Knowledge of vector-borne diseases (dengue, rickettsiosis and Chagas disease) in physicians

César I. Lugo-Caballero[1], Karla Dzul-Rosado[1], Irving Dzul-Tut[2], Ángel Balam-May[2] and Jorge Zavala-Castro[1]

[1]Laboratory of Emerging and Reemerging Diseases, Regional Research Center Dr. Hideyo Noguchi, Universidad Autónoma de Yucatán (UADY); [2]Faculty of Medicine, UADY, Mérida, Yuc., Mexico

Abstract

Background: *The ecological conditions of Yucatan made it a suitable region for the acquisition of vector-borne diseases such as dengue, rickettsiosis, and Chagas disease. As the epidemiological burden of these diseases shows an alarming increase of severe cases, the early establishment of diagnosis and therapeutics by first-contact physicians is a critical step that is not being fulfilled due to several reasons, including poor knowledge.* **Objective:** *To determine the level of knowledge related to dengue, Chagas disease, and rickettsiosis among rural first-contact physicians of Yucatan.* **Methods:** *A survey was applied to 90 first-contact physicians from rural clinics of Yucatan, which included 32 items related to the diagnosis, treatment, and prevention of dengue, rickettsiosis, and Chagas disease. Answers were analyzed by central tendency statistics.* **Results:** *Differences were observed among every category, however; diagnosis and therapeutics showed the lower values. Globally, 62.5% of respondents showed moderate knowledge, 37.5% poor knowledge, and 0% adequate knowledge.* **Discussion:** *Results suggest that a strong campaign for a continuous diffusion of knowledge regarding these diseases is needed. In regions with high prevalence of these kinds of diseases, like Yucatan, the impact of these results on the epidemiological burden of these diseases must be evaluated.*

KEY WORDS: *Dengue. Chagas disease. Rickettsiosis. Medical knowledge.*

Introduction

There are an important number of so-called "forgotten" diseases that are particularly prevalent at zones surrounding the Gulf of Mexico, owing to their subtropical temperate weather, urbanization and extreme poverty of their inhabitants. This is aggravated by the reduced impact preventive programs have on communities, limited access to health services and poor interest of government systems[1,2]. According to different reports, dengue, Chagas disease and rickettsiosis are among the main vector-borne diseases (VBD) in the states of southeastern Mexico, which includes Yucatán[1,3].

Dengue, which is transmitted by *Aedes aegypti*, is caused by one of the four serotypes of this virus, which infects more than 50,000 million people around the world every year[4]. This disease has a broad clinical spectrum, which includes fever, headache, exanthema, myalgia, arthralgia and, occasionally, state of shock[4].

Chagas disease is a biphasic parasitic disease caused by *Trypanosoma cruzi*, which is mainly transmitted by bedbugs of the *Triatoma* genus[5]. The acute

Correspondence:
César I. Lugo-Caballero
Avenida Itzáes, 490 x calle 59
Col. Centro
C.P. 97000, Mérida, Yuc., México
E-mail: cesar.lugo@correo.uady.mx

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phase has no typical clinical characteristics, except for an edematous lesion at the site of the insect bite, known as "chagoma"; conversely, the chronic phase is characterized by congestive heart failure[5]. According to the World Health Organization (WHO), Chagas disease is the cause of at least 12,000 annual deaths[5].

Finally, rickettsiosis is caused by different bacterial species of the *Rickettsiae* genus, which are transmitted by ticks, fleas and lice[6]. This disease, which is characterized by intermittent evening fever associated with exanthema, myalgia and arthralgia, has a mortality that is close to 20% in Mexico[6,7].

Yucatán is one of the states with the highest number of cases of dengue, with official figures being higher than 5000 cases only in 2011[8]. On the other hand, the number of people with *T. cruzi* chronic infection has been estimated to correspond approximately to 61,992 cases in Yucatán[9]. With regard to rickettsiosis, this state has reported a seroprevalence of 5.8% and an increasing number of cases[10]. In addition, 40% of patients clinically diagnosed with dengue, but without confirmatory serology, have been reported to actually have a rickettsiosis infectious process[11]. These data reflect an important under-reporting of cases, which may be the result of failures in the epidemiological surveillance system or in their clinical diagnosis by first-contact doctors, which increases morbidity and mortality[8,9,12].

