16.7 per 100,000) in 1987; 463 (15.4 per 100,000) in 1988; 628 (20.2 per 100,000) in 1989 and 729 (21.1 per 100,000) in 1990 (25). These fluctuating incidences are shown in Table IV. In 1985, an official system for reporting human cases of brucellosis was established by the Ministry of Health, under the supervision of the Communicable Diseases Control Programme Division. However, health authorities believe that, for various reasons, human brucellosis is significantly under-reported, especially by the private health sector.

Consumption of infected dairy products has been shown to be the most important mode of transmission of Brucella species and the cause of clusters of brucellosis within families. Contact with diseased animals proved to be the second most important mode of transmission of Brucella species to humans (15). Many countries have imposed measures to control or eradicate brucellosis, due to the economic impact and hazard to human health associated with the disease. The principal approaches for control include the following:

- detection of the disease, usually by serological methods
- the vaccination of remaining animals

<table>
<thead>
<tr>
<th>Table IV</th>
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<tbody>
<tr>
<td>Incidence of brucellosis in humans, sheep and goats in Jordan between the years 1988 and 2000</td>
</tr>
<tr>
<td>Year</td>
</tr>
<tr>
<td>1988</td>
</tr>
<tr>
<td>1989</td>
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<tr>
<td>1997</td>
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<tr>
<td>1999</td>
</tr>
</tbody>
</table>

* Data from the annual reports of the Ministry of Health (1988-2000) (25)
** Data from the annual reports of the Ministry of Agriculture (1989-2000) (24)
– education in the general principles or hygiene to prevent the re-introduction of infection (16, 18).

Brucellosis evidently became a problem in the northern part of Jordan at the beginning of the 1980s. Both people and animals suffered from the disease and the first isolates from humans identified the strain as *B. melitensis*. (This identification was made at the Central Laboratory, Ministry of Health.) In the intervening years, biotype 3 (97.5%) and biotype 1 (2.5%) of *B. melitensis* have been reported from 39 cultures, received from different parts of Jordan (28).

However, between the years 1996 and 1998, the authors identified *B. melitensis* biotype 3 as the only bacterium isolated from aborted foetuses from all the provinces. The same was found in relation to the human isolates. It is clear from public health data and the data from veterinary laboratories that *B. melitensis* biotype 3 is the principal field strain which causes brucellosis in humans and animals in Jordan (4, 15, 25).

Live attenuated *B. melitensis* strain Rev. 1 is the main vaccine for sheep and goats (5, 9). The ability of the vaccine to produce a high level of immunity against experimental infection has been demonstrated for both these species (13, 35). Interestingly, about 3.4% of the isolates obtained from aborted sheep foetuses and vaginal discharges were identified as the Rev. 1 vaccine strain (4). This result is in full agreement with previous reports from other laboratories, arguing against the application of Rev. 1 vaccine in the adult population.

Eleven flocks surveyed in the present study were vaccinated with the reduced dosage of Rev 1 vaccine (Table I). However, brucellosis was still diagnosed in vaccinated as well as non-vaccinated flocks, which may indicate the low efficiency of the vaccine in protecting animals. In contrast, after 13 years of vaccination with the reduced dose (1 × 10⁵ CFU), the government data show a significant reduction in the annual number of human brucellosis cases, as well as in the number of abortions among sheep and goats (Table IV). These results support the general belief that control of human brucellosis can be achieved, merely by continuing the vaccination of sheep and goats and by educating the public to consume only pasteurised milk and milk products.

Other researchers recommend vaccinating female lambs and kids, aged between three and six months, with a single subcutaneous standard dose of 10⁹ viable organisms (30). It seems probable that, after 13 years of vaccination with the minimal dose to control brucellosis on the national level, Jordan should change its policy to vaccinating young female animals with a full standard dose. Moreover, the application of an ocular reduced-dose vaccine (1 × 10⁶ CFU) has been trialed successfully, reducing the risks and adverse effects of a subcutaneous vaccine. This method thus avoids problems, while achieving significant protection of the animals (30).

