A confirmed case of Kunjin virus disease encephalitis acquired in rural Darwin, NT—The mosquito story

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Abstract

A Kunjin virus (KUN) case with encephalitis symptoms was reported from the Darwin area, Northern Territory on 17 June 2010. The diagnosis was confirmed on 5 August. Adult mosquito trapping showed high vector mosquito numbers at the time originating from large swamps in the Howard Springs area. The sentinel chicken program across the Top End indicated probable KUN activity in the area, but no arboviruses were isolated from the mosquitoes collected. With an incubation period for KUN of between 7 – 12 days and an onset date of 15 June, the patient most likely contracted the KUN around 5 June at his Howard Springs residence.

Key Words: Arbovirus; Kunjin; encephalitis; vectors; Culex annulirostris; mosquitoes; sentinel chickens

Case Report

An 80 year old Caucasian male presented to Royal Darwin Hospital on 17 June 2010 with a 3 day history of fever and worsening hip pain. On presentation he was febrile at 40 degrees Celsius and mildly confused. Over a 72 hour period his conscious state gradually worsened to a Glasgow Coma Scale of 9. He developed encephalitis with progressive hypertonia of all limbs, including clonus of the lower limbs. He had marked progressive bilateral central nystagmus. His previous history was significant for recent cardiac bypass surgery in February 2010, in preparation for planned surgical management of his severe left hip osteoarthritis. He also reported chronic idiopathic myelofibrosis and previous heavy alcohol intake.

Presentation neutrophil count was normal at 7.4 x 10⁹ /L and C reactive protein mildly elevated at 13 mg/L. Chest x-ray and cultures of blood, urine, bone marrow and his left hip were non-diagnostic. CT brain with contrast was normal on day 3 of his admission. MRI brain revealed non-specific white matter changes in the brain stem and right thalamus. On day 7 of his presentation he underwent a lumbar puncture which revealed a reactive pleocytosis of 26 leucocytes (96% mononuclear cells) with elevated protein 1.48 g/L and reduced glucose 2.5 mmol/L. Initial PCR was reported positive for Murray Valley encephalitis virus (MVE) on 29 June 2010, with CSF IgM subsequently reported equivocal for MVE and positive for Kunjin virus (KUN) on 5 July 2010.¹ The Centre for Disease Control (CDC) staff informed Medical Entomology (ME) of the suspected case of MVE on 1 July 2010. The PCR result for MVE was later rescinded and repeat attempts to isolate virus from CSF and blood failed.

The diagnosis of KUN disease was confirmed on 5 August when serial paired serology from 23 June 2010 and 20 July 2010 revealed a 4-fold increase in KUN neutralising antibodies from 2560 to 10,240. MVE neutralising antibodies were not detected in either of the paired sample. Subsequently, the same result was reported from a second laboratory.

Despite fever persisting for 14 days, he remained haemodynamically stable, with hypertension being a significant management problem. Complications of his hospital stay included an acute gastrointestinal haemorrhage and a hospital acquired pneumonia. After 4 weeks his sensorium began to improve and he was discharged to a rehabilitation ward on the 4 August 2010. His main barrier to being discharged as of the 1 October 2010 was his severe hip osteoarthritis.

ME received the first Flavivirus Disease Case Investigation form from CDC on 5 July 2010. The patient had been in Adelaide between February and 3 June 2010, and otherwise predominantly remained in his residence in rural Howard Springs, approximately 22 km south east of Darwin city. He did not have flyscreens
Figure 1 Howard Springs adult mosquito EVS trap sites
on his doors at home and usually slept with the doors open. He travelled on only 2 occasions to the local shops and once to an outpatient medical appointment at the local hospital. When his conscious state improved the patient reported being troubled by occasional mosquitoes at his residence since his return from Adelaide.

**ME sentinel chicken surveillance and media warnings**

Sentinel chickens are maintained in the NT to give advanced warning for flavivirus disease. From January to June 2010, sentinel chickens in Jabiru and Tennant Creek seroconverted to MVE in April and May respectively, with 1 seroconversion in Howard Springs in June. Seroconversions to KUN occurred in Howard Springs in January and 1 in the Adelaide River Coastal Plains flock in June. As of October in the 2010/11 year there was 1 seroconversion to KUN each in Leanyer, Coastal Plains and the Nhulunbuy flocks in July, with none in the Howard Springs flock. The Howard Springs flock is located in Howard River Park near to the extensive Howard Swamp.

On 4 and 30 March and 14 April 2010 MVE media warnings for the entire NT were issued by Department of Health & Families, for the period until the end of June 2010. Due to the suspected MVE case in Howard Springs in June, an additional media warning was released on 2 July, for the period to the end of July 2010.