Medical infrastructure in Mexico is accessible to less than 50% of the population, particularly in rural areas[1,13]. In these areas, the coverage depends on doctors that are making one year of social service in rural clinics before graduating (medical undergraduate on social service [MPSS – *Médico Pasante en Servicio Social*]), and who serve as first contact between patients and the health system, similar to other countries[14]. These doctors lack an academic program focused on the management of the VBDs they may find in these communities, and there are even studies that report that only 40-60% have the necessary knowledge for their diagnosis, management and report[15,16]. In particular, these doctors have been shown to lack knowledge with regard to dengue, rickettsiosis and Chagas disease diagnosis and management[17-20].

Considering these data and the importance of opportune diagnosis in patients that potentially have VBD, it is important knowing if first-contact doctors of endemic areas are capable of managing these diseases[1]. The purpose of this work is to determine, by means of a survey, the level of knowledge with regard to dengue, rickettsiosis and Chagas disease in MPSS of Yucatán rural areas, which are socially and ecologically similar to endemic zones from other countries.

Methods

Instrument construction an validation

The survey was constructed considering epidemiological, clinical and preventive aspects of three VBDs that are endemic of Yucatan: dengue, rickettsiosis and Chagas disease. These diseases are included in the curriculum of every medical school in Mexico. The survey was constituted of 32 questions with different answers and a scoring system that defined "poor knowledge" (less than 16 correct answers), "partial knowledge" (between 16 and 28 correct answers) and "adequate knowledge" (more than 28 correct answers). This definition was based on the validation of the survey by experts, in the way that has been previously done in the literature[15]. The time for answering was established at 50 minutes. Prior to being used, the survey was reviewed and validated by an expert committee formed by physicians of different specialties. After this validation, the instrument was used in a pilot study conducted with last academic year students of the Universidad Autónoma de Yucatán medical school. Cronbach's α coefficient was calculated at 0.83, which defines a good to excellent score in the instrument's internal consistency and fidelity and, therefore, after some wordings were corrected, the survey was regarded as being ready for this work.

Participants

In Yucatán, there are 290 MPSS who, regardless of their school of origin, are distributed in 270 primary care rural clinics[14,21]. Considering this number, the sample size (56 participants) was calculated using the following formula: $n = k^2Npq/e^2(N - 1) + k^2pq$, using the following values: $k = 90\%$, $p = 0.5$, $q = 0.5$, $e = 0.01$ and $n = 290$. The participants were randomly selected by random raffle, which took place during the meetings of the MPSS with health authorities. After being explained the purposes and scope of the study, the selected participants signed their informed consent and answered the survey. In spite of the required sample size being 56 participants, 90 surveys were included in the study.

Table 1. General knowledge with regard to vector-borne diseases (n = 90)

Topic	Categories	Number of doctors	Percentage
Academic training	Attended courses related to VBD during their academic training	90	100
	Never attended courses related to VBD during their academic training	0	0
Diagnostic reference centers (DRC)	Knows DRCs location and procedures	33	37
	Knows about the existence of DRCs, but ignores their location or procedures	49	54
	Ignores about the existence of DRCs	8	9
VBD report	Knows that VBDs must be reported, as well as the procedure	60	66
	Knows that some VBDs must be reported, but ignores the procedure	19	21.5
	Ignores the imperative to report VBDs and the procedures	11	12.5
Visual recognition of vectors	Can identify the dengue vector	85	94
	Can identify Chagas disease vector	63	70
	Can identify rickettsiosis vector	63	70
	Can identify dengue, Chagas disease and rickettiosis vectors	51	57

Data were analyzed in Microsoft Excel spreadsheets (Microsoft Corporation, USA), using the Prism software (Graphpad, USA).

Results

All participants attended topical courses on VBD during their academic training, which enables them to answer the survey; in addition, 90% of participants had diagnosed a VBD before. Only 57% was able to correctly identify the VBDs to be examined. Since these diseases represent an important epidemiological problem, aspects about the report of cases were investigated. Only 37% knows the diagnostic reference laboratories and the reporting procedures, whereas 66% only knows the VBD report process (Table 1).

