Intussusception in Taiwanese Children: Analysis of Incidence, Length of Hospitalization and Hospital Costs in Different Age Groups

Wan-Ling Ho,[1] Tien-Wu Yang,[1] Wei-Chu Chi,[2] Hong-Jen Chang,[3] Li-Min Huang,[1] and Mei-Hwei Chang[1]

Background and Purpose: This study investigated the characteristics of intussusception in Taiwanese children of different age groups, including the incidence, length of hospitalization and hospital costs.

Methods: Children with a diagnosis of intussusception who were hospitalized from 1999 through 2001 were identified from a nationwide health insurance claims database. The incidence of intussusception was calculated by age, gender, and season. Length of hospitalization and hospital costs were also analyzed.

Results: A total of 6988 cases of intussusception were identified in Taiwan from 1999 to 2001. Among them, 4859 cases occurred in children below 15 years of age. The average incidence among children below age 15 years was 34.5 per 100,000, with a peak incidence of 118.8 per 100,000 observed among children younger than 24 months old. The highest incidence of intussusception in Taiwanese children occurred between 12 and 24 months of age. According to the data for patients below 15 years of age hospitalized for intussusception in year 2000, males were more likely to be affected than females (61.3% *vs* 38.7%). Intussusception-related hospitalizations were rare in infants in the first few months of life, increased in those 6 to 12 months old, and peaked among children 1 to 3 years old. Among the 952 patients with intussusception admitted to hospitals in 2000, 297 (31.2%) received surgery, incurring higher median medical costs (New Taiwan Dollars [NT$] 42,265 or US$ 1234) and longer median hospital stay (6.2 days) than the 655 patients who did not require surgery (NT$ 6290 or US$ 185 for hospitalization of 2.4 days).

Conclusions: The study found that the incidence of intussusception peaked in the second year of life in Taiwanese children. There was also a male predominance and lack of seasonal variation in incidence.

Key words: Hospital costs; Hospitalization; Incidence; Intussusception

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The live, oral, rhesus-human rotavirus reassortant-tetravalent vaccine (RRV-TV) was licensed for use in the United States on August 31, 1998. It was subsequently recommended for routine use in infants in a 3-dose series given at 2, 4, and 6 months of age. This recommendation was based on the morbidity and economic burden of severe dehydrating rotavirus gastroenteritis among infants and young children. Ten months post-licensure of the RRV-TV, 15 cases of intussusception had been reported to the Vaccine Adverse Events Reporting System. Thirteen of these children developed intussusception after the first dose of rotavirus vaccine at a median age of 3 months, which is younger than the median age of intussusception in the background population.[1] The Advisory Committee for Immunization Practices declared a temporary halt of its use in July 1999, followed by withdrawal of the recommendation in October 1999.[1]

However, rotavirus infection remains a significant cause of severe diarrheal illness of infants and young children in both developed and developing countries. It causes estimated 55,000 hospitalizations and 20 to 30 deaths per year in the United States and more than 800,000 deaths per year globally.[2] The withdrawal of the RRV-TV from our arsenal of vaccines to prevent childhood diseases was a major disappointment. Although RRV-TV is not licensed for use in Taiwan, further rotavirus vaccine development is anticipated. This study investigated the incidence of intussusception in Taiwan according to age, gender, and seasonal patterns. The length of hospitalization and medical costs were also analyzed.

[1]Department of Pediatrics, National Taiwan University Hospital, Taipei; [2]Institute of Preventive Medicine, College of Preventive Medicine, National Taiwan University, Taipei; [3]Bureau of National Health Insurance, Taipei, Taiwan.
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Reprint requests and correspondence to: Dr. Li-Min Huang, Chief, Division of Pediatric Infectious Diseases, National Taiwan University Hospital, No. 7, Chung-Shan South Road, Taipei 10016, Taiwan.

Methods

National Health Insurance system in Taiwan

With the implementation of the National Health Insurance (NHI) system in 1995, people in Taiwan have been provided with comprehensive access to medical care, such as health prevention, clinical care, hospitalization, resident care, and social rehabilitation. As of June 2002, 21,750,489 individuals were enrolled in the NHI system with a coverage rate of 96% (96.06% in year 1999, 96.16% in year 2000) compared with 92% in the launch period. The Bureau of NHI (BNHI) had contracts for these services with 16,703 medical institutions, which represent 91.79% of medical institutions in Taiwan.

