MRSA and Horses

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Lecturer in Bacterial Zoonotic Disease

FVE MRSA Meeting 8th April 2008
What I am going to talk about

• MRSA in horses
  – Community-acquired (CA) and hospital-acquired (HA)
  – Clinical cases of MRSA in horses
• Molecular epidemiology of equine MRSA
• Public health significance of equine MRSA
• Conclusions
Molecular methods

- Resistance conferred by \textit{meca} gene, which encodes penicillin-binding protein 2a (PBP2)
- Encoded on a mobile gene cassette
  - SCC\textit{mec} of which there are five main types (I-V).
  - PCR assays to determine SCC\textit{mec} types and subtypes (IV)
- Macro-restriction PFGE (gold standard)
- \textit{Spa} gene typing (protein A)
- Multi-locus sequence typing
Community versus hospital-acquired infection

In Canada

- Nasal swabs collected from 2,283 horses admitted to OVC-VTH (Oct 02-Jun 04)

- MRSA isolated from 120 horses (5.3%)
  
  - Community-associated carriage rate- 2.7%
  - Nosocomial carriage rate- 2.3%
  - Nosocomial MRSA infection rate- 0.18%
  - Horses positive on admission were significantly more likely to develop clinical MRSA infections

Community versus hospital-acquired infection

Slovenia
- Nasal swabs from 300 horses – No MRSA found¹

Denmark
- Nasal swabs from 100 horses- No MRSA found²

Holland
- Nasal and pastern swabs from 200 horses- No MRSA found³

Community versus hospital-acquired infection (cont-)

Austrian equine hospital found a higher mean incidence of infection with MRSA, of 0.48%, over a two year period.

- All found to be the same strain

- German study

Of 135 equine clinical cases where S. aureus was implicated, 8% were MRSA.

1Cuny et al, 2006, Eurosurveillance.11(1);1101-7.
Community versus hospital-acquired infection (cont-)

North-American community surveillance study
- 4.7% of horses (n=972) and 13% of in-contact humans (n=107) positive for Canadian epidemic MRSA-5.

- > 20 horses was a risk factor for equine colonisation.
- Regular contact with >20 horses was a risk factor for human colonisation.
- On all premises with colonised horses, at least one in-contact human had an identical strain.

Community versus hospital-acquired infection

• Nasal carriage
  – Community-acquired
  – Hospital-acquired
• 3 Large equine tertiary referral hospitals (May 2005 to July 2005)
• Results
  – 633 nasal samples were collected (365 horses).
• MRSA was not isolated from any of these samples.

MRSA in horses at the Philip Leverhulme Equine hospital (PLEH)

- Nasal, perineum and skin swabs taken from 67 horses (Nov 2003-Feb 2004)
  - 12% positive (n=8 nasal and n=2 skin)
- 40 horses screened in the community, none positive for MRSA
- May 2004- Two clinical cases
  - Pleuropneumonia case and Joint infection
- June 2004
  - Clinical case- Dermatitis
- May 2005
  - Clinical case- Joint infection
- 12 veterinary staff screened, none positive for MRSA

Antimicrobial susceptibility testing

Proportion of MRSA isolates resistant to antibiotics

- Methicillin
- Oxacillin
- Gentamicin
- Ciprofloxacin
- Fusidic Acid
- Co-trimoxazole
- Tetracycline
- Vancomycin
MRSA PFGE typing

- PFGE revealed a number of distinct equine strains
- Not related to EMRSA-15 (ST22), EMRSA-16 (ST36) or Canada type 5 MRSA (CMRSA-5)
Summary of types of horse MRSA isolates at PLEH

<table>
<thead>
<tr>
<th>No of isolates</th>
<th>Source</th>
<th>Date</th>
<th>ST*</th>
<th>Spa gene type</th>
<th>SCCmec</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Carriers (nasal/skin)</td>
<td>Nov 03-Feb 04</td>
<td>254</td>
<td>t036¹</td>
<td>IV</td>
</tr>
<tr>
<td>1</td>
<td>Pleuropneumonia</td>
<td>May 04</td>
<td>254</td>
<td>t216¹</td>
<td>IV</td>
</tr>
<tr>
<td>1</td>
<td>Joint infection</td>
<td>May 04</td>
<td>660</td>
<td>t036¹</td>
<td>IV</td>
</tr>
<tr>
<td>1</td>
<td>Nasal carrier</td>
<td>Feb 04</td>
<td>658</td>
<td>ND</td>
<td>II</td>
</tr>
<tr>
<td>1</td>
<td>Dermatitis</td>
<td>June 04</td>
<td>ND</td>
<td>t127(CC1)¹</td>
<td>IV</td>
</tr>
<tr>
<td>1</td>
<td>hock wound</td>
<td>May 05</td>
<td>ND</td>
<td>t020(CC22)¹</td>
<td>IV</td>
</tr>
<tr>
<td>1</td>
<td>Carrier (nasal)</td>
<td>Oct 06</td>
<td>ND</td>
<td>t064 (CC8)</td>
<td>ND</td>
</tr>
<tr>
<td>3</td>
<td>Carrier (nasal)</td>
<td>Jun 07</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>1</td>
<td>Carrier (nasal)</td>
<td>Feb 07</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>3</td>
<td>Carrier (nasal)</td>
<td>May 07</td>
<td>ND</td>
<td>t032 (CC22)</td>
<td>ND</td>
</tr>
</tbody>
</table>

