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OUTBREAK INVESTIGATION OF AN EMERGING DISEASE (EQUINE MORBILLIVIRUS)

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Les règles habituelles de gestion de la santé animale impliquent une réponse rapide, efficace, à toute maladie nouvelle dans les populations animales. Cet article décrit l'application des principes épidémiologiques et d'une démarche diagnostique précise qui ont permis d'élucider la cause d'un foyer d'une nouvelle maladie respiratoire chez les chevaux et d'en effectuer la maîtrise.
Le 22 septembre 1994, un syndrome nouveau associant symptômes respiratoires graves et mort chez des chevaux pur-sang a été signalé aux autorités de santé animale de l'Etat du Queensland. Des quantités importantes de mousse, stable, parfois rouge, apparaissaient aux naseaux à la phase terminale, comme dans la peste équine, maladie exotique pour l'Australie. Deux personnes ont été atteintes, dont l'une est décédée. Un nouveau virus a été isolé et, après définition d'un cas, le foyer a été décrit dans le temps, dans l'espace et dans la population. Le taux de létalité a été calculé et on a pensé que la maladie n'était guère contagieuse.
D'autres études ont démontré l'absence du virus dans la population équine, établi que la maladie pouvait être reproduite expérimentalement chez le chat et le cobaye, et trouvé un hôte naturel du virus chez des chiroptères du genre Pteropus.
Rétrospectivement, un second foyer a été identifié, ayant atteint deux chevaux et une personne, à 800 kms du foyer de Brisbane et six semaines avant lui.
La méthode utilisée s'est révélée utile et efficace, même en cas d'application à une maladie nouvelle.

INTRODUCTION

Contemporary standards of animal health management require a rapid, effective response to unusual disease events in livestock populations. Early detection and the application of appropriate investigative methods enable the nature of the disease to be elucidated and, where the possibility of disease spread exists, control measures to be implemented. This ensures that domestic and international trade can proceed without unacceptable risk.
A model approach for the investigation of disease outbreaks has been proposed by Lessard (1988). This model details ten procedures or sub-objectives to be followed in a sequential order, culminating in the reporting of findings. Experience has shown that this methodology has application both when known conditions occur in outbreak form and when previously unknown conditions emerge. This paper describes the application of the method to the latter. The application of epidemiological principles and a meticulous diagnostic process enabled a novel cause to be elucidated and control to be instituted.

BACKGROUND

On 22 September 1994, an unusual syndrome associated with severe respiratory signs and death in thoroughbred horses was reported to the Queensland State animal health authority. The initial report was received from a stable complex situated near to racetracks in suburban Brisbane. The owner of the stable complex was hospitalised at the time and a worker was ill. First signs of illness were noticed in horses that had competed on 17 September 1994. At the time this illness was attributed to recovery from racing. By the morning of 22 September 1994, two horses had been privately necropsied on the previous day, five other horses at the complex and one horse at an adjacent complex had died, and three horses were noticeably ill. Two other horses that had been moved from the stable complex were also seriously ill, one fatally. The owner died within a few days after a period on a respirator. Clinical signs reported included fever, severe respiratory distress, ataxia and swelling of the head, including the supraorbital fossa. Copious quantities of stable, sometimes red-tinged froth flowed from the nostrils in the terminal stages. The signs seen closely resembled the pulmonary form of African horse sickness, a viral disease that does not occur in Australia (Geering et al. 1995).

THE INVESTIGATION PROCESS

Establishment of a diagnosis: Post mortem examinations were immediately carried out on four recently deceased horses. Samples were submitted to the Australian Animal Health Laboratory (AAHL), Geelong to exclude the diagnosis of African horse sickness. Following exclusion, a detailed diagnostic process began. This involved description of the histo-pathological syndrome, and laboratory examinations that included virology, bacteriology, mycology and toxicology. A novel virus was isolated by scientists at AAHL and identical viruses were isolated from other horses by scientists at the Animal Research Institute, Yeerongpilly (Murray et al. 1995). The isolates originated from different horses, at two independent laboratories using different cell lines. Transmission trials at AAHL using first, crude tissue extracts and later, the supernatant from the virus cultures, reproduced a similar disease in experimental horses.

