Seroprevalence of Q fever among blood donors and screening for Coxiella burnetii DNA in environmental dust in a French conurbation recently confronted to clustered human cases


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Seroprevalence of Q fever among blood donors and screening for *Coxiella burnetii* DNA in environmental dust in a French conurbation recently confronted to clustered human cases

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International intracellular bacteria meeting 2022

August 26th
Human clustered Q fever cases

No common source identified despite
- Surveys on infected patients
- Veterinary investigations

This emergence raised issues regarding
- the risk of exposure for the general population
- the risk of blood donation in this area

April-May 2017
17 suspicions
12 cases confirmed by the National Reference Centre

“exposure area” conurbation of 23 municipalities

EXPAIRCOX research project
Including the current study

Aim 1
To assess the exposure of the local human population to C. burnetii

Aim 2
To assess the seroprevalence of C. burnetii infection in local blood donors

International intracellular bacteria meeting – Lausanne 2022 – Elsa Jourdain
Environmental investigations - METHODS

Various public places from 13 municipalities within the “exposure area”

--

DNA extraction

PCR analyses

Coxiella burnetii

IS1111 sequence

Swabs (COPAN SRK Solution™)

Wipes (SODIBOX™)

Dust samples

+ External Positive Control

OUTDOOR

INDOOR

Swabs

Wipes

Small ruminant farms

Human population

Blood donation

Spring 2018

Various public places from 13 municipalities within the “exposure area”

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Environmental investigations - METHODS

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Spring 2018

Various public places from 13 municipalities within the “exposure area”

International intracellular bacteria meeting – Lausanne 2022 – Elsa Jourdain
Environmental investigations - RESULTS

160 dust samples from public places

Detection of *C. burnetii* DNA

✓ in 12 samples
by droplet digital PCR only

<table>
<thead>
<tr>
<th></th>
<th>Outdoor</th>
<th>Indoor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wipes</td>
<td>2/63</td>
<td>6/19</td>
<td>8/82</td>
</tr>
<tr>
<td>Swabs</td>
<td>1/21</td>
<td>3/57</td>
<td>4/78</td>
</tr>
<tr>
<td>Total</td>
<td>3/84</td>
<td>9/76</td>
<td>12/160</td>
</tr>
</tbody>
</table>

✓ collected from 6 municipalities

- 3 with 1 positive sample
- 3 with several positive samples
  = those with the highest small ruminants densities

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Environmental contamination - DISCUSSION

Detection of bacterial DNA in dust from several public places one year after the outbreak

Consistent with previous results in the US

Kersh et al. AEM 2010

Associated risk of infection for the general population

- In 2018 ??
- In 2017 ???

Serosurvey on blood donors sampled in 2017 to gain knowledge on the prevalence of infection
Serosurvey on blood donors - METHODS

**Retrospective study**
- Not opposed to the use of their samples for biomedical research
- Donating blood within the “exposure area”
- Personal data
  - Age, sex, residence place
  - Donation place and date

**Blood donors**

**Step 1: cross-sectional**
1 sample per donor – n=2,500

- **Occasional donors**
  - Unique sample
  - May 2017 to Dec 2017

- **Regular donors**
  - Latest sample
  - Donated between May 2017 and Dec 2017

**Step 2: infection history**
several samples per donor

- **Regular donors**
  - 1 to 19 samples
  - Oct 2016 to Dec 2017

**C. burnetii-specific antibodies**

1. **Initial screening:**
   - All Ig classes
   - If titre ≥ 50

2. **Phase 1 & 2**
   - IgG, IgM, IgA
   - Positive if titre ≥100

**C. burnetii-specific DNA**

**Real-time PCR**

- If ≥ 1 sample seropositive

**IFI test**

- if titre ≥ 50

- If seropositive
## Serosurvey on blood donors - RESULTS

### Results Summary

- **Seroprevalence**: Approximately 2%
- **Variations with residence location**: Up to 5% to 16% in 4 municipalities
- **No significant association with**:
  - Ruminant density
  - Sex and age

### Cross-sectional Data

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seronegative</strong></td>
<td>2,320</td>
<td>92.80</td>
</tr>
<tr>
<td><strong>Titre =50</strong></td>
<td>131</td>
<td>5.24</td>
</tr>
<tr>
<td><strong>Titre ≥100</strong></td>
<td>49</td>
<td>1.96</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,500</td>
<td>100</td>
</tr>
</tbody>
</table>

### Age Distribution

- **(60,70)**
- **(50,60)**
- **(40,50)**
- **(30,40)**
- **(20,30)**
- **(18,20)**

### Number of Donors

- **Age**
  - (60,70): 200
  - (50,60): 400
  - (40,50): 200
  - (30,40): 400
  - (20,30): 0
  - (18,20): 0

### Absence of Donors

- **(50,60)**: 0
- **(40,50)**: 0
- **(30,40)**: 0
- **(20,30)**: 0
- **(18,20)**: 0

### Variations with Residence Location

- Up to 5% to 16% in 4 municipalities

### Significant Factors

- **No significant association with**:
  - Ruminant density
  - Sex and age

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*International intracellular bacteria meeting – Lausanne 2022 – Elsa Jourdain*
Serosurvey on blood donors - RESULTS

Step 1: cross-sectional

<table>
<thead>
<tr>
<th>Titre ≥50</th>
<th>Occasional donors</th>
<th>51</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regular donors</td>
<td>129</td>
</tr>
</tbody>
</table>

Step 2: infection history

129 donors
459 samples

ZOOM
n=60 donors

Serological titre

- Seronegative
- ≥50
- 100

Titre 50 at screening = false positive

n=69 donors
## Serosurvey on blood donors - RESULTS

### 60 donors ➔ 4 serological profiles

<table>
<thead>
<tr>
<th>Profile</th>
<th>Participants</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Negative then IgG ≥100</td>
<td>N=10</td>
</tr>
<tr>
<td>2</td>
<td>IgG ≥100 overtime</td>
<td>N=19</td>
</tr>
<tr>
<td>3</td>
<td>IgG ≥100 alternating with 50 or =50 overtime</td>
<td>N=17</td>
</tr>
<tr>
<td>4</td>
<td>IgG =50 alternating with negative</td>
<td>N=14</td>
</tr>
</tbody>
</table>

### Real-time PCR tests ➔ all negative

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Serosurvey on blood donors - DISCUSSION

Cross-sectional survey on 2,500 donors

Seroprevalence ~2%
5 to 16% in 4 municipalities

Other recent studies on blood donors

<table>
<thead>
<tr>
<th>Study</th>
<th>Seroprevalence</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gidding et al. 2014</td>
<td>1.6-4.9%</td>
<td>2,740</td>
</tr>
<tr>
<td>Slot et al. 2012</td>
<td>12%</td>
<td>543</td>
</tr>
<tr>
<td>Noden et al. 2014</td>
<td>26%</td>
<td>319</td>
</tr>
<tr>
<td>Beaudeau et al. 2020</td>
<td>13%</td>
<td>347</td>
</tr>
</tbody>
</table>

Infection history for 60 donors

- 35 to 49 = past exposure
- 11 (10?) = recent infection

No DNA detection

Further supports that transmission by blood donation is UNLIKELY
...all the more so since donations from symptomatic patients are prohibited

BUT... necessity of watchfulness for C. burnetii acute and persistent infections and Q fever chronic fatigue in this area.

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