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An Age-Stratified Longitudinal Study of Primary Spontaneous Pneumothorax

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A B S T R A C T

Purpose: The objective of this study was to determine the age-stratified incidence, frequency, and duration of recurrence of primary spontaneous pneumothorax (PSP).
Methods: This study analyzed the epidemiology of PSP among hospitalized patients using the National Health Research Institutes of Taiwan database. The incidence of PSP was determined from a cohort of 19,562 deidentified individuals with PSP between 2001 and 2013. The insurants consisted of 99% of the Taiwan population of about 23 million people. A 5- to 12-year long-term recurrence analysis was based on data from 11,190 patients with PSP between 2001 and 2008.
Results: The incidence of PSP in in-patients increased from 5.05 to 7.18/100,000 in a 13-year analysis. The age group at highest risk was 15–22 years with incidence rates >11/100,000 and readmission rates of 17%–31%. About 20% of patients had more than one attack based on long-term follow-ups. About .8% of patients had more than three hospital admissions. Only 3.9% of patients had repeated or recurrent attacks after more than 4 years. All patients who had been admitted on more than four occasions were adolescents, except for four patients who were aged between 20 and 24 years old.
Conclusions: Adolescents with PSP had a higher incidence of attacks and more frequent and longer periods of vulnerability to recurrence. The majority of patients experienced recurrence during the first 4 years after the first attack.

IMPLICATIONS AND CONTRIBUTION

Using national database, this paper provided a longitudinal 5–12 years follow-up of the primary spontaneous pneumothorax in-patient information. Adolescents with primary spontaneous pneumothorax had a higher incidence and more frequent and longer periods of recurrence. The majority of patients experienced recurrence during the first 4 years after the first attack.

Primary spontaneous pneumothorax (PSP) is common in young adults [1–4]. The disease appears to be age-related and affects mostly older adolescent males [5,6]. Other studies [7–9] have revealed another peak at aged 55 years and older patients regardless of sex differences. Although the clinical presentation of PSP has been well described in the literature, the epidemiology and clinical course of PSP have not been fully elucidated [2]. Long-term follow-up to reveal the duration of this disease, the nature of recurrence with age-stratified data will be of critical importance to help us to establish a better management strategy, especially in younger patients.

The aims of this study were to use a nationwide longitudinal cohort data set to determine the age-stratified incidence of PSP

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between 2001 and 2013 and to identify the pattern of long-term recurrence of PSP among those admitted between 2001 and 2008.

Methods

Study design and population

This was a retrospective analysis of patients aged 11–40 years who were hospitalized with a diagnosis of PSP between 1997 and 2013 in Taiwan. Patients with PSP who required hospitalization for supportive treatment, close observation, or invasive treatment were all included.

Inclusion criteria and participating cohort

The flow diagram of inclusion criteria and participating cohort is shown in Figure 1. The database contains all in-patient information in Taiwan, including primary, secondary, and tertiary hospitals. Trends of overall incidence and demographic information, including age, sex, treatment procedures, length of hospital stay, and number of hospitalizations, were obtained and analyzed for each patient.

This study used the data bank of the National Health Insurance Research Database of Taiwan (NHIRD) to analyze the clinical course of in-patient PSP. The NHIRD is provided by the National Health Research Institutes of Taiwan and includes data on 23 million insurants, which is >99% of the Taiwanese population.

We queried the NHIRD for patients with a principal discharge diagnosis of "spontaneous pneumothorax." The principal diagnosis is defined as "the condition that is the chief reason for hospitalization or the first diagnosis code on discharge." Patients with PSP were identified using diagnostic codes ([512.8] and [512.0]) from the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9 CM) [10]. As there are not two distinct ICD-9 CM codes for PSP and secondary spontaneous pneumothorax, the two groups of patients were coded using the ICD-9 CM codes [512.8] or [512.0] for PSP.

We excluded patients with other lung disease or other significant infectious disease. Consequently, all patients with a second diagnosis related to other lung diseases were deleted. ICD-9 CM diagnostic codes [496], [492.0], [486], [491.21], [137.0], [518.81], [518.1], [492.8], [401.9], and [511.9] were the top 10 associated diseases on our deleted list. We also excluded pneumothorax that developed after admission or a traumatic pneumothorax at the initial presentation. This approach eliminated almost all cases except PSP. Patients who had incomplete data were excluded from the analysis.

Individual patients in the NHIRD are identified by a unique computerized number, so repeated hospitalizations of the same patient can be detected. The data were recompiled after deidentification and encryption.

Age-stratified incidence of PSP. We included patients who were admitted between 2001 and 2013. To decrease the number of patients who might have had their first attack before 2001, we also examined data for 1997–2000. Patients who had their first attack before 2001 were excluded. Therefore, if a patient was listed in 2001, the patient was assumed to have had their first attack in that year. The same rule was applied to the following years. The age-stratified incidence rates (per 100,000 person years at risk) for PSP was calculated by dividing the patient's number from the same age population in the corresponding years using the Taiwan population census data [11]. Incidence rate ratio (IRR) was defined as the ratio of two incidence rates.

Long-term PSP recurrence pattern. Recurrence was defined as rehospitalization at least 14 days after a previous discharge because most persistent air leaks resolve within 15 days [12]. As the universal insurance system covers 99% of the population and health care providers, follow-up losses occur only if citizenship is discontinued. Therefore, we were able to analyze recurrence over 5–12 years of follow-up for in-patients who had their initial PSP attack between 2001 and 2008.

This study was exempted from full review by the institutional review board because data in the NHIRD are deidentified. The Bureau of National Health Insurance cross-checks and validates the medical charts and ensures the accuracy of the NHIRD diagnostic coding.

Statistical analyses

The incidence rate was defined as the number of new cases reported per population over a given period. We linked data between years; since patients with a recurrent pneumothorax in subsequent years retained the same identity, the rates were not overestimated. All data were linked using SQL server 2008 (Microsoft Corp., Redmond, WA) and analyzed using R software (R 3.0.2, The R Foundation for Statistical Computing, Vienna, Austria). Poisson regression was used for the PSP incidence and recurrence rates formed by all combinations of participants aged 11–40 years. The natural log of the incidence and recurrence rates was modeled as a linear combination of age and year using R software. All probability values were two sided and were considered significant with a p-value $< .05$.

Results

Age-stratified incidence of PSP

In total, 19,562 patients (age range, 11–40 years) with 24,298 admissions were identified from the NHIRD cohort between 2001 and 2013. The demographic data were shown in the right lower part of Figure 1. The age-stratified incidence rates for PSP are shown in Figure 2. The incidence rate was highest among adolescents, peaked at 17 years of age (IRR, 1.99; 95% confidence interval [CI], 1.95–2.03; $p < .001$), declined as age increased (IRR, .87; 95% CI, .86–.87; $p < .001$), and leveled off at the age of 25 years. The incidence of PSP tended to increase from 5.05/100,000 in 2001 to 7.18/100,000 in 2013. The mean length of hospital stay decreased from 7.12 ± 4.53 days in 2001 to 5.71 ± 3.16 days in 2013 ($p < .001$).

More males than females developed PSP (male/female odds ratio 9.7, with 95% CI, 9.25–10.18; $p < .0001$). The likelihood of a male developing PSP increased from 8.2 to 8.9 times that in female patients between 2001 and 2013. The recurrence rates did not differ between male and female patients (19.7% vs. 17.9%, $p = .0696$).

Analysis of PSP recurrence pattern

The majority of patients had only one attack. The frequency of admissions, numbers of patients, and clinical courses of single and multiple attacks are shown in Table 1.