Identification and Epidemiological Analysis of Ciguatera Cases in Puerto Rico

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ABSTRACT—A survey of the emergency room records of 10 hospitals in five areas of Puerto Rico from 1980 to 1982 disclosed 122 apparent ciguatera cases involving 212 individuals. Assuming that these records represented 10-15 percent of the total number of cases during this period, an estimate of 8-11 cases per 10,000 residents per year was calculated. The sample obtained was separated in two groups based on the clinical symptoms present. The frequency distribution of several demographic indicators, episode descriptors, and clinical symptoms was analyzed. The most frequent toxic fish in coastal towns was barracuda, Sphyraena barracuda, *while hogfish (Labridae) and grouper,* Epinephelus *spp., were the most toxic in the metropolitan area. Toxic episodes occurred during all months of the study period. Most episodes involved fish eaten at the evening meal and the first symptoms, all gastrointestinal, appeared 1-7 hours later. The type and frequency of occurrence of the clinical symptoms agreed well with those reported in other Caribbean studies.*

Introduction

Ciguatera is a type of food poisoning caused by ingesting any one of a wide spectrum of tropical fish. The disease is endemic in parts of the tropical Pacific and the Caribbean. The current hypothesis concerning the origin of ciguatoxin is that specific dinoflagellates living in association with macroalgae produce toxins that are accumulated in the tissue of fish through the food web of the coral reef. Humans acquire the disease by eating the flesh of these toxic fish.

Toxic fish have a normal appearance, taste, and smell, and the toxins they contain are not inactivated by cooking or refrigeration. There are no specific laboratory tests for the disease, and diagnosis depends on the clinical signs and symptoms presented by the patients. These usually begin with gastrointestinal (GI) disturbances which are followed by neurological and cardiovascular symptoms. Sensory disturbances such as paresthesias of the perioral region and the distal extremities, generalized pruritus and abnormal temperature sensations are considered distinctive features of the disease (Lawrence et al., 1980).

Although the disease is characterized by a low mortality rate, it is occasionally fatal and represents a major cause of morbidity in areas where it is endemic (Bagnis et al., 1979; McMillan et al., 1980). Sometimes the neurological disturbances are prolonged, resulting in alterations in the patient's normal life patterns. In addition, the existence of this disease has important economic implications for the fishing industry in tropical areas.

In view of the medical, social, and economic importance of this disease, this study was initiated to gather data on the occurrence and clinical manifestations of ciguatera cases in Puerto Rico. The results of this study complement available epidemiological data giving a more complete picture of ciguatera in the Caribbean.

Methods

Sample Selection

Information concerning ciguatera cases in five coastal regions of Puerto Rico during 1980, 1981, and 1982 was obtained through a survey of the emergency room records of 10 major public and private hospitals. In addition, the records of the Puerto Rico Poison Control Center, as well as patients and private physicians, were consulted to supplement this information. The localities studied and the approximate size of the population served by these hospitals are shown in Figure 1. Cases in which the patient's major complaints were acute GI disturbances, or whose final diagnosis was either ciguatera fish poisoning or food poisoning, were identified by consulting the records of the hospital emergency rooms. Only those patients with GI symptoms within 24 hours of eating fish were selected for further study.

A questionnaire was designed to organize the data obtained from the hospital records and interviewees. It contained five demographic indicators, 10 episode descriptors, and questions about the onset, duration, and intensity of four GI and 17 neurological symptoms. Using this form we were able to identify 122 apparent ciguatera episodes involving a total of 212 individuals. All individuals eating from the same fish were considered as belonging to the same episode.

Data Analysis

Files were created for each identified individual using the missing data code whenever information was not available. To identify more closely those cases presenting what is generally considered

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the characteristic symptomatology of the disease, the sample was divided into two groups. Group A consisted of those cases where at least one individual per episode, in addition to the GI symptoms, showed any two of the following neurological alterations: Malaise, pain, paresthesias, temperature inversion, metallic taste, or pruritus. The cases not meeting these selection criteria formed group B. The frequency distribution in both groups of all the variables studied was determined using the Statistical Package for the Social Sciences (SPSS) computer program. Relationships among selected items were also established using cross-tabulations.