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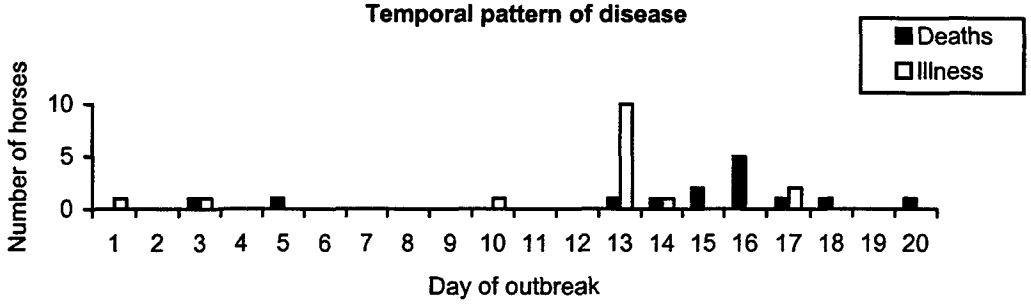
Definition of a case: Fever, acute respiratory disease with pulmonary oedema and/or death constituted a case definition. When traceback occurred, incomplete records and lack of a full investigation of possible earlier cases presented problems in establishing the extent of the outbreak. The index case was determined to be a pregnant thoroughbred mare that had been brought, noticeably ill, from a spelling paddock in a nearby suburb to the stables where she died two days later. Advice that a second horse at the spelling paddock had died at about the same time with no record of illness led to that animal being included as a suspect case.
Establishing the existence of an outbreak: This incident clearly represented an unusual event both in terms of morbidity rate and case fatality rate. Possible infectious and toxic causes needed to be considered.
Determining a temporal pattern: The day that the index case was brought to the stable complex has arbitrarily been considered to be day 1 of the outbreak. Investigations showed that two horses that had recently moved from the affected stables complex satisfied the case definition. One horse had died on day 3 of the outbreak and the other was clinically ill. The epidemic curve constructed at the time of the response appears below (Figure 1). The incubation period of natural cases was mostly between 8-11 days with a maximum of 16 days. The mean time between onset of clinical signs and death was 2.1 days. Later serological surveillance showed that a total of 20 horses had been infected (21 if the suspect case was included). Three of these had largely resumed a normal appearance following life-threatening clinical courses. Four other horses suffered mild illness. The seven surviving horses were euthanased to eliminate any possibility of disease transference from them.

Figure 1
Temporal pattern of disease



Determining a spatial pattern: The outbreak occurred primarily on a single stable complex of approximately 1000 square metres in area. The index case had moved to the complex two days prior to her death. Three infected horses had moved to two isolated properties soon after their exposure to the index case. Two horses resident in stables directly adjacent to the main stables were also infected. All infected animals had been held in close proximity to the index case. However not all horses were affected. Some of those maintained in the midst of affected stalls did not become infected.
Determining an animal pattern: Apart from the index case and an aged stallion, all affected horses could be classed as "horses in work". Mares and foals not routinely handled but held within the complex were unaffected.
Analysing data: The case fatality rate (applied to all infected horses some of which showed only transient signs) was 0.65. Apart from a complete absence of infection in mares and foals, no factor-specific risks could be attributed to the outbreak. Analyses included examining food and water as sources of infection.
Creating hypotheses: It was hypothesised that all infected horses became infected as a result of direct or indirect contact with the index case. The lack of virus transmission beyond those horses infected from the index case was unexpected but suggested that the virus was not readily transmitted from horse to horse. It was postulated, from pathological effects and the history of contact, that virus was excreted in pulmonary exudates and not spread by aerosol. It seems likely that some mechanical means of aiding transmission was involved.
Intensive follow-up: As this virus was new to the investigators, intensive follow-up was required to establish if the virus existed in the wider horse population. Baldock et al. (1995) reported that 5909 negative serological tests, including 4833 horse tests, were conducted between September 1994 and April 1995. Experimental challenge with the virus of a range of species was undertaken. A similar respiratory disease could be reproduced in cats and guinea pigs (Westbury et al. 1995). The search for a natural host examined a wide range of other animals. Young et al. (1996) found antibody able to neutralise the virus in flying foxes (fruit bats of the Pteropus genus). Sero-prevalence of around 12% has been found with antibodies present in all four Australian species of flying foxes. In September 1996, two years after the equine morbillivirus was isolated from horses, an apparently identical virus was isolated from flying foxes (Halpin et al. 1996). This virus is referred to as bat paramyxovirus (BPV).
Reporting: Research findings have been progressively published in the scientific literature. Media coverage of the outbreak has been extensive and international in its scope. The communications opportunities afforded by the internet have been used with results and updates available through discussion groups and on the world wide web. A series of information sheets has been published and made available through the Queensland Department of Primary Industries' world wide web site. These sheets have been designed to provide accurate material in a readable form for general consumption. Such reporting was dynamic and timely.

