DOI:10.3969/cjz.j.issn.1002－2694.2013.03.018

Epidemiology of human rabies in Guangxi, China, 1951-2010

YANG Jin-ye, MO Yi, TAN Yi, MO Zhao-jun, MO Jian-jun, ZHOU Kai-jiao

(*Guangxi Zhuang Autonomous Region Center for Disease Prevention and Control, Nanning* 530028, *China*)

ABSTRACT: The objective of the present study was to summarize and analyze the epidemics of human rabies in Guangxi, China, from 1951 to 2010, and to investigate the epidemiological factors and the features for providing scientific evidence for development of the prevention and control strategies. A descriptive epidemiological method was used to conduct statistical analysis on the epidemiological data of rabies and reported cases in Guangxi between 1951 and 2010. Totally, 17 210 cases of human rabies were reported during these 60 years and the overall incidence was high. The epidemic peak appeared around every 10 years from 1951. The epidemic focus was expended annually, from the north to the south and from the east to the west. Most of cases were found in rural areas, being caused by dog bites with category Ⅲ exposure mainly in head, face and upper limb. The average latent period was 63 days. Though provided by proper post-exposure treatment, some patients still died during or after rabies vaccination. Statistical data from surveillance site of human rabies exposure clinics showed that the morbidity was 2.75/100 000. In the year from 2006 to 2010, the positive rates of nucleic acid of rabies virus in brain tissues of the dogs with healthy appearance were 1.9%, 0.93%, 0.91%, 0.40% and 0.00%, respectively. Results suggested that prevalence of human rabies is high in Guangxi and shows a periodic epidemic situation. The factors including keeping large number of dogs, low vaccination rate in dog, high rate of virus carrying among healthy appearance dogs, high exposure rate of human to dogs, low awareness of self-protection, and the unaffordable cost of vaccination are all contributed to the epidemics. The continued expansion of natural epidemic focus, inadequate management of infection source, and inadequate implementation of comprehensive prophylaxis are the main reasons for the reemerging of human rabies in Guangxi.

KEY WORDS: rabies; epidemiological factors; Guangxi Zhuang Autonomous Region

Supported by the Research Project from Health Department of Guangxi Zhuang Autonomous Region (No. Z2011078)

Rabies is a viral disease that causes acute encephalitis in both humans and animals. Guangxi is one of the provinces that have the most reported cases. In recent years, 300 to 400 cases were reported annually in Guangxi Zhuang Autonomous Region. The rabies in the province was once effectively under control, for example, only 24 cases were reported in 1995. However, due to multiple reasons, it is reemerging in 21 centuries. Currently, human rabies cases were reported in most of the cities and counties around the province, and the incidence is particularly high in some areas. The reemerging of rabies became a major public-health problem in Guangxi, which also threatened the safety and stability of the society. Based on rabies surveillance data in Guangxi, we analyzed the characteristics and associated factors of rabies epidemic and discussed the responding strategies.

Materials and methods

Data resources

Data of human rabies in Guangxi were collected from the Guangxi Infectious Disease Epidemic Annual Reports.

Data analysis

Excel, Map Info 10.0, and relevant epidemiological methods were used for statistical analysis of the data.

Result

Characteristics of the epidemic from 1951 to 2010

The first human rabies case in Guangxi was reported in 1951. A total of 17 210 human rabies cases were reported in the province since then. The epidemic peak appeared around every 10 years before the 1990s (Figure 1). The annual incidence was 0.47/100 000 in 1950s, 0.82/100 000 in 1960 s, 1.20/100 000 in 1970s, and 1.49/100 000 in 1980 s, which showed an upward trend. The incidence of human rabies in 1981 was 2.46/100 000, which was much higher than that in any other year during the six decades. After that, a series of com-

prehensive prevention strategies were implemented, resulting to the gradual decline of the incidence. The average annual incidence in 1990s was merely 0.14/100 000. In the 21st century, the epidemic was reemerging and the number of reported cases went up rapidly. In 2004, the incidence was 1.24/100 000 and was the highest in recent 10 years. After 2004, the epidemic reduced gradually and the incidence was only 0.62/100 000 in 2010.

