

Background

The European bat lyssaviruses are two distinct viruses related to the ‘classical’ rabies virus, but found mainly in European bat species. They are able to cause pathological rabies in both bats and other mammalian hosts, including man. Whilst the European bat lyssavirus causing the most confirmed cases (EBLV-1) is associated mainly with the Serotine bat, the virus has never been found in the UK, possibly due to the small populations and restricted range of its host. Evidence of the rarer EBLV-2, associated primarily with the Daubenton’s bat has been found across the UK; either as dead or dying bats testing positive for the presence of the virus (and exhibiting behavioural symptoms), or of bats showing antibodies specific to EBLV-2, indicating that they have been exposed to the virus at some point in their lives. However, there have only ever been 18 confirmed cases of EBLV-2 infection, including two human fatalities, of which four bat cases and one human case have been in the UK. The common nature of the primary host species and its national range, and the apparent widespread distribution of EBLV-2 cases have made lyssavirus infection in Daubenton’s bats, and the human and conservation issues associated with this, the cause of some concern and the subject of research.

Rationale

This work aims to describe, for the first time, the quantified development of a European bat lyssavirus (EBLV-2) infection in its native British host. This is vital for an informed scientific contribution to government policy formation and is the key underpinning study to three related streams of research. Firstly, this work will demonstrate the susceptibility of Daubenton’s bats to a variety of virus challenges and describe how many succumb to the disease (key in describing the effects of endemic lyssavirus on bat conservation and necessary for predictive epidemiological modelling). This will provide a valuable opportunity to record the early signs and manifestations of disease in bats. Secondly, it will describe the proportion of bats that secrete live virus and therefore act as vectors of the disease to con-specifics or other native wildlife (key in an assessment of the human risks and of predictive epidemiological modelling). Thirdly, it will provide the context against which current and future government funded surveillance programmes for lyssaviruses in British bats can be interpreted. Current surveillance work is collecting data but we are currently unsure of the relationships between a sub-clinical infection (sufficient to raise antibodies), virus production and the incidence of full-blown clinical disease. The absence of this information limits the interpretive power of the research. Without this proposed study, researchers and policy makers will be reduced to using ad-hoc anecdotal evidence from the sporadic incidence of EBLV2 in the wild (often unsatisfactory as the bat is usually recovered already dead) and evidence gathered in other countries using bat / lyssavirus models inappropriate to the UK. Of particular concern in this respect is that the pathology of ‘classical rabies’ (RABV) in US bats, appears to show unexpected combinations of symptoms. Little is known about the pathology of the European bat lyssaviruses and whilst similar unexpected pathologies might be anticipated there is also limited evidence that suggests that there may also be distinct differences in the pathology of EBLVs in their co-evolved European host bat species. This work, partly as a result of its diverse national partnership, and partly because of necessity will probably help form policy in a number of states or other Pan-European organisations (e.g. EUROBATS), and a justification of its utility should be at the international scale.

Method

Up to fifty Daubenton's bats, caught from the wild in England, will be held in an appropriate and humane laboratory, and infected with an English isolate of EBLV-2 or used as non-infected controls. The bats will be studied to monitor the development and progress of the lyssavirus infection, and to definitively describe diagnostic symptoms (antibody sero-conversion, virus excretion and behaviour).

The bats will be caught from locations across England. All aspects of the capture process have been examined and a demanding list of license restrictions is in place to ensure the highest welfare standards are adhered to and ensure the continued viability of the populations from which the bats are drawn. This study is an Anglo-German collaboration. The bats will be held for up to 7 days in England, before being transported to Germany where they will be housed to the highest standards, in a facility experienced in looking after bats for extended periods. There is not the capacity in the UK's specialised facilities for undertaking this study.

A number of virus challenge routes will be used to explore potential infection mechanisms and the development of lyssavirus pathology; all are potential routes of infection within wild populations of bats. The bats will be monitored continually to examine for detectable signs of infection (behaviour -scored on a predetermined scale, blood test for antibodies and saliva swabs for live virus). Bats will be held for approximately 30 days quarantine to establish baseline serology and to allow them to acclimatise to their surroundings. The bats will then be studied for 90 days to assess their response to challenge with virus. This could be extended if results provided a basis for further observation. If a bat shows signs of distress (especially those behaviours considered to be symptoms of a pathological lyssavirus infection), then it will be humanely killed to limit suffering. All of the bats will be humanely killed at the end of the study to assess whether they have been asymptotically infected. The work has undergone extensive ethical review and carries all appropriate licenses. The work will be published in order to ensure that the results are of maximum use to other bat workers, the public and decision making institutions across Europe.