A SECOND FOCUS

A third human case (a second fatality) was diagnosed in October 1995 (Allworth et al. 1995). This diagnosis was investigated (Rogers et al. 1996) and a second focus of infection was found on a rural property over 800 kilometres from Brisbane. Retrospective examination of paraffin block tissues found that two thoroughbred horses at pasture were infected with the same virus (Hooper et al. 1996). These horses had died in August 1994, approximately six weeks prior to the outbreak described above. A renewed effort to find further evidence of the virus in Queensland (Ward et al. 1996) failed to demonstrate any further infection in the horse population.

DISCUSSION

The two foci have no known connection in terms of common stock, equipment or transport. The identification of the flying fox as a natural host may provide the explanation for these two apparently unconnected incidents. Work is continuing to elucidate why this novel virus has occurred on two occasions, widely separated geographically but closely clustered temporally. The infection may have come from flying foxes, where the virus may be a natural and fairly harmless infection. Spill-over to horses is known to have occurred on only two occasions. Epidemiological studies provide strong evidence for establishing that the initial Infection spread from the index case in each outbreak to other horses and to three humans.

Australia has invested heavily in contingency planing for exotic animal diseases to protect its advantageous disease status. This process has led to the development of the Australian Veterinary Emergency Plan (AUSVETPLAN). This plan includes specific disease strategies for known threats but also describes approaches for investigations and responses that are generic in nature and can be applied to most situations. The procedures detailed in AUSVETPLAN are also applied successfully to emergencies that arise from outbreaks of endemic diseases.

The outbreak of the equine morbillivirus (bat paramyxovirus) sparked an interest amongst scientists and captured the imagination of media agencies throughout the world. The virus has been restricted in its occurrence but has shown itself as the cause of severe disease in horses and humans. The marriage of diagnostic procedures and the epidemiological approach to outbreak investigations has been demonstrated as essential to achieving an acceptable outcome. Experience has shown that these principles apply even when the cause of the outbreak is entirely novel.

BIBILOGRAPHY

Allworth T., O'Sullivan J., Selvey L., Sheridan J., 1995. Equine morbillivirus in Queensland. Comm. Dis. Intell. 19 (22), 575.

Baldock F., Douglas I., McKenzie A., Black P., Pitt D., Auer D., 1996. Equine morbillivirus infection: Epidemiological aspects of the 1994 Queensland outbreaks. Proc. 11th Int. Conf. Racing Analysts and Veterinarians, Queensland, Australia 287-290.

Geering W., Forman A., Nunn M., 1995. Exotic disease of animals: a field guide for Australian veterinarians. Australian Government Publishing Service 101-105.

Halpin K., Young P., Field H., 1996. Identification of likely natural hosts for equine morbillivirus. Comm. Dis. Intell. 20 (22), 476.

Hooper P., Gould A., Russell G., Kattenbelt J., Mitchell G., 1996. The retrospective diagnosis of a second outbreak of equine morbillivirus infection. . Aust. vet. J. 74 (3), 244-245.

Lesard P., 1988. The characterization of disease outbreaks. Veterinary Clinics of North America 4(1), 17-32.

Murray K., Selleck P., Hooper P., Hyatt A., Gould A., Gleeson L., Westbury H., Hiley L., Selvey L., Rodwell B., Ketterer P., 1995 A morbillivirus that caused fatal disease in horses and humans. Science 268, 94-97.

Rogers R., Douglas I., Baldock F., Glanville R., Seppanen K., Gleeson L., Selleck P., Dunn K., 1996. Investigation of a second focus of equine morbillivirus infection in coastal Queensland. . Aust. vet. J. 74 (3), 243-244.

Ward M., Black P., Childs A., Baldock F., Webster W., Rodwell B., Brouwer S., 1996. Negative findings from serological studies of equine morbillivirus in the Queensland horse population. Aust. vet. J. 74 (3), 241-243.

Westbury H., Hooper P., Selleck P., Murray P., 1995. Equine morbillivirus pneumonia: susceptibility of laboratory animals to the virus. Aust. Vet. J. 72, 278-279.

Young P., Halpin K., Selleck P., Field H., Gravel J., Kelly M., Mackenzie J., 1996. Serologic evidence for the presence in Pteropus bats of a paramyxovirus related to equine morbillivirus. Emerging Infectious Diseases 2 (3), 239-240.