Results

Demographic Characteristics

In both groups, the most affected persons were adults, nearly half of whom were in the 20-30 years range (Table 1). Sex ratios were also similar in both groups.

Episode Characteristics

The type of fish eaten was reported by 68 individuals in each of the two groups representing 85 percent of group A and 52 percent of group B (Fig. 2). Hogfish (Labridae) (28 percent) and grouper, *Epinephelus* spp. (26 percent), were the fish most frequently reported in group A, while in group B, barracuda, *Sphyraena barracuda* (46 percent), was the most frequently reported species. Although some of the fish were caught by the victims themselves, most of the ciguatoxic fish were purchased in fish markets or eaten at restaurants, particularly in the metropolitan area.

Distribution of the cases among the five surveyed areas is shown in Figure 3. Most of the cases included in group A were from the metropolitan area (43 percent) but only 3 percent of those in group B were from this locality. The rest of the cases in the latter group were equally distributed among the other four areas: Fajardo (27 percent), Humacao (25 percent), Ponce (23 percent), and Mayaguez (22 percent). No toxic barracuda were involved in the episodes reported in the metropolitan area (Table

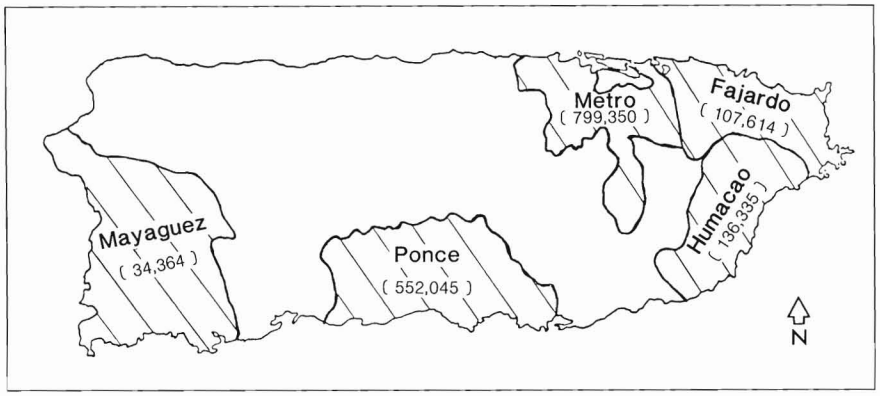

Figure 1.—Areas included in the epidemiological survey of ciguatera in Puerto Rico. Areas outlined are labelled as named in the study, and numbers in parentheses indicate the approximate size of the population served by the medical facilities surveyed. Data were obtained from the Statistics Division, Health Department, Commonwealth of Puerto Rico.

Table 1.—Age and sex distribution of apparent ciguatera cases in Puerto Rico from 1980 to 1982, grouped by symptom pattern.

Item	Group A	Group B
Age (years)	(*n* = 76)	(*n* = 132)
⩾19	10 (13%)	31 (23%)
20-39	39 (13%)	53 (40%)
40-59	20 (26%)	35 (27%)
⩽60	7 (9%)	13 (10%)
Sex	(*n* = 80)	(*n* = 132)
Male	45 (56%)	75 (57%)
Female	35 (44%)	57 (43%)

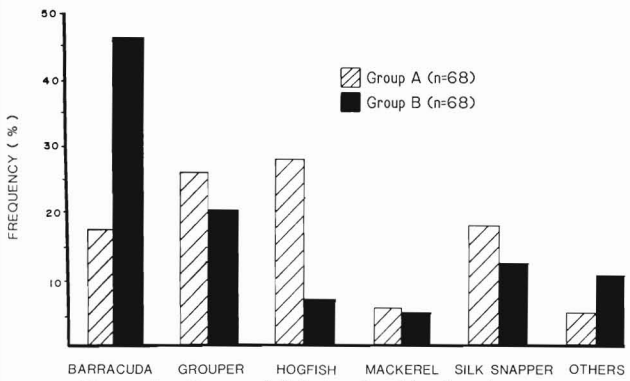

Figure 2.—Types of fish involved in the ciguatera cases identified. Frequency is indicated as percent of the cases (n) reporting the common name of the fish consumed.