It is evident that brucellosis in humans and animals is increasing in many parts of the world, including the Mediterranean region, western Asia and parts of Africa, Eastern Europe and Latin America (12). Thus, a number of WHO programmes have been established to strengthen brucellosis surveillance and control activities at the national and global levels, in collaboration with the Food and Agriculture Organization and the World Organisation for Animal Health. One such regional control programme is being promoted by the WHO in the eastern Mediterranean region (12).

In terms of diagnosing the disease, the RBT and ELISA demonstrated a higher number of sero-positive animals (Table III). Studies comparing the sensitivity of different serological tests for diagnosing brucellosis, mostly related to *B. abortus* infection in cows, indicate that the buffered-plate antigen agglutination test and the CFT are more sensitive than the traditional TAT (20). However, the application of these methods in surveillance programmes where *B. melitensis* is endemic, and Rev. 1 is applied as a vaccine, might not be fully reliable.

The finding that the vaccine strain Rev. 1 persists in vaccinated animals and is excreted in the milk might shed new light on the issue of serological standardisation of tests to diagnose *B. melitensis*. The authors consider that the incidence of brucellosis in Jordan is probably higher than that which has been reported by the Ministry of Health, since some individuals develop subclinical disease, which is usually diagnosed serologically in surveys of high-risk groups (veterinarians and sheep-herders, etc.) or during investigations of disease outbreaks (abattoir workers) (10). A majority of such patients probably have a mild influenza-like illness, which is seldom followed by sequelae. Approximately one-third of patients with more symptomatic forms of the disease experience an acute onset of illness with impressive systemic toxicity, while the remaining two-thirds develop symptoms over one or more weeks (10, 36). A recent survey conducted in Saudi Arabia found that almost 20% of the human population had been infected and the disease was still active in over 2% of those examined. Similar figures can be expected from most countries in which the disease is endemic in the animal population (10, 12, 17, 32).

In conclusion, the results of this study showed that direct contact with infected animals, as well as the ingestion of raw milk and/or dairy products, such as cottage cheese, are the main sources of human infection. The most reliable method of diagnosis is the isolation of the *Brucella* species and serological testing. Since the efficacy of the reduced dose of the Rev. 1 vaccine is questionable, disease prevention in sheep and goats should be encouraged by...
vaccinating young female sheep and goats aged from three to eight months with a full dose of the Rev. 1 vaccine.

The veterinarians who provide health recommendations and services to sheep and goat herders must remain constantly alert for indications of animals with brucellosis. The best approach for preventing human brucellosis is control or total elimination of the disease in the animal population, thus avoiding the risk of contact with infected animals and consumption of their raw milk and milk products. Finally, WHO provides information on brucellosis for consumers and travellers, covering both dietary precautions and disease prevention measures, such as the heat treatment of milk and its derived products (12).

Acknowledgements

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Étude de la brucellose humaine et animale en Jordanie entre 1996 et 1998

F.K. Al-Ani, S. El-Qaderi, N.Q. Hailat, R. Razziq & A.M. Al-Darraji

Résumé
Entre 1996 et 1998, un total de 2 494 prélèvements de sang humain et animal ont été réalisés pour recherche d’anticorps de la brucellose. Ce total incluait 1 594 échantillons de sang animal, recueillis chez 1 050 ovins, représentant 20 troupeaux, et 544 caprins, représentant huit troupeaux. Les sérums ont été soumis à l’épreuve du rose Bengale, à l’épreuve d’agglutination en tube, au test de la fixation du complément et à l’épreuve immunoenzymatique. De plus, des renseignements anamnestiques ont été recueillis pour tous les troupeaux. Le taux d’avortements dus à la brucellose chez les moutons se situait entre 0,5 % et 56 %, avec une moyenne de 33,2 %. Les chèvres avaient un taux d’avortement plus élevé. Trente-quatre avortons recueillis dans ces 20 troupeaux ont été soumis à un examen bactériologique et pathologique. Une culture pure de Brucella melitensis biovar 3 a été isolée à partir de 21 de ces avortons.
Les échantillons de sang humain ont été recueillis dans deux groupes : tout d’abord, chez 800 personnes apparemment en bonne santé qui venaient à l’hôpital local pour des examens médicaux de routine, et en second lieu, chez 100 personnes constituant un groupe à haut risque pour la brucellose, comme des vétérinaires, des bergers et des techniciens de laboratoire. Les titres d’anticorps anti-Brucella pour les 900 sérums humains ont été mesurés par une micro-méthode d’agglutination. Le pourcentage cumulé de sérums présentant un titre supérieur à 1 : 80 était plus élevé dans le groupe à risque que dans la population normale (7 % contre 4,1 %). Bien que ces résultats ne soient pas statistiquement significatifs, le pourcentage plus élevé de sujets présentant des anticorps dans le groupe à haut risque indique peut-être un accroissement du facteur de risque dans le personnel des professions agricoles et vétérinaires en Jordanie.
Les auteurs en concluent que la brucellose est courante chez les caprins et les ovis en Jordanie, ce qui expose la population humaine à des risques élevés. La vaccination contre Brucella melitensis Rev. 1 a été reconnue à l’échelle internationale comme la clé permettant de maîtriser l’extension de la maladie.
Estudio de la brucelosis humana y animal en Jordania de 1996 a 1998