**Mosquito investigations**

ME set 4 adult mosquito CO2 baited encephalitis virus surveillance (EVS) traps in the Howard Springs area on 5 July 2010, sited at the south western edge of Dutchies Lagoon, the patient’s residence, the Howard Springs Reserve and west of the Howard Springs Rd and Gunn Point Rd intersection (see Figures 1-5). The traps were collected on 6 July and most of the collected mosquitoes were processed for virus isolation.
Table 1: Adult mosquito non-monitoring results, Howard Springs 06/7/2010

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<thead>
<tr>
<th>Trap location</th>
<th>No. of females</th>
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between 6 July and 9 July 2010 at the ME laboratory. The processed mosquitoes were sent to the Berrimah Veterinary Laboratory for virus isolation.5

Climate information

Only 5mm of rain was recorded for Howard Springs in May and no rainfall in June 2010. The Darwin airport received a total of 66mm of rain in May, with a total of 46mm recorded between 27 to 29 May. No rain was recorded in June 2010 by Bureau of Meteorology (BOM). However, large swamps in the Howard Springs area, such as Dutches Lagoon and Howard Swamp would still have contained large amounts of water in June, providing an extensive mosquito breeding habitat since the end of the wet season.

Results of mosquito trapping and investigations

The Howard Springs area adult mosquito trapping results showed elevated to high numbers of the principal potential MVE and KUN vector, the common banded mosquito (Culex annulirostris), as well as high numbers of the non MVE and KUN vectors Anopheles bancroftii and Coquillettidia xanthogaster at all sites (Table 1).6 An. bancroftii and Cq. xanthogaster breed in fresh water swamps, with over 300 specimens per trap/night indicating an appreciable nearby pest problem.

The high Cx. annulirostris numbers (2,019 per trap) in the Howard Springs Rd trap indicated a severe pest problem at that site, with 600 Cx. annulirostris per trap/night considered to indicate an appreciable pest level to nearby residents.7 The numbers at the residence, while not at an appreciable pest problem level, would have still constituted a pest problem, and would have been high enough to result in numerous bites to relatively unprotected people at that site at the time of trapping.

Cx. annulirostris breeds in temporary and longer term freshwater flooded areas and swamps with emergent vegetation.5 Cx.annulirostris has a flight range of 2km to greater than 10km, and an examination of aerial photos indicated that the majority of this species were probably coming from the extensive Howard Swamp area, which is located about 6 km north east of the patient’s residence. Other potential major sources of Cx. annulirostris are the paperbark swamp located about 2 km north west of the residence and Dutchies Lagoon. However, at this time of the year the paperbark swamp would have been in the process of drying and would not have been as productive a source of Cx. annulirostris compared with the Howard Swamp because of the more discrete margins, the reduced amount of emergent vegetation, and the concentration of aquatic insect predators of mosquito larvae in the former site. Both An. bancroftii and Cq. xanthogaster have a flight range of approximately 3 to 5km, with the results indicating that these species were breeding in the same 2 major breeding sites above and dispersing to the case residence locality.

Routine mosquito larval or disease reactive adult mosquito control is not feasible in rural areas such as this, due to the large extent of swamps and wetlands suitable for mosquito breeding and harbourage, the inefficiency of such operations, and the relative large cost to public benefit ratio.

Virus isolation results

No arboviruses were isolated from the collected mosquitoes.

Conclusions

The incubation period for MVE and KUN is between 7 and 12 days.8 With an onset date of 15 June 2010, the patient most likely contracted KUN disease around the 5 June 2010 while at his Howard Springs residence.

The present trapping was carried out approximately 3 to 4 weeks after the probable transmission period in June, and hence mosquito numbers would probably have been higher at the time of disease transmission. Cx. annulirostris were most likely breeding in high numbers in the swamp areas to the north east and north west of the case residence, with the most productive source being the Howard Swamp, with appreciable numbers also from the closer Dutches Lagoon, and hence relatively high numbers would have been present in the case residence area around the acquisition date of the disease.
Sentinel chicken results from January to July 2010 did not indicate high KUN activity in the Top End, but the seroconversion to KUN in Howard Springs in January and the single chicken seroconversions in Leanyer, Coastal Plains and Nhulunbuy flocks in July indicated that KUN was indeed present across the Top End and likely to have been present in June. While the Top End of the NT is endemic for both MVE and KUN, and activity is usually detected each year in at least some of the flocks, sentinel chicken surveillance is not likely to be able to pinpoint all risk areas. The KUN activity demonstrated by the sentinel chicken program across the Top End during the disease case acquisition period indicates that the virus was probably present in the Howard Springs locality in June.

Although large scale larval or adult mosquito control in rural areas is not practical, there are opportunities for personal protection and reduction in vector contact by using personal protection such as screens, protective clothing, insect repellents and applying insect barrier sprays such as bifenthrin.

In summary, the patient most likely contracted KUN disease in the Howard Springs locality due to the high numbers of vector Cx. annulirostris and the probable presence of KUN in this locality in June 2010.

KUN cases have been recorded in the NT from Darwin to Alice Springs, with over 8 cases since 1997, and the last case in the Darwin region occurring in the Darwin rural area in March 2000. While KUN cases usually present relatively mild symptoms compared with MVE, and are not usually associated with encephalitis symptoms, this is one of the few confirmed cases of KUN encephalitis recorded in Australia.

References
7. Whelan et al 2009 ME annual report CDC DHF.