Acta virol. 12 : 453–456, 1968

THE PATOIS GROUP OF ARBOVIRUSES*

S. SRIHONGSE, R. E. SHOPE

Gorgas Memorial Laboratory, Panama, R. de P.; and Yale Arbovirus Research Unit, Department of Epidemiology and Public Health, Yale University School of Medicine, New Haven, Conn., U. S. A.

Received March 14, 1968

Summary. — Five previously described arboviruses — Patois, Zegla, Sontecomapan, Shark River and Pahayokee — are virtually indistinguishable by complement-fixation (CF) testing and related by haemagglutination-inhibition (HI) testing, with Sontecomapan not readily distinguishable from Patois. It is proposed that these viruses be designated the Patois group. By HI testing, Patois group viruses show minor cross-reactions with groups C, Guama, Simbu and Capim in the Bunyamwera supergroup.

Serological techniques have been widely used in classifying arboviruses because of the stability and reproducibility of serological reactions. An early concept of serological grouping proposed by Casals (1957) implied that such virus groups were mutually exclusive, i. e., members of one group could not be related to members of another. Later, Whitman and Shope (1962) reported that Guaroa virus was serologically related to members of both the Bunyamwera group and the California complex. Subsequently, Casals (1963) proposed revision of his earlier concept to recognize that, for practical purposes, there were arbovirus groups in which some members were distantly related to those of other groups. These inter-group serological relationships have been consistently and repeatedly demonstrated, although only with hyperimmune sera.

Casals (1963) reported such relationships among groups C, Guama and Capim, and among groups California, Bunyamwera, Bwamba, Simbu and Koongol. Additional observations made at the World Health Organization (WHO) International Reference Centre at Yale University as well as by workers at the Cornell University Medical College (M. L. Zarate and W. Scherer, personal communication), The Communicable Disease Center in Atlanta, Georgia (Fields *et al.*, 1967) and the University of California (Reeves *et al.*, 1968), have prompted the WHO International Reference Centre to propose that these eight groups — Bunyamwera, Bwamba, C, California, Capim, Guama, Koongol and Simbu — be classified in the "Bunyamwera supergroup" of arboviruses (Casals, 1963; WHO, 1967).

The present studies, involving five additional arboviruses, provide evidence both for establishment of a new serological group, which it is proposed to

* This work was carried out at the Yale Arbovirus Research Unit. The Unit is supported in part by The Rockefeller Foundation.

Table 1. Complement fixation reactions of Patois group viruses

Mouse ascitic fluid	Mouse liver antigen					
	Patois	Zegla	Sonte-comapan	Shark River	Paha-yokee	Normal
Patois	16/256*	16/256	16/64	16/256	16/64	0/0
Zegla	16/256	16/256	16/64	16/256	16/16	0/0
Sontecomapan	32/64	32/256	32/64	32/64	32/16	0/0
Shark River	32/64	32/256	32/64	32/64	32/64	0/0
Pahayokee	8/64	8/64	8/64	16/64	16/16	0/0
Group Vesicular Stomatitis (control)	0/0	0/0	0/0	0/0	0/0	0/0

* Reciprocal of ascitic fluid titre/reciprocal of antigen titre. Antigens were diluted 4-fold starting at 1 : 4; ascitic fluids were diluted 2-fold starting at 1 : 4.

name the Patois group, and for inclusion of this group in the Bunyamwera supergroup.

Of the five viruses studied, Patois and Zegla were isolated during 1961 and 1962 in Panama, and were initially described as belonging to arbovirus group C, although a relationship by HI test to group Guama was also noted (Sribongse *et al.*, 1966). The third agent, 63 A 49 virus (Sontecomapan), isolated more recently in Mexico, was initially described as being closely related to Patois and distantly related (HI) to members of groups Guama, C, Bunyamwera and Simbu (Zarate and Scherer, personal communication). The remaining two viruses, Shark River and Pahayokee, isolated still more recently in Florida, were initially reported to be closely related to Patois and Zegla, respectively, and more distantly to group Guama viruses (Fields *et al.*, 1967).

---

1) Titres adjusted to correspond to 4 antigen units. 0 = no reaction at 1 : 10 dilution.
2) Nearly complete inhibition at this dilution.
3) The following viruses were used in polyvalent vaccines to immunize mice for grouping ascitic fluids:

Group A: Eastern equine encephalitis, Western equine encephalitis, Mucambo, Pixuna, Mayaro, Semliki Forest, O'nyong-nyong, Sindbis, Aura, Una, Chikungunya, Ross River, Getah, Bebaru, Highlands J, Middelburg, Ndumu, Venezuelan equine encephalomyelitis.

Group B: Bussuquara, Dengue types 1, 2, 3, 4, Edge Hill, Entebbe bat, SA H 336, Ilheus, Japanese encephalitis, Kokobera, Kunjin, Meningoencephalitis of turkeys, Modoc, Murray Valley encephalitis, Ntaya, St. Louis encephalitis, Spondweni, Stratford, Tembusu, Uganda S, U. S. bat salivary gland, Usutu, Wesselsbron, West Nile, Yellow fever, Zika, Langat, Powassan, Montana Myotis Leukoencephalitis.

Group Phlebotomus fever: Anhanga, Bujaru, Candiru, Chagres, I 47, I 58, I 81, Icoaraci, Itaporanga, Naples sandfly fever, Sicilian sandfly fever.

Group Vesicular stomatitis: VSV-Indiana, VSV-New Jersey, Cocal.

Group Tacaribe: Tacaribe, Junin, Amapari.

Group C: Oriboca, Marituba, Murutucu, Nepuyo, Caraparu, Itaqui, Apeu, Madrid, Ossa.

