Foot-and-mouth diseases virus type C: the first target for eradication?

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INTRODUCTION

- Waldemann C FMD serotype first described in Europe in 1926; later referred to simply as FMD “Type C”

- Although it became relatively widespread, and was an important component of the global FMD situation, it had always a relatively restricted distribution compared to types O and A

- Never as robust as other types of FMD – lower profile
Recent history indicates a greatly reduced incidence of outbreaks and geographic distribution.

In the last 20 years the type C virus has been restricted to 4 geographic clusters of countries:
- South America
- The Philippines
- Eastern Africa
- South Asia

However, foci are in areas of relatively poor surveillance so there is need for caution in interpreting surveillance data.

Doubtful laboratory identifications are a constraint as are gaps in the archive.
METHODS

- RNA extraction using RNeasy Kit (QIAGEN)
- One-step amplification of VP1 region using Ready-To-Go™ RT-PCR Beads (GE Healthcare)
- Amplicon cleanup using ExoSAP-IT® (USB Corp.)
- Cycle sequencing using CEQ Quick Start Kit and the CEQ8000 automated sequencer (Beckman Coulter)
- Phylogenetic analysis using MEGA 4.0 to construct mid-point rooted neighbour-joining tree
SOUTH AMERICA FOCUS

- Formerly relatively widespread and prevalent in South America in the 1950s to 1970s

- Not seen since 1993 in Argentina: C₃-like viruses
FMD virus type C: the first target for eradication?

FMD virus type C in South America
SOUTH AMERICA FOCUS: the Amazona outbreak 2004

- An outbreak occurred in 2004 on an island in the Amazon River
  - Cattle, sheep and swine; 3 secondary outbreaks
  - In infected and vaccinated zone (trivalent O, A, C)
  - “No close relationship with any isolates in the PAHO data bank”
  - Not related to vaccine strains

- Statements from report:
  - “Amazon region is in the northern livestock crescent where the animal health and veterinary delivery systems are not as effective as those of other parts of the country.”
  - “The area as a whole depends on the import of animals and meat from other parts of the country.”

- ENIGMA 1: where did this virus come from in 2004?
Source: Dr Eduardo Correa Melo, Director, PANAFTOSA-PAHO/WHO
FAO EMPRES Bulletin

Location of the outbreak of FMD type C virus in the Municipality of Careiro da Várzea, Amazonas, Brazil, September 2004

Source: MAPA/SDA/DDA
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The Philippines

- Close and clear relationship to South America
- A continuum of viruses over 10 years illustrating slow but constant evolution
- BUT type C virus was not seen from 1990 to 1994
- **Until** On 6 September 1994 first outbreak of FMD detected in swine farm in Novaliches, Quezon City, Manila: type C
THE PHILIPPINES

- Second outbreak detected within days: type O

- In thousands of subsequent outbreaks over several years all viruses were identified as type O

- Except for:
  - 27 September 1994 Indang, Cavite (2 outbreaks, swine) confirmed WRL
  - 25 January 1995 Bulacan (swine)
  - 25 March 1995 Bulacan (swine)
  - 8 September 1998 Valenzuela abattoir, Manila (swine)

- It has not been found since

- **ENIGMA 2: Where was the virus between outbreaks?**
THE PHILIPPINES RELATED TO SOUTH AMERICA

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First recorded in sub-Saharan Africa in 1957 (Kenya and Ethiopia)

Early isolates from eastern African countries show independent lineages with a common origin possibly representing a single introduction

Angolan outbreak in 1973 clearly linked to south America

All other occurrences detected were in eastern Africa and primarily Kenya

Kenyan field isolates available are closely related to vaccine strain K267/67

Kenya endemic until 1988 but later situation uncertain
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- Probably introduced from Europe in the 1950s (vaccine?)
- No outbreaks have been confirmed since 1996
- All later viruses from India are closely clustered

- Possibly this suggests a relationship to vaccines but vaccine strains are needed to confirm this and the information is not available
- Viruses from other South Asian countries reflect the situation in India
- Reports from Pakistan and Afghanistan since 2000 are unlikely to be correct
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FEASIBILITY OF ERADICATION

- An eradication programme is unlikely to succeed unless it is founded on a sound understanding of epidemiology.

- In the case of FMD type C there are deficits in understanding which could compromise eradication.

These are the issues relating to where the virus had been in the Philippines and Brazil prior to causing outbreaks in 1994 and 2004 respectively.
FEASIBILITY OF ERADICATION

- However, a proximate analysis suggests that:
  - The earlier persistence of virus in the reservoirs where it was occurring was related largely to vaccine use (and livestock trade).
  - There is no reason to suspect the presence of type C FMD virus outside the foci described above.
  - The virus could well have been eliminated from the Philippines – last seen more than 10 years ago.
  - The virus could well have ceased to circulate in South Asia and eastern Africa (last seen more than 10 years ago).
  - If type C vaccine use in eastern Africa and South Asia is discontinued then the disease might not return.
  - The best way to determine what is happening in South America is to cease using type C vaccine and intensify surveillance.
RECOMMENDATION

- Establish justification and a coordination mechanism

- Cease all use of FMD type C vaccine.

- Maintain type C vaccine bank(s) within an emergency preparedness programme to be deployed if the type C FMD reappears.

- Strengthen FMD surveillance in the four foci where the virus was last seen and include an active virological and serological search for type C FMD virus.

- Strengthen the availability of laboratory diagnostic confirmation (antigen trapping and typing ELISA plus solid phase antibody blocking ELISA) and access to Reference Laboratory (WRL) services.
CONCLUSION

The global eradication of FMD virus type C is probably feasible

BUT

It requires a coordinated effort with a strong active surveillance and epidemiological component

and

JUSTIFICATION
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