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New introduction and spread of rabies among dog population in Bangui☆

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ABSTRACT

Rabies is endemic in the Central African Republic (CAR) and a neglected enzootic disease which represents a serious public health problem. Before April 2009, rabies was not a notifiable disease in CAR. Vaccination of animals is expensive and not commonly done. In 2005, none rabies case was recorded in Bangui. To understand how rabies was introduced and propagated in the city of Bangui from 2006 to 2008, we analyzed samplings of dog brain as well as reviewed the records of dog owners. A total of 86 out of 101 samples (84.8%) tested positive for rabies virus during this period. Previous phylogenetic analysis of some strains circulating in Bangui between 2006 and 2008 indicated that virus of cosmopolitan and Africa 2 clade are found. Given the time frame and location of these samples, one possible explanation for this alarming result may be that two different strains of rabies virus were introduced at different times in Bangui. Stray dogs are solely responsible for the spread of the epidemic.

1. Introduction

Rabies is a fatal neuropathogenic disease caused by the rabies virus which remains a serious public health problem in developing countries. The domestic dog is the most important vector of human exposure (Wandeler et al., 1993). An exposed person can be saved through an immediate full-course post-exposure treatment however, the supply of rabies immunoglobulin is inadequate worldwide, and in developing countries, vaccine often is not available or is of doubtful quality. Despite the availability of human and animal vaccines, each year at least 55,000 human die from rabies (Knobel et al., 2005). From an economic point of view, prevention of rabies in humans only by post-exposure treatment is less cost-effective than dog vaccination, since such treatment does not stop the spread of the virus in animal reservoir (Bogel and Meslin, 1990). In Africa, stray dogs are the main reservoir and source of human cases (Mansfield et al., 2006; Cohen et al., 2007). Therefore, vaccination of animals is expensive and not commonly done. Very few data are available on the rabies propagation in an African urban environment.

No official and regular intervention strategies against canine rabies exist. Post-exposure treatment often is delayed by the search for cash to buy vaccines, which moreover, are not always available, and no antirabies serum exist. Mass vaccination of dogs is a logical strategy for preventing human rabies and exposure in this context.

However, in CAR the surveillance system for rabies consists in observation of biting animals by the veterinary service. No attempt to control dog rabies through vaccination has been conducted in the country. The only attempts by the municipality in the city of Bangui have always been euthanized stray dogs which yielded no significant result. No data on the prevalence of rabies in CAR is available. The only data available are that of the molecular characterization of strains of rabies that have circulated in the CAR from 2006 to 2008. Further studies are underway to characterize the strains isolated during the last decade in order to know the cycle of emergence episodes rabies. Demographic study in CAR in general and Bangui in particular to estimated the dog's population or prevalence of rabies was never done. In Bangui, dog rabies vaccination is available at the veterinary clinic, and vaccination coverage of owned dogs is around 10% a year (veterinary source).

We followed an outbreak of canine rabies in Bangui and Bimbo, two adjacent cities in south of Central African Republic (CAR) since