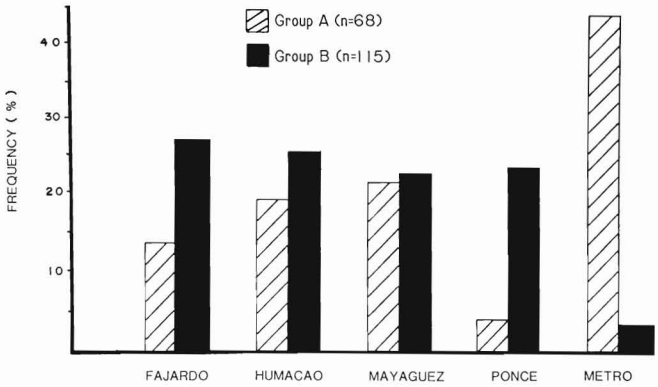

Figure 3.—Distribution of the ciguatera cases identified among the five areas surveyed. Frequency indicated as percent of the cases (n) reporting the locality where toxic fish was consumed.

2). Here, hogfish, grouper, and silk snapper, *Lutjanus vivanus*, were the reported toxic fish. Barracuda were the most frequent toxic fish in the areas that are important fishing centers, such as Fajardo and Humacao.

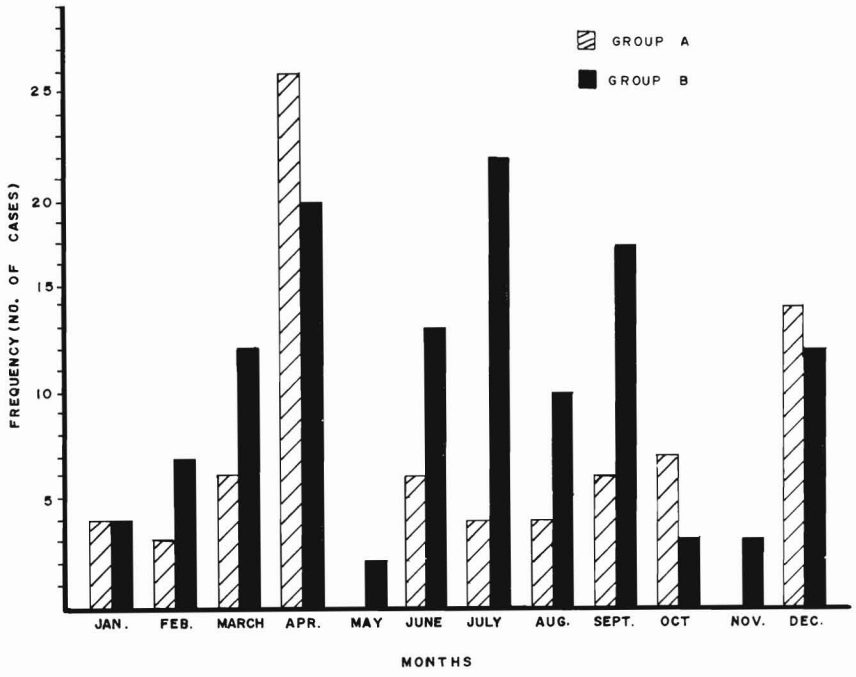

Figure 4.—Distribution of the total number of ciguatera cases identified in the study by month of occurrence. Size and characteristics of groups A and B are described in the text.