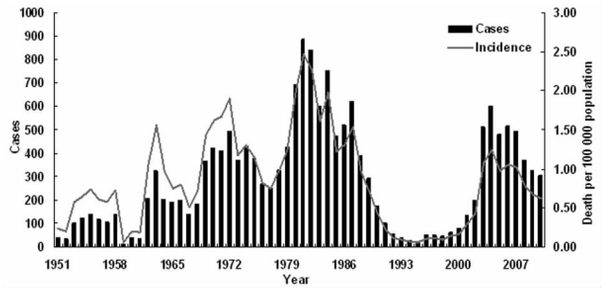

Fig. 1　Annual number and morbidity of rabies case in Guangxi, 1951 to 2010

Geographic characteristics of human rabies in Guangxi from 1951 to 2011

There were relatively more cases in 56 counties in the north, south-east and south-west of Guangxi in 1950s. In 1960s, the epidemic spread to the north-east, center and south-east of Guangxi. However, the epidemic in northern mountain areas reduced in this period. In 1970s, the epidemic spread from the east to the west and 62 counties had reported cases of human rabies. In 1980s, the human rabies outbroke throughout the province and 87 counties had reported cases, which meant only 3 counties have no reported case. Meanwhile, the incidence among counties was much higher than that in 1960s and 1970s. The human rabies incidence in 1990s showed a sharp decrease, but still reported in about 80 counties, which indicated that the epidemic had spread throughout the province. Since 2000, the epidemic has reemerged and increased rapidly, and all of the counties and districts in Guangxi have reported cases.

Guangxi is a mountainous region. The mountainous areas dotted in 37 counties cover an area of 102 237 square kilometers, the hilly areas dotted in 34 counties cover an area of 71 475 square kilometers, and the plain areas dotted in 41 counties cover an area of 63 069 square kilometers (Figure 2). The incidences of human rabies in different landforms were varied. The incidence in hilly areas was much higher than that in the plain and mountainous areas. From 1951 to 2010, the number of human rabies cases and cumulative incidences in mountainous, plain, and hilly areas were respectively 3 875 and 0.70/100 000, 6 194 and 0.76/100 000, and 7 141 and 1.04/100 000. The differences among data from these areas had statistical significance ($\chi^2=533.304$, $P=0.000$).

Epidemiological analysis of human rabies cases from 2004 to 2010

A total of 2 408 human rabies cases in Guangxi were collected between 2004 and 2010.

Animals and sources of infection

Of these cases, 1 965 persons (81.60%) were attacked by dogs, 137 (5.69%) by cats, and 269 (11.17%) without confirming biting history. For animals, 1 004 (45.76%) had their owners, 532 (24.25%) raised by neighbors, 264 (12.03%) did not have owners, and 394 (17.96%) were from unknown sources.

Exposure parts and categories of contact

Of all the collected cases, 1 885 cases had known exposure parts and category of contact. According to the category of contact with animals by WHO, 1 404 cases (74.48%) had category I contacts and 481 (25.52%) had category II contacts. About 55.76% (1 051/1 885) of the cases had upper limbs exposure, following by lower limbs (27.96%, 527/1 885), and neck/face (11.09%, 209/1 885).

Post exposure prophylaxis (PEP)

Most of the cases did not receive wound treatment after exposure and vaccination. More than 98% of the patients did not receive injection of rabies immune globulin (RIG) or anti-rabies serum. Detailed data can be seen in Table 1.

Latent period analysis

The shortest latent period of these 2 408 cases was 6 days and the median was 63 days. Removing the cases with latent period of over one year (caused by faint memory), 1 696 cases with complete information were screened and analyzed. Factors including age at recording, gender, exposure part, category of contact, etc., were analyzed.

Tab. 1 Post-exposure prophylaxis of category Ⅱ and Ⅲ exposure cases

	No. case	No. wound treatment (%)	No. vaccination (%)	No. passive immunity preparation (%)
Category Ⅱ	497	363 (73.04)	466 (93.76)	/
Category Ⅲ	1 424	916 (64.33)	1 201 (84.34)	1 394 (97.89)
Total	1 921	1 279 (66.58)	1 667 (86.78)	/