Group Guama: Catu, Guama, Moju, Bimiti.

Group Simbu: Simbu, Oropouche, BE An 84785 (Utinga), Manzanilla, Yaba-7, Sathuperi, Ingwavuma, Akabane, Buttonwillow.

Group Bunyamwera: Bunyamwera, Wyeomyia, Germiston, Kairi, Cache Valley, Batai, Sororoca, Ilesha, Guaroa.

Group California: California, Tahyña, Trivittatus, Melao.

Group Capim: Capim, Guajara, Bushbush.

Table 2. Haemagglutination-inhibition reactions of Patois group viruses

Ascitic fluid	Antigen (L, liver; S, serum; B, brain)													
	Patois L	Zegla S	Sonte comapan S	Shark River S	Pahayokee S	Sindbis B	Yellow fever B	Chagres B	Murutucu S	Catu S	Manzanilla B	Bunyamwera B	Tahyña B	Guajara B
Patois	*160*[1])	0	80	20	0	0	0	0	0	0	0	0	0	0
Zegla	0	*80*	0	0	20	0	0	0	0	0	0	0	0	0
Sontecomapan	160	$<20^2$)	*320*	80	$<20^2$)	0	0	0	0	20	0	0	0	0
Shark River	40	0	40	*320*	0	0	0	0	0	10	0	0	0	0
Pahayokee	0	20	0	0	*80*	0	0	0	0	0	0	0	0	0
Gp. A[3])	0	0	0	0	0	*2560*	0	0	0	0	0	0	0	0
Gp. B	0	0	0	0	0	0	*320*	0	0	0	0	0	0	0
Gp. Phlebotomus fever	0	0	0	0	0	0	0	*80*	0	0	0	0	0	0
Gp. Vesicular stomatitis	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gp. Tacaribe	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gp. C	10	10	20	10	$<10^2$)	0	0	0	*640*	20	0	0	0	10
Gp. Guama	10	10	20—40	10	0	0	0	0	10	*1024*	0	0	10	20
Gp. Simbu	0	0	20	<10	0	0	0	0	0	20	*80*	10	40	20
Gp. Bunyamwera	0	0	0	0	0	0	0	0	0	$<10^2$)	0	*80*	20	0
Gp. California	0	0	0	0	0	0	0	0	0	$<10^2$)	0	0	*640*	0
Gp. Capim	0	0	20—40	10	0	0	0	0	$<10^2$)	20	0	0	0	*320*

In the present studies, these five viruses were compared by CF testing and found to be so closely related as to be virtually indistinguishable (Table 1). In addition, their previously observed HI relationships were confirmed in tests using immune ascitic fluids from mice given three injections of vaccine (Table 2). These HI tests showed that Sontecomapan was very closely related to Patois, and Pahayokee closely related to but distinguishable from Zegla; Patois, Zegla and Shark River were readily distinguishable.

In further HI testing, using polyvalent group ascitic fluids prepared concurrently in mice given four infections, antigens of the Patois group were not inhibited by ascitic fluids of groups A, B, Phlebotomus fever, Vesicular stomatitis, Tacaribe, Bunyamwera and California. In several instances, however, these antigens were inhibited to low degree by ascitic fluids of groups C, Guama, Simbu and Capim. The Sontecomapan antigen was the most cross-reactive.

When only Patois and Zegla viruses were known, it was preferable to classify them in group C (Srihongse *et al.*, 1966). With newly recognized relatives, however, it is now appropriate to propose a new group, the Patois group, and to include it in the Bunyamwera supergroup, thus recognizing the distant relationship to viruses in groups C, Guama, Simbu and Capim while maintaining the concept of Casals (1963) that distant intergroup relationships should be allowed without prejudicing the group concept.

Admittedly, the specificity of the reported inter-group cross-reactions is not proved and they may be a result of the presence of contaminating agents such as murine viruses. Nevertheless, these cross-reactions within the Bunyamwera supergroup fully correspond with those observed by investigators working in other laboratories with independently prepared reagents (Whitman and Shope, 1962; Casals, 1963; Zarate and Scherer, personal communication; Fields *et al.*, 1967; Reeves *et al.*, 1968; Srihongse *et al.*, 1966).

References

Casals, J. (1957): The arthropod-borne group of animal viruses. *Trans. N. Y. Acad. Sci.*, Ser. II, **19**, 219.

Casals, J. (1963): New developments in the classification of arthropod-borne animal viruses. *An. Microbiol. (Rio de J.)* **11** (A), 13.

Fields, B. N., Henderson, B. E., Coleman, P. H., Calisher, C. H., and Work, T. H. (1967): Isolation and characterization of three viruses serologically related to group C and/or Guama arboviruses. *Bact. Proc.* **1967**, 166.

Reeves, W. C., Scrivani, R. P., Hardy, J. L., Roberts, D. R., and Nelson, R. L. (1968): Buttonwillow virus, a new arbovirus isolated from mammals, birds and *Culicoides* gnats in Kern County, California. *Amer. J. trop. Med. Hyg.* **17** (in press).

Srihongse, S., Galindo, P., and Grayson, M. A. (1966): Isolation of group C arboviruses in Panama including two new members, Patois and Zegla. *Amer. J. trop. Med. Hyg.* **15**, 379.

Whitman, L., and Shope, R. E. (1962): The California complex of arthropod-borne viruses and its relationship to the Bunyamwera group through Guaroa virus. *Amer. J. trop. Med. Hyg.* **11**, 691.

WHO (1967): Arboviruses and Human Disease. *Wld Hlth Org. techn. Rep. Ser.* No. 369, Geneva.