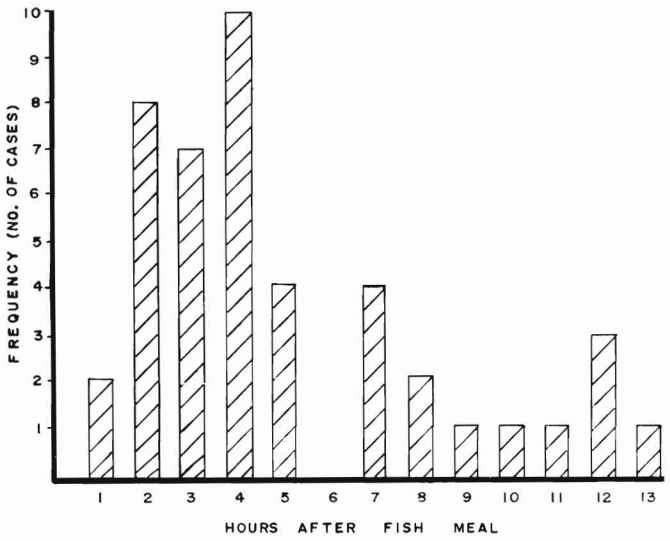

Figure 5.—Onset of first ciguatera symptoms. The time elapsed after fish consumption for the appearance of GI symptoms is indicated in the abscissa. Data obtained from cases in group B reporting fish consumption at evening meal.

Toxic episodes occurred during all months of the study period. Peaks were observed in both groups in April and also during summertime in group B (Fig. 4). In group B, 60 percent of the episodes resulted from eating fish at the evening meal (6-8 p.m.) and 21 percent from fish eaten at lunch time (12-2 p.m.). Those persons that became sick from eating the fish at the evening meal were selected for information regarding onset of symptoms. Among these, the first symptoms appeared 1-7 hours after ingestion of fish (Fig. 5).

Symptomatology

The type and frequency of GI and neurological symptoms reported by patients is shown in Table 3. As expected from the original sample selection procedure, GI symptoms occurred with similar frequencies in groups A and B, with diarrhea being the most common disturbance. From two to four of these symptoms appeared concurrently in an individual in over 80 percent of the samples. Interestingly, in group A, selected specifically by the presence of a given set of neurological symptoms, all four GI symptoms appeared together in 53 percent of the patients. A few individuals (7 percent) did not report any GI disturbance but were added to this analysis since they belonged to episodes meeting the criteria for inclusion.

Among the neurological symptoms studied, the most frequent of those used as selection criteria for group A was malaise (65 percent) followed by arthralgia (60 percent), and myalgia (56 percent). In this group, characteristic sensory disturbances such as paresthesia

Table 2.—Frequency distribution of fish involved in the toxic episodes studied in Puerto Rico by area surveyed.

	Number of cases					
Type of fish[1]	Fajardo	Humacao	Mayaguez	Ponce	Metro	Total
Barracuda	14	13	10	6	0	43
Grouper	1	12	11	0	6	30
Hogfish	5	0	0	1	13	19
Silk snapper	3	0	7	0	7	17
Others	4	2	3	1	1	11
Total	27	27	31	8	27	120

[1]Fish common names are those reported by patients to emergency room physicians or interviewers.

of the fingers and temperature inversion were present in 54 and 48 percent of the patients, respectively. However, metallic taste, recognized as another peculiar feature of the syndrome, was apparent in only 25 percent of the patients included in group A. Within group B, dizziness appeared in 32 percent of the cases, but no other neurological symptom exhibited a frequency above 13 percent.

It was not possible to analyze the frequency of occurrence of cardiovascular symptoms in our sample since, unfortunately, adequate reports of vital signs determinations were absent in over 80 percent of the cases identified.

Discussion

The existence of ciguatera poisoning in the Caribbean is well documented in the literature but the epidemiological data available to date is fragmentary and limited (Ragelis, 1984). Thus, estimates about the incidence of the problem in this area are questionable. The data on the incidence of poisoning episodes in Puerto Rico obtained in this study may also be incomplete and biased towards the more acute cases due to our use of hospital records as the main source of information and the fact that not all the hospitals in each area were surveyed.