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Resumen
Entre 1996 y 1998 se recogieron un total de 2.494 muestras sanguíneas de personas y animales, que después fueron sometidas a pruebas de detección de la brucelosis. De ellas, 1.594 provenían de animales (1.050 muestras de ovejas de 20 rebaños y 544 muestras de cabras de 8 rebaños). Las muestras séricas fueron sometidas a las pruebas de Rosa de Bengala, aglutinación en tubo, fijación del complemento y ensayo inmunoenzimático. Por otra parte, se elaboró un historial completo de cada rebaño. El índice de abortos debidos a brucelosis oscilaba entre el 0,5% y el 56% en ovejas, con un valor medio de 33,2%, y en las cabras era superior. Tras el examen bacteriológico y patológico de 34 fetos ovinos abortados procedentes de 20 rebaños, se obtuvieron cultivos puros del biovar 3 de *Brucella melitensis* a partir de 21 de esos fetos.

Las muestras de sangre humana procedían de dos grupos: por un lado 800 personas aparentemente sanas que se presentaron a hospitales locales para someterse a un reconocimiento médico de rutina; y por el otro 100 personas pertenecientes a grupos de alto riesgo de brucelosis como veterinarios, pastores o técnicos de laboratorio. Para calcular los títulos de anticuerpos contra *Brucella melitensis* a partir de 21 de esos fetos, se utilizó la prueba de microtitulación por aglutinación. El porcentaje acumulado de muestras séricas con un título superior a 1:80 era más elevado en el grupo de riesgo que en la población normal (7% frente a 4,1%). Aunque esos resultados no sean estadísticamente significativos, el mayor porcentaje de positivos podría indicar un factor de riesgo más elevado entre los profesionales de la ganadería y la veterinaria en Jordania.

Los autores llegaron a la conclusión de que la brucelosis es común en los ovinos y caprinos de Jordania, lo que entraña grandes riesgos para la población humana. La vacuna preparada con la cepa Rev. 1 de *Brucella melitensis* ha sido

Mots clés
reconocida en el plano internacional como un instrumento básico para luchar con éxito contra la enfermedad. Entre 1996 y 1998 se administró repetidamente a todos los animales, a título experimental, una dosis reducida de la vacuna \((1 \times 10^6)\) unidades formadoras de colonias, UFC). Los datos acumulados sobre el índice anual de casos de brucelosis en el hombre indican una disminución del número de personas afectadas al año, y otro tanto cabe decir del índice de abortos en animales, lo que supone un claro indicio de que el programa de vacunaciones ha funcionado bien. Sin embargo, considerando que también se han aislado cepas salvajes de \textit{Brucella} en animales vacunados, los autores recomiendan elevar la cantidad de vacuna a la dosis completa (esto es, \(1 a 2 \times 10^6\) UFC) y vacunar a las hembras jóvenes (entre tres y ocho meses de edad). Para evitar casos de brucelosis en el hombre, conviene informar y formar a la gente sobre los peligros que entrañan tanto el contacto con animales infectados como el consumo de la leche o los productos lácteos crudos.

**Palabras clave**


**References**