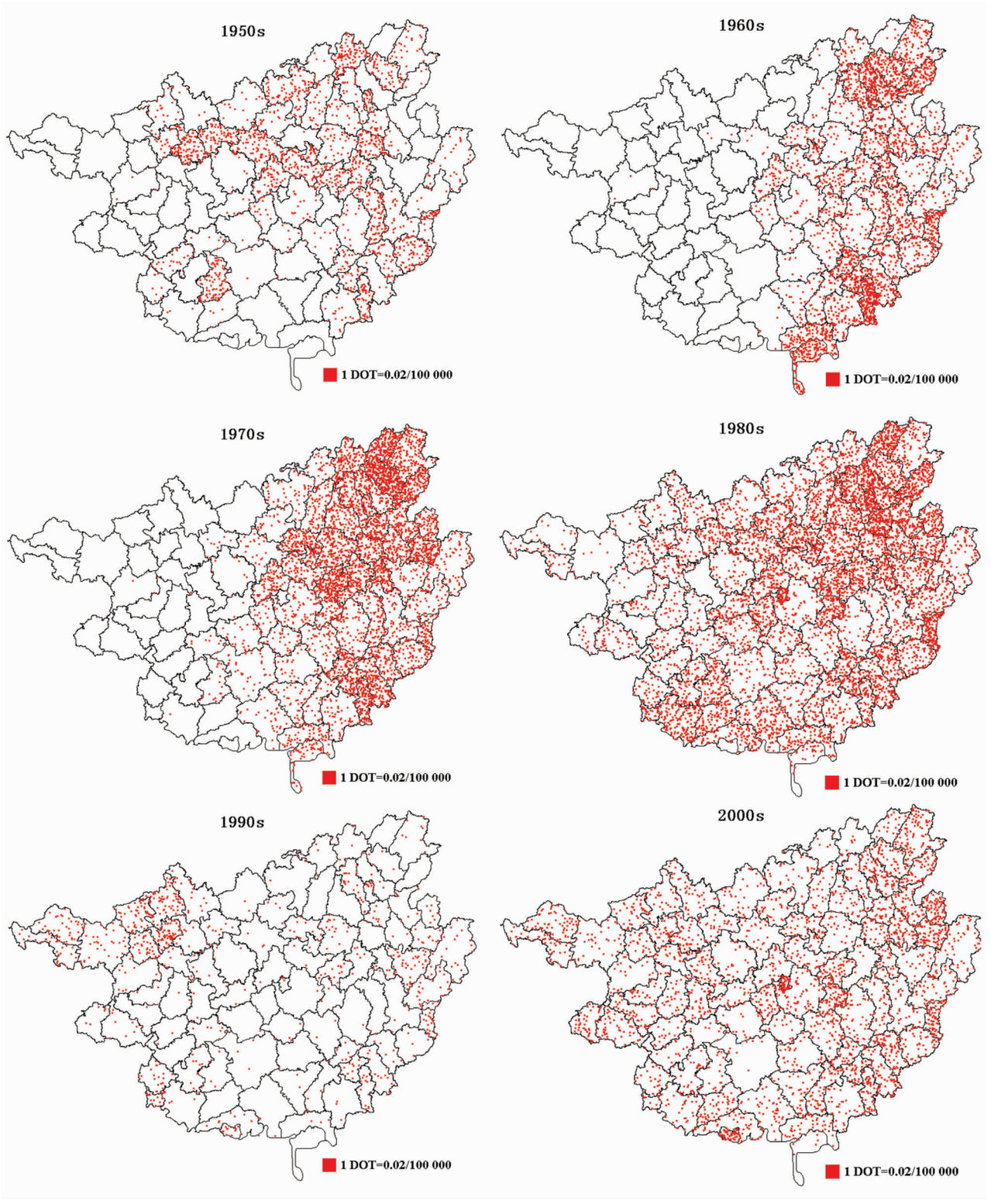

Fig. 2 Geographic distribution of human rabies in Guangxi, 1951-2010

The results showed that in the multiple linear regression equation, exposure parts (b＝10.821, F＝6.090, p＝0.000) and category of contact (b＝3.751, F＝2.052, p＝0.040) were correlated with the latent period. For the patients of category III contacts and exposures in the head, neck or face, the latent period was relatively shorter.

In the 239 cases that died during or after rabies vaccination, the median of latent period was 20 days; 208 (87.03%) cases received vaccination within 24 hours, while 31 (12.97%) after that. Only 21.34% of the cases developed human rabies after receiving the full regime of vaccine, and the rest 78.66% developed rabies symptoms before completing the full course (Table 2).

Tab. 2　Morbidity of cases during or after rabies vaccination

	1st injection	2nd injection	3rd injection	4th injection	5th injection
No. case	0	5	47	136	51
Proportion %	0.00	2.09	19.67	56.90	21.34

The 208 cases, which received vaccination within 24 hours but still developed rabies, had exposures in the head, face or neck (77 cases), upper limbs (71 cases), or closed to heart or multiple wounds (30 cases). Most of the cases (175 cases) had category III contacts. Only 29 cases (13.9%) with category III contacts received passive immunization.