Sixty-one percent of participants know that dengue is caused by a virus. As for clinical manifestations of a probable case, 53.5% answered correctly: fever, headache, arthralgia, myalgia and exanthema. The tourniquet test is an aid for clinical diagnosis of this disease, and its usefulness and interpretation are known by 87.5% of participants. In addition, 82.1% considers that blood count is the most important laboratory test to support a clinical diagnosis. With regard to management, 96.4% considers that it is based on symptom relief with supportive treatment. The importance of clinical and laboratory surveillance during the first 72 hours of evolution is only considered by 53.6% of participants. Finally, as regards prevention, 60.7% knows larviciding mechanism and usage, which is the main preventive method in our region (Table 2).

Sixty-three percent know rickettsiosis etiologic agent. This disease is suspected in patients with fever, exanthema, arthralgia and myalgia, according to 54% of participants. As for diagnosis, 73% knows the usefulness of the Weil-Felix test; in contrast, only 35% considers that indirect immune fluorescence (IIF) and polymerase chain reaction (PCR) are confirmatory tests. The usefulness of doxycycline as the treatment of choice is known by 42%, and 46% considers that treatment should be started with clinical suspicion supported by patient history. With regard to prevention, 82.14% know that the most important is having available methods to prevent domestic animals infestation with ticks (Table 3).

T. cruzi is identified as Chagas disease etiologic agent by 77% of interviewed subjects, although 68% consider that it is only transmitted by the vector. For 78.6% of these doctors, a patient with asthenia, adynamia and edematous lesion on the eyelid may suggest a case of Chagas disease. With regard to diagnosis, 57% considers that the Weil-Felix test and thick blood smear microscopy are the adequate confirmatory tests for this disease. In addition, only 57% would consider using a chest X-ray test looking for cardiomegaly to support the diagnosis. The use of nifurtimox and benznidazole as drugs of choice for the treatment of this disease was mentioned by 48% of interviewed subjects, although only 17% is aware of their serious adverse effects. With regard to prevention, 51.7% mentioned that fumigation and repair of wall fissures are useful strategies against the spread of this disease's vector (Table 4).

The results obtained in the survey were grouped according to achieved scores, which revealed that

Table 2. Knowledge with regard to dengue (n = 90)

Topic	Categories		Number of doctors	Percentage
Etiologic agent	Knows that dengue is caused by a virus		55	61
	Thinks that dengue is caused by bacteria or that it is of autoimmune etiology		35	39
Diagnosis	Clinical data present in possible cases of dengue	Fever, headache, musculoskeletal pain, exanthema	48	53.6
		Fever associated with retro-ocular pain	18	19.6
		Fever, anemia, jaundice. History of residence in an endemic area	21	23.2
		Fever, exanthema and positive serology	3	3.6
	Tourniquet test	Analyzes capillary fragility with an aneroid sphygmomanometer; it is positive with 10-20 petechiae per cm^2	79	87.5
		Has the purpose to detect a > 20 mmHg increase in systolic over diastolic pressure	6	7.1
		Is a serologic rapid test	3	3.6
		Allows detecting hematocrit elevations	2	1.8
	Most valuable complementary test	Complete blood count (CBC) with differential	73	82.1
		Coagulation tests with hematocrit value	13	14.3
		Chest X-ray	2	1.8
		Thick blood smear test	2	1.8
Management and treatment	Pharmacological management	Aspirin as antipyretic	2	1.8
		Systemic corticoids	2	1.8
		Supportive treatment for symptom relief	86	96.4
	Medical surveillance	Should be strict within the first 72 hours	48	53.6
		Should be strict during the entire convalescence process	36	39.3
		Weekly surveillance on an outpatient-basis	6	7
Prevention	Larviciding	Is a series of laboratory tests to identify the etiologic agent in acute cases	10	10.7
		Is an action intended to eliminate female mosquitoes	10	10.7
		Is a program that contemplates talks on prevention in vulnerable communities	11	12.5
		Is an action intended to eliminate all adult vectors	4	5.4
		Is an action intended to eliminate the vector larvae	55	60.7

62.5% of participants have moderate knowledge, 37.5% poor knowledge and 0% have adequate knowledge on the analyzed VBDs.