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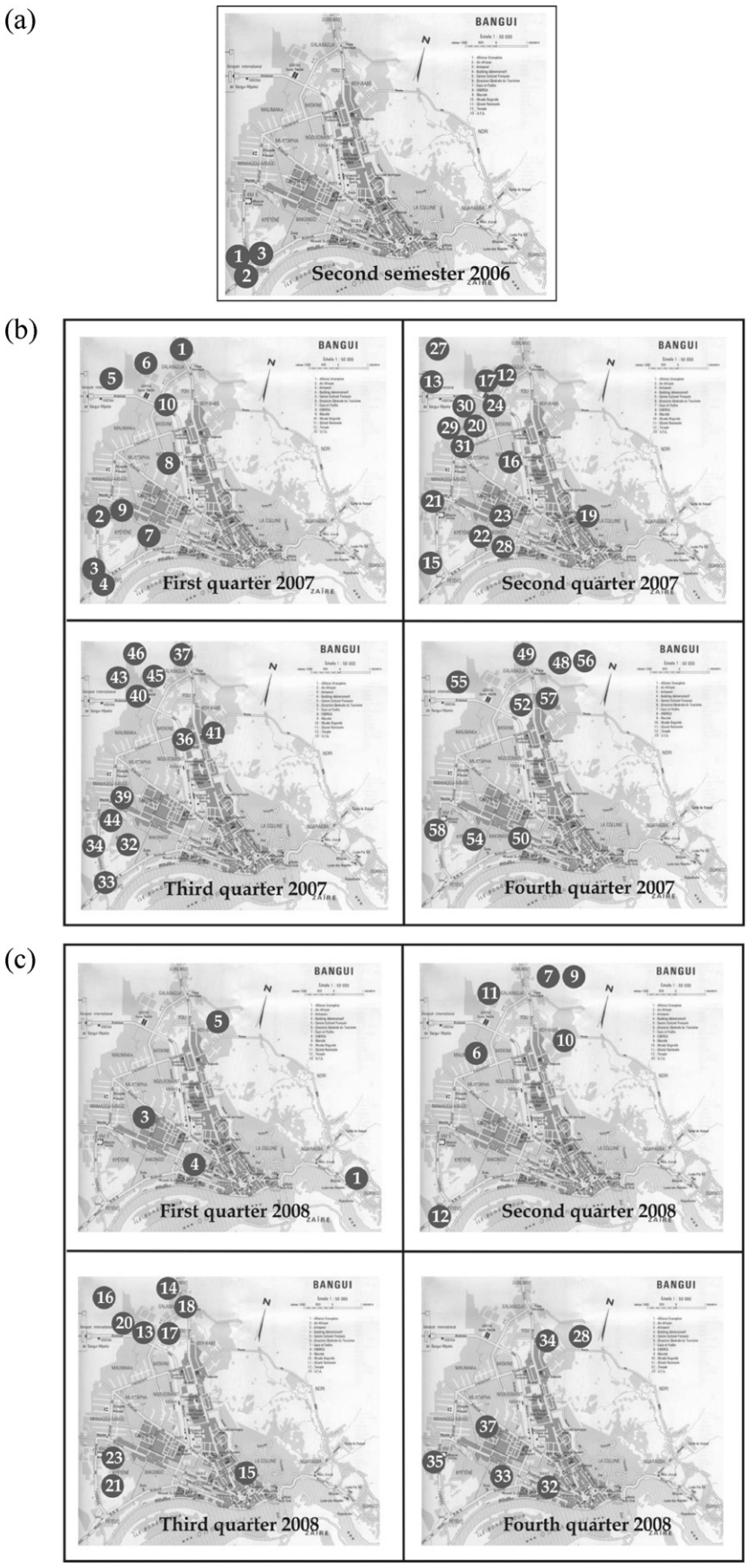

Fig. 1. Distribution of rabies cases Bangui per semester in 2006 and by quarter from 2007 to 2008. Animal sample received at the IPB were numbered chronologically each year starting with number 1. Each disc on the map corresponds to the number of the positive dog sample and the location of the owner. (a) Location of the first cases of canine rabies, south of Bimbo 2006. (b) Propagation of canine rabies in Bangui in 2007. (c) Evolution of canine rabies in Bangui in 2008.

August 2006 which extends over two and a half years. The epidemiologic features of this epidemic are presented.

2. Data collection and methods

Owners regularly brought their animals to the veterinary clinic of the Ministry of Agriculture where they are examined and euthanized if rabies was suspected. The brain is removed and sent to the "Institut Pasteur de Bangui" (IPB) for diagnosis. Data were recorded concerning the animal owner (name, address), including the history of animal bite(s), clinical symptoms and putative diagnosis. People who had been bitten or had had contact with an infected animal are advised to go to the IPB (the Centre for Prevention and Treatment of rabies, created at the IPB in May 2007) for evaluation and subsequent vaccination if needed.

The National Reference Laboratory for rabies at the IPB performs direct immunofluorescence for the rapid diagnosis of rabies and molecular technique for confirmation.

From August 2006 to December 2008, 101 samples of animal brain (94 dogs, 3 cats and 4 goats) were received for diagnosis. Following manufacturer's recommendations, Ammon's horn imprints of suspected animals were fixed in acetone, stained with adsorbed rabies anti nucleocapsid conjugate (BIO-RAD, 92430 Marne-la Coquette, France) and examined under a fluorescence microscope (LEITZ LABORLUX, D5 Wetzlar NPL, Germany).

For molecular diagnosis, RNA was extracted from using QIAamp Viral RNA mini Kit (Qiagen Gmbh, D-40724 Hilden) following the manufacturer's instructions, re-suspended in AVE Elution Buffer (Qiagen Gmbh, D-40724 Hilden), and stored at −80 °C until use. Reverse transcription (RT) and polymerase chain reaction (PCR) were performed by using the Lyssavirus primers PVO5m: ATG ACA GAC AAY YTG AAC AA position 7170–7189 and PVO6: CCR TTC CAR CAG GTA GGD CCP position 7486–7467 (Bourhy et al., 2005). These primers amplified a 317 nucleotide region of the polymerase gene.