Status of human exposure and clinical surveillance in recent years

Status of human exposure

In 2007, Guangxi CDC conducted a survey in the rural areas of Xinbin District, Laibin City, Guangxi, to investigate the status of human being exposed to rabies. The results of the survey indicated that the exposure rate in people to dogs and cats (category II/III contact) was 7.3% per year. Among which, 68.0% of the patient with category II contact received proper full regime of PEP (wound treatment, vaccine, and RIG), and 13.8% of the patient with category III contacts received proper full regime of PEP (wound treatment, vaccine and RIG). The difference in proper PEP between contact category II and III had statistical significance (χ^2＝21.604, $P\leqslant 0.01$). Results of the multivariate logistic regression analysis indicated that the categories of contacts and species of animals were both related to whether the patients could receive full regime of PEP[1] or not.

Clinic based surveillance of human rabies in Guangxi, 2008－2010

From 2008 to 2010, 72 806 patients went to the 12 rabies PEP clinics for their treatment, which were 26 252 in 2008, 23 469 in 2009, and 23 089 in 2010. Male to female ratio was 1.23 to 1. Most of the cases had exposure to upper or lower limbs, which were 33 569 and 49 186, respectively. Besides, 2 952 cases (4.05%) had exposure to head or face. Major attacking source were dogs (49 186 cases, 67.56%) and cats (15 355 cases, 21.09%), and these two animals made up 88.65% of the overall cases. The rabies cases were mainly composed by category II and III contacts, which were 53 482 cases (73.46%) and 13 741 cases (18.87%), respectively. About 62.02% of category II and III contacts received wound treatment and 99.86% received vaccination. Nevertheless, only 54.76% of the cases received passive vaccination (mainly with RIG, 99.44%) after category III contacts, and only 0.56% received ERIG. Totally, 2 patients (category III exposure) did not receive RIG and both (2/72 806; 2.75/100 000) developed rabies after the 4th administration of vaccine. Within the same period, 25 death cases were reported in the surveillance site and none of them got vaccination.

Etiological surveillance and analysis, 2006－2010

From 2006 to 2010, brain samples were collected from healthy-looking dogs in 14 cities in Guangxi and all the samples were tested by RT-PCR. Results showed that 1 352, 1 728, 881, 749, and 787 samples were tested in 2006, 2007, 2008, 2009, and 2010, respectively. Number of positive samples from these tests were 26, 16, 8, 3, and 0, and the positive rate were 1.9%,

0.93%, 0.91%, 0.40%, and 0.0%, respectively, which showed a decreasing trend.

Discussion

Guangxi is one of the provinces in China that have the highest prevalence of human rabies. Since 1951, 5 peak periods of epidemic had been seen, which was similar to epidemic situation in China, especially the epidemic trend in Guangdong, Hunan, Guizhou, Jiangxi and Fujian[2]. Since 1985, government in Guangxi put more human-power, materials and funding support in prevention and control of human rabies. Animal husbandry and public security sectors collaborated with each other in implementing the "Act of Dog Administration". Comprehensive prevention and control strategies, including dog administration, vaccination and proper killing, and human rabies vaccination, have been implemented[3]. The incidence of human rabies reduced to 0.05/100 000 in 1995, which was the lowest record in the history of Guangxi. However, the human rabies epidemic reemerged after that due to the laxity of prevention and control, the expansion of geographic distribution, and the increase of vaccine cost which related to the accessibility of receiving human rabies vaccine[4]. The dynamic epidemic diagrams of human rabies in Guangxi and in a few other provinces in southern China indicated that the epidemic of rabies in the nature also fluctuated, which is consistent with the epidemic trend of human rabies. Although the rules of rabies epidemic have not yet been fully understood, effective and comprehensive prevention and control strategies implemented before the peak period of epidemic might be stabilized or decreased the peak value.

Many factors have greatly affected the epidemic of human rabies in Guangxi, including geographic distribution, large population exposed to the risk, low self-protection awareness, the cost of vaccines, etc. While the dogs are the major host animal and source of human rabies infection. Case analysis shows that 81.6% of human rabies was transmitted through dog bite. The clinic surveillance shows that almost 70% of human rabies cases were caused by dogs. Based on the data from the home visit surveys conducted by Yulin CDC between 1999 and 2008, the average density of owing dogs in rural families was 14.80 dogs/100 person but only 7.39% of the dogs was vaccinated[5], which was much lower than the WHO recommended vaccine coverage ratio (80% of the dogs).