Discussion

Although 75% of emerging infectious diseases in humans have been estimated to be zoonotic in origin, and that out of these 28% are VBDs, their inclusion in medical training programs is not generalized in endemic countries[22]. Many risk factors and social determinants are common for the transmission of VBDs in vulnerable communities[1,9,23]. These include ecologic factors (weather, vegetation, hosts and vectors availability), and determinant factors such as poverty, lack of attention by the government and limited access to health systems, even to first contact care[1]. This situation is worrying, since it is at this level where doctors play a determinant role in order to reach a diagnosis and establish opportune treatment, as well as to be being the link with superior levels; therefore, it is important to determine their level of knowledge about these highly prevalent health problems.

In the case of our country, and particularly in our setting, VBDs (including dengue, Chagas disease and rickettsiosis) are among the main public health problems. Reporting of these diseases is a determining step for their epidemiological surveillance, in addition to being mandatory according to Mexican official standards[24]. Only 66% of interviewed subjects knows these procedures, which suggests that there is under-reporting of cases of these diseases[7,9].

Yucatán, as other endemic zones, has an important number of cases of dengue every year, and clinical and epidemiological characteristics must therefore be well known by doctors[8]. In this work, the participants had no problem to identify the vector (94%); however, the group of symptoms included in the definition of

Table 3. Knowledge with regard to rickettsiosis (n = 90)

Topic	Categories		Number of doctors	Percentage
Etiologic agent	Know that rickettsiosis is caused by bacteria		57	63
	Ignore rickettsiosis' etiologic agent		33	38
Diagnostic	Clinical findings suggesting a case of rickettsiosis	Dilated cardiomyopathy and visceromegaly	13	14
		Fever, exanthema, arthralgia and myalgia	48	54
		Patients present with an edematous lesion at the site of the vector bite, mainly on the eyelid	16	18
		Patients present with multiple ulcers distributed from vector bite site to other parts of the body	13	14
	Weil-Felix test	Is a test that guides diagnosis, not a confirmatory test	66	33
		Is rickettsiosis confirmatory test	13	15
		Serves to obtain a prognosis of patient evolution	11	12
	Most adequate confirmatory test	IIF and PCR	32	35
		Weil-Felix test	32	35
		Pathogen isolate and culture are indispensable	22	25
		Tourniquet test	4	5
Management and treatment	Pharmacological management	Doxycycline	38	42
		Combination of cephalosporin and third-generation fluoroquinolone	23	25
		Dicloxacillin	14	16
		Antigen fractions	15	17
	Moment to start treatment	With clinical suspicion supported by patient history	41	46
		Only after laboratory confirmation	19	21
		Treatment is effective regardless of the moment it is started	30	33
Prevention	Best preventive strategy	Use of vaccines in susceptible people	3	3.57
		Use of methods that prevent ectoparasitic infestation in domestic animals	75	82.14
		One single fumigation is sufficient	6	7.14
		Larviciding	6	7.14

probable case (WHO)[25] is known by 53.6% of participants. These definitions and groups of symptoms are better known by doctors who also have constant outbreaks and for this reason they receive continuous education about this disease[26]. On the other hand, the usefulness of the tourniquet test and complete blood count was adequately mentioned by 87.5% and 82.1%, respectively. According to its guidelines, the WHO considers that the management of probable cases should be oriented to symptom relief, as well as to strict surveillance of their evolution[25]; these options would be correctly observed by 96.4% and 53.6%, respectively, which is similar to findings reported by other groups[19,26,27]. With regard to prevention, larviciding (*abatización*), which consists in the use of temephos (Abate®) in water containers in order to eliminate the vector's eggs and larvae, it is known by 60.7% of participants, and its impact on vector control as a consequence of its promotion at rural health centers might therefore be minimal. In general terms, knowledge about dengue is similar to that reported by other groups with similar surveys working in endemic areas, ranging from sub-optimal to poor[19.26-28].

Adequate knowledge on rickettsiosis can impact on the reduction of the number of serious or fatal cases resulting from delayed diagnosis or treatment. In our study, only 54% knows the clinical presentation of this disease, in spite of being very similar to dengue. Although this figure is higher in comparison with other studies carried out in the USA, where 44% knows the clinical course, the percentage is far from ideal values[17]. The Weil-Felix test is regarded as a mere diagnostic guidance, which is known by 74% of survey respondents; in contrast, only 35% knows the usefulness of IIF and PCR, which are considered to be diagnostic[29]. As for treatment, international guidelines suggest doxycyclin early administration in case of diagnostic suspicion of rickettsial infection[7,29]. In this