3. Results and discussion

Of 101 samples tested, 86 (84%) including 82 (95. 3%) dogs, 3 (3. 5%) goats and 1(1. 2%) cat were found positive for rabies virus antigens. The first rabies cases appeared in August 2006. This was the first positive result after eighteen months of negative results. The first three cases were located in the southern border of Bimbo (Fig. 1a). Then, in early 2007, new cases appeared for the first time in the northern border of Bangui. In the following months, rabid dogs appeared in Bangui itself, predominantly in the northern and western sectors, with a limited number of cases in the central and eastern parts of the city (Fig. 1b). The epidemic was officially declared in February 2007 and a large number of cases were registered during the first half of the year. After a minor decline, a second wave of cases was recorded in mid-2008 in the cities of Bangui and Bimbo (Fig. 1c). Since 2008, the intensity of the epidemic has gradually decreased and levels of infection remain low with one or two cases per month.

Six human cases were reported in 2007 and one in 2008 among which 3 were confirmed biologically. According to the reports from the vaccination centre of the IPB the number of people vaccinated was proportional to the number of positive cases diagnosed (unpublished data).The likelihood of two separate introductions of rabies in Bangui is strengthened by the preliminary results of molecular analysis showing the co-circulation of two strains belonging to two distinct phylogenetic lineages AF1 and AF2 (Bourhy et al., 2008; Talbi et al., 2009). The strains belonging to the AF2 lineage have been described previously in Bossangoa in the north of CAR. Thus, the emergence of this strain in Bangui corresponds to an extension from its previous known territory, possibly because of movements of populations related to social trouble in the north. A complementary phylogenetic study should clarify this point.

Rabies is a major and recurrent zoonotic problem in CAR with two epidemics reported in the country a first in 2006 in Baboua north western CAR on the border with Cameroon and a second in 2008 in Kaga-Bandoro about 300 km north of Bangui. The dynamics of rabies among the dog population has been studied with regard to the African continent but its propagation in a micro environment (at a city level) has never been described (Bourhy et al., 2008; Hampson et al., 2007; Talbi et al., 2009). The almost concomitant apparition of rabies on two opposite sides of the city may explain the rapid spread of the virus throughout the different boroughs. As analysis of 341 wild rodents (263 *Mastomys*, 125 *Arvigantes* and 8 *Cricetomys gambianus*) and 48 bats (47 *Eidolon helvum* and 1 *Rousetus aegyptiacus*) remained negative, and only a limited number of other domestic animals were infected, the implication of animals other than dogs in the persistence of rabies is unlikely. During the study period of 94 dogs tested, 15 were declared on the filings as having no known owner therefore considered stray. Thus, stray dogs seemed to be the main source not only of this extension of the infection but of its persistence as well (Hampson et al., 2008, 2007). It is however likely that only a fraction of the rabid dogs were seen at the veterinary clinic, while the others were either killed or abandoned and eventually died of the illness, because the owner were either ignorant of the surveillance system or feared legal action.

It has to be noted that geographically, the cases were not evenly distributed. They were concentrated at the periphery of the city within two impoverished areas in the north and the south of the city. On the contrary, few cases were reported in the centre and the east of the city where upper class populations live in individual homes protected by enclosures. Curiously, in Bangui, stray dogs do not appear to be numerous and only a few can be seen in daytime (during the study period of 94 dogs tested, 15 were declared on the filings as having no known owner therefore considered stray) and never in packs as it is reported in other cities where rabies is endemic (Widdowson et al., 2002). The farther away from the city centre the poorer the population, as described in Mexico City (Eng et al., 1993). People live in very close contact in small, crowded, shabby houses while stray dogs roam among the alleys.

4. Conclusion

Non-selective elimination of stray dogs to reduce the vector population is no longer recommended as a strategy against rabies by WHO (WHO Expert Committee on Rabies, 1992). Therefore, the fight against canine rabies in CAR is difficult because of limited resources, which have not permitted to put in place dogs vaccination policy. The general public does not have a good knowledge about rabies and its prevention. Dog owners perceived the price of the vaccine and long distances to the clinic as major obstacles to regular vaccination (veterinarian declaration). Thus health authorities should act to intensify the awareness of the problem and incite people to report any suspicion. As a consequence, it is likely that canine rabies will remain a public health problem all over the country and particularly in Bangui and Bimbo where resides one sixth of the country total population.

Conflict of interest

The authors have declared that no competing interests exist.

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