The comprehensive prevention and control strategies, including dog administration, vaccination, proper killing of dogs, and human rabies vaccination, have been proved to be effective in 1980s, which is also been proved to be the successful experiences in western countries[2-3,6]. However, factors including lack of effective administration of dogs, large numbers of dog population, lower rate of dogs' vaccination, and stray dogs in a state of neglect all contribute to a more difficult status in the control of rabies and cause the spread of that into different areas. Many patients were attacked by their own dogs or their neighbors' dogs, but less attention were paid on the danger of being infected. And patients that did not receive proper PEP lead to the infection of human rabies. On the other hand, etiological surveillance data showed many healthy-looking dogs were carrying the virus. In 2003, Dr. Gu and his team used lab testing methods to prove that healthy-looking dogs did carry rabies virus[7]. The continuous surveillance data suggested that from 2006 to 2010, the infection rate of dog rabies went down gradually, which met the dynamic diagram of human rabies. By analyzing the characteristics and associated factors, we thought that the control of human rabies was largely depending on the control of dogs. Nowadays, how to administer the dogs effectively and efficiently was a new challenge for us.

Analysis of the human rabies cases indicated that even proper PEP was received, some cases still died during or after rabies vaccination. Some papers that published in China have the similar results[8-9], but it was not commonly occurred. The clinic-based surveillance data shows the death rate is only 2.75/100 000. One of the characteristics refers to the relatively shorter latent period (20 days), usually after the 4th shot of vaccine, which was supposed to be the peak hour of antibody. No patient developed rabies after the 1st shot but there was a few cases developed rabies after 5 shots and died. The reason for this is still under investigation. Possible reason could be the change of vaccine, individual differences, or the virus was supposed to be protected by nerve sheath from being killed by anti-rabies antibody when entering into

neural cells[10-12]. Dr. Yang considered that using sufficient amount of anti-rabies serum or RIG to conduct infiltration injection in the exposure part could block the entry of virus into neural cells. This would be a key point for reducing incidence and preventing early death[13]. Besides, pre-exposure prophylaxis is another import prevention strategy.

References

[1]Mo Y, Mo ZJ, Liu B, et al. A cross-sectional study on knowledge, attitude and practice regarding rabies on rural residents in Guangxi[J]. Appl Prev Med, 2010, 16(6): 343-345. (in Chinese)
莫毅,莫兆军,刘波,等.广西人群狂犬病知识、态度及行为调查[J].应用预防医学,2010,16(6):343-345.

[2]Zhang YZ, Xiao DL, Sun YH, et al. The epidemic situation of human rabies from 1984 to 2002 and its preventive measures in China[J]. Chin J Epidemiol, 2003, 24(10): 883-886. (in Chinese)
张永振,肖东楼,孙玉辉,等.中国1984－2002年狂犬病流行情况及防制对策[J].中华流行病学杂志,2003,24(10):883-886.

[3]Lu JH, Wu TC. Epidemic status and evaluation on the effects of control of rabies in Guangxi during the past 45 years[J]. Chin J Epidemiol, 1997, 12(11): 408-411. (in Chinese)
陆家华,吴泰才.广西45年狂犬病疫情动态与防制效果分析[J].疾病监测,1997,12(11):408-411.

[4]Song M, Tang Q, Xu Z, et al. Analysis on the factors related to rabies epidemic in China, in 2005[J]. Chin J Epidemiol, 2006, 27(11): 956-959. (in Chinese)
宋淼,唐青,许真,等.中国2005年狂犬病流行相关因素分析[J].中华流行病学杂志,2006,27(11):956-959.

[5]Liu YW, Li W, Lu YJ, et al. Epidemiological survey of 505 rabies cases in Yulin City, Guangxi Autonomous Region[J]. Dis Surveill, 2009, 24(10): 757-760. (in Chinese)
刘义威,李文,卢耀娟,等.广西玉林市505例狂犬病流行病学调查[J].疾病监测,2009,24(10):757-760.

[6]Cliquet F, Aubert M. Elimination of terrestrial rabies in Western European countries[J]. Dev Biol (Basel), 2004, 119:185-204.

