



Short report

Caring for a patient with rabies: implications of the Milwaukee protocol for infection control and public health measures

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SUMMARY

This article discusses the infection control and public health measures taken whilst managing a case of laboratory-confirmed rabies, and the challenges faced in implementing these measures. Case management requires intensive multi-disciplinary co-ordination. The Milwaukee protocol, which to date has five reported human rabies survivors associated with its use, has been suggested as a potential management pathway for human rabies. Consensus among hospital and public health clinicians would aid future deployment of this approach in selected cases.

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Introduction

Rabies is a viral illness causing encephalitis that is almost always fatal. Belonging to the Rhabdoviridae family and the Lyssavirus genus, rabies is a significant cause of mortality in the developing world. Transmission to humans usually occurs via the salivary route as a result of a bite from an infected animal. Dogs account for the majority of cases of animal rabies (54%), although bats are increasingly becoming the source of human

rabies in the USA. In the UK, rabies has been eradicated amongst the terrestrial animal population, and therefore recent cases of transmission to humans from terrestrial animals have been associated with exposure whilst abroad. However, bats in the UK do carry lyssaviruses, thus posing a risk for the acquisition of human rabies [1]. European bat lyssavirus type 1 (EBLV-1) is the predominant strain circulating amongst bats in Europe [2]. However, within the UK, only cases of EBLV-2 infection have been identified in the bat population [2]. The Daubenton's bat (*Myotis daubentonii*) is the only bat species in the UK in which EBLV-2 has been isolated [2], and in 2002, an unvaccinated bat handler in Scotland who did not receive rabies postexposure prophylaxis died from a laboratory-confirmed EBLV-2 infection [3]. Bat bites are typically less conspicuous than those from terrestrial animals, and specialist advice should be sought promptly if a bat bite is felt by an individual, regardless of whether or not a skin break is visible, and irrespective of whether or not the bat species is known [1].

The incubation period following exposure to rabies has been reported to be as long as 19 years, although most individuals will become unwell within 90 days of exposure. Initial symptoms are non-specific and include fever, malaise, headache, nausea and vomiting. This prodromal period lasts between two and 10 days. Subsequently, infected individuals develop agitation, delirium, hydrophobia and autonomic dysfunction. Ultimately, coma and death occur from cerebral oedema or myocarditis.

Early recognition and timely management of exposures protects patients from this fatal viral infection. Where this has failed to prevent disease, caring for patients with suspected and/or confirmed rabies (a Hazard Group 3 pathogen) poses a major challenge. Following the survival of a patient [4], the Milwaukee protocol has been suggested as a potential clinical algorithm. However, a co-ordinated approach both between and within relevant organizations is required with early laboratory confirmation in order to avoid exposure of others including healthcare workers. It is important that preparation and rehearsal of pre-incident planning takes place and that protocols are followed.

This article describes the infection control and public health management implications of the Milwaukee protocol in a case of rabies. The patient presented to a district general hospital, and was subsequently managed in partial concordance with the Milwaukee protocol in the intensive care unit (ICU) of a London teaching hospital.

Methods

Setting

The Queen Elizabeth Hospital is a district general hospital in South East London, and forms part of the Lewisham and Greenwich NHS Trust. A consultant microbiologist is available 24 h/day for clinical and infection control advice.

The Hospital for Tropical Diseases (HTD) based at University College London Hospitals (UCLH) serves as a tertiary referral centre for infectious diseases. Infection doctors encompassing infectious diseases physicians, virologists and microbiologists provide a 24-h consultant-led service for clinical advice and referrals. Over 1300 patients are admitted under the care of the infectious diseases team each year. The hospital is

supported by an infection control team (with microbiology and virology support) which provide a 24-h service. There is also a dedicated occupational health department. For critically ill patients, UCLH hosts a 35-bed ICU. The unit is staffed by a multi-disciplinary team that cares for approximately 2500 patients each year.

In the UK, Public Health England provides 24-h advice regarding management of cases of public health interest.

Summary of the case

The infectious diseases doctor on-call for the HTD received a call from the Emergency Department of Queen Elizabeth Hospital, Woolwich referring a 58-year-old patient with suspected rabies [4]. Nine weeks prior to her presentation, the patient had sustained a bite to her right forearm by an ownerless puppy whilst in India. She was accepted for transfer to UCLH, and admitted directly to the ICU at UCLH the same day. Treatment of the patient was principally guided by the Milwaukee protocol Version 3.1 (most recent version now is Version 5.0) [5]. The protocol is based on induced coma and neurotransmitter substrate replenishment whilst allowing the body's immune system to clear the virus, and aims to rebalance the rabies-induced tetrahydropterin deficiency that leads to dopamine and serotonin deficiency and poor nitric oxidase activity [6]. The current Department of Health rabies guidance [7] was also used in terms of infection prevention and control aspects of case management. Despite the intense multi-disciplinary efforts made, the patient's clinical condition deteriorated progressively. The patient progressed to profound autonomic disturbance and died 10 days after admission. Pathak *et al.* published the clinical features, and ante- and post-mortem laboratory findings of this case [4].

Results

Infection control measures

Initial management at the referring hospital

A diagnosis of rabies was suspected by the patient's general practitioner who had a telephone discussion with the emergency medicine consultant at Queen Elizabeth Hospital. The case was subsequently discussed with the microbiology consultant, who alerted Public Health England. Strict infection control precautions were advised and followed. The patient was cared for by a small team of charge nurses and consultants in order to minimize exposure. There were no direct exposures to the patient's bodily secretions without personal protective equipment (PPE) as strict contact precautions were followed from the outset. Postexposure vaccination was offered to six members of staff of Queen Elizabeth Hospital, two of whom completed the full five-dose course. The other four staff members opted not to receive the vaccine.

The patient and members of staff at UCLH

The patient was admitted to a single-bed room with en-suite sanitary facilities, a lobby and negative pressure ventilation on the ICU. Urine and faeces from the patient, although considered non-infectious, were disposed of in an en-suite toilet and any residual matter was put in the clinical waste. Prior to

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