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SHORT COMMUNICATION

Incidence of *Aeromonas* bacteremia in southern Taiwan: *Vibrio* and *Salmonella* bacteremia as comparators



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KEYWORDS

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The aim of the investigation was to describe the incidence of *Aeromonas* bacteremia in a city with a population of about 1.87 million inhabitants, located in southern Taiwan, between 2008 and 2010. Such data were compared with the incidences of *Vibrio* and *Salmonella* bacteremia in the same period and the incidence of *Aeromonas* bacteremia in other countries in the literature. The data revealed the average annual incidences of bacteremia due to *Aeromonas*, *Vibrio*, and *Salmonella* species were 76, 38, and 103 cases/million inhabitants, respectively. The incidence of *Aeromonas* bacteremia was higher than those in Western countries.

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Introduction

Members of the genus *Aeromonas* are responsible for a wide range of illnesses in humans, including gastroenteritis, skin and soft-tissue infections, and septicemia. It is generally believed that patients acquire aeromonads from oral consumption of or direct mucocutaneous contact with contaminated water or food. Similar to the cases of non-cholera *Vibrio* bacteremia,¹ patients with liver cirrhosis are at risk for *Aeromonas* bacteremia.^{2,3} Clinical characteristics of *Aeromonas* bacteremia have been well described by several studies, which mainly were reported from the observations of Taiwanese population.^{2,3} However, the accurate incidence of *Aeromonas* bacteremia in Taiwan is unknown. Here, we investigated the incidence of *Aeromonas* bacteremia and its seasonal variation at Tainan, a city with a population of about 1.87 million inhabitants in southern Taiwan, and the public health importance of *Aeromonas* bacteremia. The incidences of bacteremia due to *Vibrio* and *Salmonella* species, another two groups of bacteria often associated with community-acquired and food-borne diseases, were compared. The incidence of *Aeromonas* bacteremia in Western countries is also discussed.

Materials and methods

Aeromonas infection is not a reportable disease in Taiwan. To investigate the incidence of bacteremia, the case numbers of *Aeromonas*, *Vibrio*, and *Salmonella* bacteremia from January 2008 to December 2010 in nine hospitals at Tainan were collected, including two medical centers (Hospital A and B) and seven regional hospitals (Hospital C-I) serving more than 95% hospitalization in the city. The numbers of acute care beds serving in the nine hospitals are listed in Table 1. The blood culture system used in the nine hospitals is BACTEC 9240 (BD Diagnostics, Franklin Lakes, NJ, USA). Identification of the *Aeromonas* genus was based on the positive oxidase test, fermentation of D-glucose, the

absence of growth in 6.5% sodium chloride and resistance to the vibriostatic agent O/129 (150 µg), and was confirmed by one of the following commercial identification systems: the GNI Plus (Vitek Systems, BioMérieux, Hazelwood, MO, USA), API20E (BioMérieux, Marcy-l'Etoile, France), or BD Phoenix (BD biosciences, Sparks, Maryland, USA). Identification of the *Vibrio* or *Salmonella* genus was based on typical phenotypic reactions and was confirmed by one of the above identification systems. Average monthly case numbers of bacteremia at Hospitals A, B, and C, and their correlations with average monthly ambient temperature of Tainan city during 2008 to 2010 were also examined by the Spearman's correlation analysis (SAS 9.1; SAS Institute Inc., Cary, NC, USA).

Results

The collective data revealed that the case numbers of *Aeromonas*, *Vibrio*, and *Salmonella* bacteremia were 429, 213, and 580, respectively, during the 3-year study period (Table 1). The population of Tainan was 1,873,005 in 2008, 1,875,406 in 2009, and 1,873,794 in 2010.⁴ Therefore, the average annual incidences of *Aeromonas*, *Vibrio*, and *Salmonella* bacteremia were 76, 38, and 103 cases/million population, respectively. Average monthly case numbers of bacteremia at Hospitals A, B, and C, and their correlations with average monthly ambient temperature of Tainan city during 2008 to 2010 are illustrated in Fig. 1. The result showed that the monthly incidences of *Vibrio* and *Salmonella* bacteremia was correlated with monthly temperature ($r^2 = 0.80$, $p = 0.0016$; $r^2 = 0.89$, $p < 0.0001$, respectively), whereas such a temperature correlation was not evident in the case of *Aeromonas* bacteremia ($r^2 = 0.31$, $p = 0.33$).