All isolates were pvl negative


ND- not done
CC- clonal complex

* MLST results in collaboration with Mark Enright, Imperial college, UK.
MRSA Surveillance at PLEH
(Claire Scantlebury)

- 10 months surveillance (Oct 2006-Jul 2007)
- Each month nasal swabs were taken from all horses present in the hospital
- Overall 8/182 (3.52%) horses positive

![Graph showing MRSA surveillance results]
Clinical MRSA infection in the horse

- Joint/Synovial Infection
- Bone infection
- Skin infection
- (Pleuropneumonia)

Austria

Community Acquired (n=33)
- Joint 30%
- Incision 21%
- Soft tissue 21%
- Bone/tendon 12%
- Lung, sinus, udder (2 each)

Hospital Acquired (n=49)
- Incision 61%
- Catheter 16%
- Soft tissue 8.2%
- Lung, joint and eye (3 each)

83% survived, 17% died

Weese et al. 2008 (unpublished)

North America

Weese et al. 2008 (unpublished)

Cuny et al. (2006). Eurosurv,11, 44-47.
Molecular Epidemiology of MRSA in Horses

- In Europe
  - Equine hospital
    - Isolates from horses identical to each other and those isolated from veterinary personnel by PFGE.
    - MLST - ST254 (EMRSA-10)
    - However, differed from human clinical type strain of ST254 on PFGE and gentamicin resistant.
      - SCC\textit{mec} type IVd found in equine ST254, compared to type IVc in human ST254.

- Two equine cases in Austria with wound infections with ST398, t011, pvl negative².
  - SCC\textit{mec}lVa and were additionally resistant to gentamicin.

¹Cuny et al, 2006, Eurosurveillance.11(1);1101-7.
Molecular Epidemiology of MRSA in Horses

Ireland
- Equine isolates distinct from small animal isolates by PFGE and unrelated to human epidemic strains.
- All resistant to gentamicin, kanamycin, tetracycline\(^1\).
- Equine isolates were ST8\(^2\) and found to carry SCC\(mec\)IVd\(^3\).

UK
- Small number of equine MRSA subject to MLST and found to be ST8\(^4\).

\(^2\) O’Mahony, \textit{et al}, 2006, 1st International Conference on MRSA in Animals, 19-21st June, University of Liverpool, UK.
Molecular Epidemiology of MRSA in Horses

North America

- Canadian epidemic MRSA-5 (USA-500) is the predominant clone in horses in both Canada and USA, but is rare in humans.
- CMRSA-5 (ST8), SCC\textit{mec}IV, PVL negative\textsuperscript{1}.

Japan

- MRSA from horses found to be distinct by PFGE from the predominant human MRSA strains\textsuperscript{2}.

Equine MRSA and public health

• True zoonotic infections are rare.

Skin infection in three veterinary staff treating a neonatal foal (foal watch) with a CA-MRSA infection
• Isolates were Canadian epidemic MRSA-5.
• Transmission occurred despite barrier nursing precautions
• Infection in otherwise healthy individuals with no risk factors for opportunistic infection¹.

MRSA colonization may be an occupational risk for veterinary staff.
• MRSA has been isolated from the nasal swabs from 7.0% of vets and 12.0% of nurses sampled at a North American Congress
• Canadian epidemic CMRSA-5 was only isolated from large animal clinicians².

Equine vets and MRSA

- **British Equine Veterinary Association Annual Congress 2006**
  - 274 delegates provided nasal swabs
  - 20 (7.3%) were positive for MRSA
    - 17 vets, 1 nurse, 2 vet students
    - 43/274 had dealt with a MRSA positive case in the previous 3 months
    - 1/43 positive for MRSA
### Equine vets and MRSA

<table>
<thead>
<tr>
<th>No of isolates</th>
<th>Resistance profile</th>
<th>Strain type*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ox</td>
<td>ST1, t127</td>
</tr>
<tr>
<td>1</td>
<td>Ox</td>
<td>ST22</td>
</tr>
<tr>
<td>7</td>
<td>Ox, Cip</td>
<td>ST22, t032</td>
</tr>
<tr>
<td>12</td>
<td>Ox, Cip*, Co-trim*, Rif*, Tet*, Gent</td>
<td>ST8 (mostly t064)</td>
</tr>
<tr>
<td>1</td>
<td>Ox, Cip, Gent, Rif, Co-trim</td>
<td>ST612 (DLV)</td>
</tr>
<tr>
<td>1</td>
<td>Ox, Cip, Gent, Co-trim, tet</td>
<td>ST254</td>
</tr>
</tbody>
</table>

Ox- oxacillin, Cip- ciprofloxacin, Co-trim- co-trimoxazole, Gent- gentamicin, Rif- rifampicin, Tet- tetracycline

DLV- Double locus variant

*MLST in collaboration with Mark Enright, Imperial College, UK.
Conclusions

• Prevalence of MRSA in horses in the community is unknown
  – Horses have strains which are uncommon in the human population

• This may indicate that some MRSA may be circulating in the equine population independently from the human population

• Origin of MRSA in horses and the level of carriage of MRSA in the equine community?
Conclusions (cont-)

- Likely that transmission occurs both ways between humans and horses
- Horses may act as a reservoir and source of infection to humans in close contact
- Currently not much evidence to suggest that equine MRSA is a big public health risk!
- However, vets should be considered as a high risk group for community-acquired infection (BSAC 2007).
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