All diagnoses of disease(s) in each patient from all hospitals and clinics are required to be reported to the BNHI for review. The diagnoses are registered according to the International Classification of Diseases (ICD) coding system.

Study population and duration

The diagnosis of intussusception was based on the findings of barium enema examination in addition to clinical manifestations. Records of intussusception were collected from the database of the NHI using the ICD-9 code 560.0. Registered cases of intussusception from the BNHI were identified and demographic data including age at presentation, gender, seasonal distribution, and annual distribution were analyzed.

The annual mid-year population data for each age group of males and females were obtained from the National Department of the Interior. In this retrospective study, the yearly incidence of intussusception was calculated by dividing the case number by the related population of the same age group.

Incidences in different age groups, between genders, and by seasons were compared using Poisson regression analysis. The background incidence of intussusception was calculated by age, gender, and season. The length of hospitalization and medical costs were also analyzed.

Results

The case numbers of intussusception in Taiwan from 1999 to 2001 are shown in Table 1. The incidences of intussusception in Taiwan in 1999, 2000, and 2001 were 8.1, 12.7, and 10.5 per 100,000 persons, respectively, with an average of 10.6 per 100,000 persons. Intussusception occurred mainly in children, especially those less than 5 years old (98.2 per 100,000). Although children less than 15 years of age comprised only 21% of the total population, 70% of intussusception cases occurred in this group, with an incidence of 34.5 per 100,000 children (Table 2). Further analysis of the cases in 2000 by gender, seasonal trend, and medical expenses revealed that 952 children younger than 15 years were hospitalized for intussusception in Taiwan, of whom 61.3% were male (n = 584) and 38.7% were female (n = 368) [Table 3]. Intussusception-related hospitalizations were rare during the first few months of life, increased between 6 and 12 months, and peaked between 12 and 24 months (Table 4). The seasonal proportions of patients were 23.9% in spring (March to May), 26.4% in summer (June to August), 25.2% in autumn (September to November), and 24.5% in winter (December to February); thus, no significant seasonal variation was discerned (Table 5).

Of the 952 patients hospitalized for intussusception, 297 (31.2%) underwent surgery, which led to higher medical costs and a longer hospital stay than for the other 655 patients who did not need surgery (New Taiwan Dollars [NT$] 42,265/US$ 1234 *vs* NT$ 6290/US$ 185 in expenses per

Table 1. Number of cases of intussusception in Taiwan, 1999 to 2001.

Age (years)	1999	2000	2001	Total (%)
0~1	162	215	177	554 (7.9)
1~2	397	503	525	1425 (20.4)
2~3	393	453	344	1190 (17.1)
3~4	203	353	202	758 (10.8)
4~5	108	168	142	418 (6.0)
5~6	45	94	71	210 (3.0)
6~7	22	42	31	95 (1.4)
7~11	30	71	49	150 (2.1)
11~15	18	21	20	59 (0.8)
> 15	418	913	798	2129 (30.5)
Total	1796	2833	2359	6988 (100)

Table 2. Incidence of intussusception by age groups in Taiwanese subjects below 15 years of age, 1999 to 2001.*

Year	< 1 year†	< 2 years†	< 5 years†	< 15 years†
1999	59.9	104.0	83.0	29.0
2000	73.4	124.8	113.6	40.8
2001	71.8	127.0	97.4	33.5
1999-2001 (average)	68.4	118.8	98.2	34.5

* Incidence was defined as the number of cases per 100,000 children in the same age group.
† Mean of all children in the specified age category.

Table 3. Gender distribution of hospitalized cases of intussusception in patients below 15 years of age in 2000.

Gender	No. (%)
Male	584 (61.3)
Female	368 (38.7)
Total	952 (100.0)

Table 4. Age distribution of hospitalized patients below 15 years of age with intussusception in 2000.

Age	No. (%)
< 2 months	5 (0.5)
2-4 months	18 (1.9)
4-6 months	32 (3.4)
6-12 months	160 (16.8)
1~2 years	272 (28.6)
2~3 years	247 (26.0)
3~4 years	105 (11.0)
4~5 years	50 (5.3)
5~6 years	28 (2.9)
6~7 years	17 (1.8)
7~11 years	13 (1.3)
11~15 years	5 (0.5)
Total	952 (100.0)

Table 5. Seasonal distribution of hospitalized cases of intussusception in patients below 15 years of age in 2000 in Taiwan.