Discussion

The first population-based study of *Aeromonas* infections was conducted in California in 1998.⁵ The incidence of

Table 1 The case numbers of *Aeromonas*, *Vibrio*, and *Salmonella* bacteremia in nine hospitals in Tainan, Taiwan, between 2008 and 2010

Hospitals	Acute care bed no.	Case no. of bacteremia								
		<i>Aeromonas</i>			<i>Vibrio</i>			<i>Salmonella</i>		
		2008	2009	2010	2008	2009	2010	2008	2009	2010
Medical centers										
Hospital A	1200	28	30	35	16	8	8	36	32	44
Hospital B	1200	32	43	39	37	24	28	56	75	87
Regional hospitals										
Hospital C	880	42	26	31	16	12	21	31	23	40
Hospital D	250	2	8	13	3	4	7	2	11	5
Hospital E	470	10	8	6	2	4	3	19	16	16
Hospital F	380	2	0	7	0	0	0	1	0	10
Hospital G	440	11	11	17	7	5	3	13	12	8
Hospital H	790	9	7	8	1	1	3	16	16	9
Hospital I	320	3	1	0	0	0	0	0	1	1
Total case no.		139	134	156	82	58	73	174	186	220

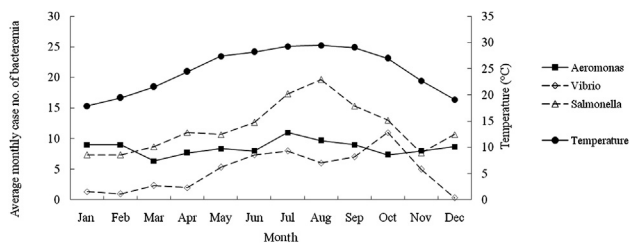


Figure 1. Monthly distribution of case numbers of *Aeromonas*, *Vibrio*, and *Salmonella* bacteremia at Hospitals A, B, and C, and the average monthly ambient temperature in Tainan between 2008 and 2010. The Spearman correlation coefficients for the correlation between case numbers of *Aeromonas*, *Vibrio*, and *Salmonella* bacteremia and ambient temperature were 0.31 ($p = 0.33$), 0.80 ($p = 0.0016$), and 0.89 ($p < 0.0001$), respectively.

Aeromonas infections, mainly gastrointestinal tract (81%), wound infections (9%), and bacteremia (5%), was 10.6 cases/million population over a 12-month period, and that of *Salmonella* infections 189 cases/million population, approximately 18-fold higher than that of *Aeromonas* infections. In England and Wales, the estimated incidence of *Aeromonas* bacteremia was 1.5 cases/million population in 2004.⁶ In France, a nationwide investigation of *Aeromonas* infections over a 6-month period in 2006 reported 78 cases of *Aeromonas* infections, of which 26% had *Aeromonas* bacteremia.⁷ Based on an estimated 61 million population, this represented the annual incidence of 0.66 episodes of *Aeromonas* bacteremia/million population. According to these data, the incidence of *Aeromonas* bacteremia in southern Taiwan was 143-, 50-, and 115-fold higher than those in California in 1998, England and Wales in 2004, and France in 2006. Similarly, a higher incidence of non-cholera *Vibrio* bacteremia in southern Taiwan in this study (38 cases/million population) than that in the Florida, USA (0.75 cases/million population) was also observed.⁸

The explanations for a higher incidence of *Aeromonas* bacteremia in southern Taiwan were not apparent, but three factors might contribute to such a geographic variation. First, patients with chronic liver diseases, the population susceptible to invasive *Aeromonas* infections,³ were common. In Taiwan, there were around 2.5 to 3 million hepatitis B carriers (10–15% of general population) and the number of hepatitis C infection was roughly about 700,000 to 800,000 (3–3.5% of general population).⁹ Second, aeromonads were ubiquitous in Taiwan, as they could be found in 88% of seafood from the retail markets and supermarkets.¹⁰ Although patients with liver cirrhosis or malignancy are instructed not to consume raw fish, consumption of contaminated food accidentally is still possible. Third, like most vibrios, which proliferate in the warm summer months,¹¹ the numbers of aeromonads would increase in the water systems during warmer seasons.¹² The relatively warmer year-round climate in Taiwan compared to those in England and France was probably another factor contributing to a higher incidence.

However, unlike our previous observation that most episodes (46% of 59 episodes) of *Aeromonas* bacteremia clustered in the warmer seasons (from June to

September),³ the seasonal variation in *Aeromonas* bacteremia was not evident in this study. In the literature, the observations of the seasonal variation of *Aeromonas* bacteremia or nonenteric infections were inconsistent. Some studies reported a predominance of occurrence in warmer months,^{3,13} whereas others did not.^{14,15} The reasons contributing to variable monthly incidence might be complex, which could not be answered by the present study.

There were some limitations in this study. First, not all hospitals were included and the incidence of *Aeromonas* bacteremia might be underestimated. Second, three cited reports for incidence comparisons were conducted in earlier periods and the situations in these countries may vary to some extent in recent years. Finally, *Aeromonas* bacteremia is not a reportable condition in Taiwan or other countries. Thus, we could not compare its incidence in Tainan with other cities in Taiwan or other tropical and subtropical countries to elucidate the role of climate in the occurrence of *Aeromonas* bacteremia.

In conclusion, in southern Taiwan the incidence of *Aeromonas* bacteremia is substantially higher than those in Western countries, and its impact on public health warrants further studies.

Conflicts of interest

All authors declare that they have no conflicts of interest related to the material discussed in this article.

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