Assuming that the cases identified represented only 10-15 percent of the actual cases occurring annually in the areas studied, one may estimate this incidence as 8-11 cases per 10,000 residents. This estimate is based on similar calculations made for the population of the U.S. Virgin Islands (McMillan et al., 1980). As indicated in Figure 1, residents in the areas studied represent about half of the total island population. This calculation was made using only cases reported from June 1981 to December 1982, since those were over 90 percent of the total sample obtained. The large number of cases identified during that period may be related to an increased awareness about the disease after press reports on the death of a ciguatera victim (Ghigliotty, 1981). This also resulted in a government ban on the sale of barracuda and a few other possibly ciguatoxic fishes. In this study, age and sex did not appear to influence occurrence and type of symptoms experienced in a toxic episode.

Information concerning types of fish eaten showed that barracuda was the most frequent toxic fish but only in the coastal towns, where it is primarily consumed by fishermen and their families. This, undoubtedly, reflects the fact that this fish may not be sold commercially in Puerto Rico. Similarly, Lawrence et al. (1980) reported that barracuda is frequently a toxic fish in Miami where its sale is also prohibited.

Our data did not show any seasonality of the disease, as ciguatera episodes were identified in every month of the year during the study period. The peaks observed in April and during summertime may reflect an increase in fish consumption rather than peaks in fish toxicity. In particular, the peak in April is probably related to more use of fish in the diet during Lent.

The diagnosis of ciguatera cases depends on the patient's clinical presentation, since there is a poor understanding of the pathophysiology of this disease. This clinical picture, apparent from our study as well as from other Caribbean studies (Table 4), includes early GI symptoms, appearing a few hours after eating toxic fish. The concurrent appearance of all four gastric disturbances in over 50 percent of the cases selected for presence of certain neurological symptoms (group A) documents the importance of these symptoms as a manifestation of the disease. In group B, which included those cases not reporting together the set of symptoms considered characteristic of the disease (Table 4), no obvious association of GI and neurological symptoms was observed. Thus, concurrent appearance of GI, neurological, and, possibly, cardiovascular symptoms appearing at a later time still seems the best criterion for an initial diagnosis of ciguatera.

Table 3.—Frequency distribution of symptoms in all cases studied, grouped by symptom pattern.

Symptom	Percent of patients with symptom	
	Group A (n = 80)	Group B (n = 132)
Gastrointestinal		
Nausea	69	70
Vomiting	69	42
Diarrhea	83	77
Abdominal pain	74	62
Neurological		
Malaise	65	13
Arthralgia	60	9
Myalgia	56	6
Paresthesia		
Fingers	54	10
Perioral	38	3
Extremities	36	13
Temperature inversion	48	2
Pruritus	45	5
Metallic taste	25	2
Headache	39	11
Dizziness	33	32
Respiratory disturbances	18	2
Visual disturbances		
Photophobia	11	2
Others (diplopia, etc.)	16	4
Irritability	13	0
Toothache	11	1
Unconsciousness	4	1

Table 4.—Frequency (%) of various ciguatera symptoms reported in Caribbean studies.

Symptom	Barkin (1974)	Lawrence et al. (1980)	Morris et al. (1982)	Engleberg et al. (1983)	This study (Group A)
Gastrointestinal					
Diarrhea	100	76	91	81	83
Vomiting	100	68	70	40	69
Abdominal pain	88	*	39	64	74
Neurological					
Headache	13	47	33	45	39
Pruritus	50	48	58	66	45
Malaise	*	30	70	*	65
Myalgia	75	86	30	34	56
Arthralgia	88	*	52	34	60
Paresthesia, fingers	4	*	40	*	54
Paresthesia, extremities	*	71	33	*	36
Perioral paresthesias	29	54	36	38	38
Temperature inversion	*	*	36	23	48
Metallic taste	*	*	27	*	25
Dizziness	*	*	21	*	33

*Not reported.

Neurological alterations seen more frequently in the selected sample A and appearing 12-24 hours after fish ingestion were malaise or general weakness, bone and muscle pain, distal paresthesias, and temperature inversion. Dizziness appeared almost equally frequent in both groups, suggesting that it could be a side effect of the intense GI disturbances reported by all patients in the sample. Close agreement between ciguatera studies in the Caribbean (Table 4) suggests that our conclusions concerning the proper diagnosis of this disease may be applied to most cases occurring in this region.

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