Season	No. (%)
March to May (spring)	227 (23.9)
June to August (summer)	252 (26.4)
September to November (autumn)	240 (25.2)
December to February (winter)	233 (24.5)
Total	952 (100.0)

patient and 6.2 days *vs* 2.4 days for hospitalization) [Table 6].

Discussion

The finding of a link between rotavirus vaccine and childhood intussusception has led to scrutiny of the incidence of intussusception for different age groups in several countries. This study determined the baseline incidence, length of hospitalization, and medical costs of intussusception before the introduction of the rotavirus vaccine in Taiwan. Most results from this study are comparable with data reported from other Asian countries. Tan et al reported a retrospective 4-year review of intussusception in Singapore in which the overall incidence among hospitalized children younger than 1 year was 71/100,000 per year in comparison with 68.4/100,000 in Taiwan (Table 2).[3] The overall incidence of intussusception among hospitalized children in Hong Kong under 1 year was 78~100/100,000 per year,[4] while in Taiwan it was 68.4/100,000 (Table 2). Furthermore, these figures from Asian countries approximate those from the United States, where the rate of intussusception among infants less than 1 year prior to licensure of RRV-TV was approximately 50/100,000 per year.[5]

In this study, intussusception was infrequently seen in the first few months after birth, but increased in incidence after the age of 6 months (Table 4). This is similar to the findings of Parashar et al,[6] who showed that relatively few infants less than 3 months old were hospitalized due to intussusception. By the age of 5 months, hospitalizations increased roughly 5-fold and remained elevated until 7 months of age.

In contrast to previous reports, more episodes of intussusception occurred during the second year of life than in infancy in this Taiwanese study (Table 1, Table 4). This finding differs from most previous studies which showed that infants were more likely to develop intussusception.[3–5] This unique finding of age distribution confirms the results of a recent hospital-based study[7] from Taiwan of confirmed cases of intussusception treated in medical centers, which found that the largest population of intussusception was between 12 and 24 months,[6] while the peak incidence of intussusception was observed between age 3-7 months in Singapore, 6-9 months in Hong Kong, 3-7 months in the United Kingdom, and 5-7 months in the United States.[3–5] The reason why Taiwanese children develop intussusception more frequently during the second year of life remains unclear. However, infectious agents are important in the pathogenesis of intussusception. Primary non-enteric adenovirus infection contributes to childhood intussusception through the development of lymphoid hyperplasia in the gut.[8–10] Other viruses involved in childhood intussusception include human herpesvirus (HHV)-6, HHV-7, and Epstein-Barr virus.[11] The epidemiology of childhood infectious agents may vary among areas and countries.[12–14] Whether such variation is responsible for the particular age distribution of intussusception in Taiwan needs further investigation.

Table 6. Comparison of medical costs and hospital stay among children below 15 years of age with and without surgery for intussusception.

Variable	Without surgery (n = 655)		With surgery (n = 297)		*p* value*
	Mean ± SD	Range	Mean ± SD	Range	
Total cost (NTD)	6290 ± 4079	840–28,960	42,265 ± 40,312	7957–391,819	< 0.0001
Claimed cost (NTD)	5679 ± 3702	756–26,064	39,392 ± 37,733	7161–364,606	< 0.0001
Surgical cost (NTD)	-	-	13,083 ± 6378	4904–62,373	-
Length of stay (days)	2.4 ± 1.6	0–11	6.2 ± 5.0	1–44	< 0.0001

* Calculated by unpaired *t* test.
SD = standard deviation; NTD = New Taiwan Dollars.

This pilot study using the NHI Research Database had several limitations. First, as a secondary database not generated primarily for academic research, some data were incomplete. Secondly, due to regulations of the Personal Electronic Data Protection Law of Taiwan, the identification numbers of all citizens and hospitals in this database were not available. We were thus unable to validate individual data, or to link our data such as vital records and census books to other databases to determine the prognosis of our subjects. Nevertheless, this database provides useful information for studying disease incidence on a national scale.

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