Table 4. Knowledge with regard to Chagas disease (n = 90)

Topic	Categories		Number of doctors	Percentage
Etiologic agent	Agent	The agent is *T. cruzi*	70	77
		Do not know Chagas disease etiologic agent	20	33
	Transmission routes	Only by the vector (Triatoma)	61	68
		By transfusion of infected blood	19	21
		Vertical transmission and congenital infection is possible	2	2
		Different species of ticks can transmit the agent	8	9
Diagnosis	Clinical findings suggesting a case of Chagas disease	Fever, obnubilation, diaphoresis, dehydration and mucosae with erythema	2	1.8
		Asthenia, adynamia, edematous lesion of eyelid and fever	71	78.6
		Fever, arthralgia, myalgia, jaundice and hepatomegaly	3	3.6
		Patients present with multiple ulcers distributed from vector bite site to other parts of the body	14	16
	Most adequate confirmatory test	ELISA and PCR	36	40
		Weil-Felix test and thick blood smear test	51	57
		There is no confirmatory test for Chagas disease	3	3
	Suggestive results in complementary tests	Chest X-ray evidencing cardiomegaly	51	57
		Liver enzymes elevation (aspartate aminotransferase, alanine aminotransferase)	27	30
		Creatinine and blood urea nitrogen elevation	8	8.9
		Hematocrit and differential blood pressure elevation	4	4.1
Management and treatment	Pharmacological management	Nifurtimox/benznidazole	43	48
		Antigen fractions	19	21
		A combination of cephalosporin with third generation fluoroquinolone	11	12.5
		Ivermectin	17	18.5
	Treatment adverse effects	Know treatment-specific adverse effects	15	17
		Ignore treatment-specific adverse effects	75	83
Prevention	Best strategy to prevent Chagas disease	Use of vaccines in susceptible people	13	14
		Use of methods that prevent ectoparasitic infestation in domestic animals	13	14.3
		Fumigation and wall cracks repair	46	51.7
		Larviciding	18	20

regard, 42% selected the treatment correctly, but only 46% considered it can be early administered without confirmation, as stated by guidelines. These percentages were higher in other studies where doctors referred to doxycycline as the treatment of choice (92%), and start of its administration even without laboratory confirmation (77-82%)[17,20].

Chagas disease presents an acute phase, generally asymptomatic, which can exhibit an edematous lesion (chagoma) that indicates the site of the vector bite[9]. A proportion of 78.6% would consider suspicious a patient with an edematous lesion on the eyelid (a particular presentation of chagoma known as the "Romaña sign"), which is a higher percentage to that reported in similar studies carried out in other countries (52%)[18,30]. The diagnosis of this disease is based in methods such as enzyme-linked immunosorbent assay (ELISA) or PCR, which were only indicated by 40% of participants. X-rays with chest protection can be useful to explore manifestations such as cardiomegaly, which typically appears 10 to 30 years after infection and is the most observed chronicity manifestation in Mexico[9]; nevertheless, only 57% would select this examination to complete their diagnosis. Available drugs for the treatment of Chagas disease are nifurtimox and benznidazole[9]. Although both are effective at early stages and their opportune administration might prevent the development of Chagas disease chronic phase, their use is limited by the seriousness of adverse effects they elicit[9]. In this

regard, 48% knows their usefulness, but only 17% knows the associated adverse effects. Finally, although there are government programs for the prevention of this disease, they are known only by 51.7% of participants.

According to the instrument scoring system, the largest proportion of participants showed poor to moderate knowledge overall, and it stands out that the lowest scores were obtained in the areas of diagnosis and therapeutics.

Although Mexico has official procedures for the report and management of these diseases, it is clear that their teaching does not receive sufficient attention in medical schools. It is possible that the existence of an important number of campaigns directed to doctors with regard to dengue has a positive impact on knowledge about this disease, and something similar might therefore be expected if there was this type of diffusion for VBDs such as rickettsiosis or Chagas disease.

Although this study has limitations, such as possible regionalization of its results or the scheme of questions and answers used, the results clearly show that academic action is urgently needed in order to better train first-contact doctors. On the other hand, it would be interesting to assess the knowledge applied by doctors at higher levels of care for the management of serious cases. In conclusion, the study attempts to provide evidences that warrant the establishment continuous education programs about VBDs at highly endemic zones, such as our country.

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