[7]Gu SW, Xu GL, Wu TC, et al. Experimental study on rabies virus carried by home bred dog in Guangxi[J]. Guangxi Prev Med, 2003, 9(1): 1-4. (in Chinese)
古绍文,徐葛林,吴泰才,等.广西家犬携带狂犬病毒的实验研究[J].广西预防医学,2003,9(1): 1-4.

[8]Zhang ZM, Li LH, Kang M, et al. Analysis on the factors related to rabies epidemic in Guangdong, in 2008[J]. South China J Prev Med, 2009, 35(6): 38-40. (in Chinese)
张正敏,李灵辉,康敏,等.广东省2008年狂犬病病例流行病学及危险因素分析[J].华南预防医学,2009,35(6):38-40.

[9]Liu FQ, Gao LD, Guo SH, et al. Analysis on incubation period of human rabies and its influential factors in Hunan province from 2004 to 2007[J]. Modern Prev Med, 2010, 37(7): 1213-1216. (in Chinese)
刘富强,高立冬,郭绥衡,等.湖南省1059例狂犬病例潜伏期长短及其影响因素分析[J].现代预防医学,2010,37(7):1213-1216.

[10]Wu TC, Gu L, Wang SS, et al. The investigation report on early death of rabies[J]. Guangxi Med J, 1989, 11(1): 63-66. (in Chinese)
吴泰才,古漓,王树声,等.狂犬病"早死"现象调查报告[J].广西医学,1989,11(1): 63-66.

[11]Yu YX. Rabies and rabies vaccine[M]. Beijing: Chinese Medicine Science Press, 2001: 36. (in Chinese)
俞永新.狂犬病和狂犬病疫苗[M].北京:中国医药科技出版社,2001:36.

[12]Wang SS, Wu TC, Gu L, et al. Prevention and control of rabies[M]. Nanning: Guangxi Science Technology Press, 1993: 11-25. (in Chinese)
王树声,吴泰才,古漓,等.狂犬病的预防与控制[M].南宁:广西科学技术出版社,1993:11-25.

[13]Yang JY, Xie YH, Mo ZJ, et al. Epidemiological survey on early death of rabies in Guangxi from 2003 to 2004[J]. Guangxi Prev Med, 2005, 11(3): 143-146. (in Chinese)
杨进业,谢艺红,莫兆军,等.2003－2004年广西狂犬病早死现象的研究[J].广西预防医学,2005,11(3):143-146.

Received: 2012-11-16; Revision accepted: 2013-01-16

广西1951－2010年狂犬病流行特征分析

杨进业,莫　毅,谭　毅,莫兆军,莫建军,周开姣

摘　要:目的　总结和分析广西1951－2010年狂犬病流行情况,探讨疫情流行规律和发病特点,为狂犬病预防控制策略提供科学依据。**方法**　采用描述性流行病学方法对1951－2010年广西狂犬病疫情资料和病例个案表进行统计分析。**结果**　60年间广西共报告17 210例狂犬病病例,发病流行强度高,每隔10年左右出现1次流行高峰;疫源地流行范围逐年扩大,并呈现由北向南、由东往西扩散的趋势;病例主要分布在农村地区;犬为主要传染源,病例以头面部、上肢和Ⅲ级暴露为主;潜伏期平均为63 d;部分病例虽及时采取正确的暴露后预防处置,但仍然在免疫期间或全程接种后出现发病的现象,狂犬病暴露门诊监测点数据显示,接种后发病率为2.75/10万;2006－2010年外观健康犬脑狂犬病毒核酸阳性率为1.9%、0.93%、0.91%、0.40%和0.00%。**结论**　广西狂犬病疫情持续高发并呈周期性流行;犬密度高、免疫率低、外观健康犬只带毒率高、人群暴露率高、自我保护意识淡薄和接种疫苗费用高是狂犬病高发的重要因素;狂犬病自然疫源地的持续扩大蔓延、传染源源头管理不力和综合防制措施落实不到位,是近年我区狂犬病疫情回升的主要原因。加强组织领导和多部门合作,根据广西实际制订出更有针对性的综合措施并认真落实到位,才能有效控制广西狂犬病疫情高发态势。

关键词:狂犬病;流行病学因素;广西壮族自治区

中图分类号:R373.9　　**文献标识码:**A　　**文章编号:**1002－2694(2013)03－0294－06

广西壮族自治区卫生厅自筹课题(No. Z2011078)

作者单位:广西壮族自治区疾病预防控制中心,南宁　530028,Email: yjyjy172@163.com