



Foreign body ingestion trends in children in the Daegu-Kyungpook Province, Korea before and during the COVID-19 period: a repeated cross-sectional study

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Background: During the coronavirus disease 2019 (COVID-19) period, children spent more time at home, which is where most foreign body ingestions (FBIs) in children occur. We compared the rate of FBI in children in the Daegu-Kyungpook Province during COVID-19 to the rate in the 2 years before the COVID-19 period.

Methods: The period from January to December in the year 2020 was defined as the COVID-19 period, and the corresponding time period in 2018 and 2019 was defined as the pre-COVID-19 period. Medical records were analyzed retrospectively for pediatric patients aged 0–15 years who visited outpatient and emergency rooms at seven tertiary referral hospitals in Daegu-Kyungpook Province.

Results: The annual occurrence rate of FBIs in patients visiting seven tertiary referral hospitals was not different during COVID-19 compared to that in the pre-COVID-19 period and the median age of these patients during the COVID-19 and pre-COVID-19 periods was similar. However, occurrence rates increased in the groups aged 0–3 and 4–6 years but decreased in the group aged 7–15 years during the COVID-19 period. The proportion of male patients as well as inpatients increased significantly during the COVID-19 period (both $P=0.01$). The proportion of foreign bodies located in the post-pyloric region increased during the COVID-19 period ($P=0.02$). The most common symptom, foreign body sensation in the neck, was similar in both groups. There was no significant difference in the foreign body removal method between the two groups. The occurrence rates of swallowing of toys, coins, magnets, button batteries, and superabsorbent polymers non-significantly increased; and the food ingestion rate decreased, while the non-food ingestion rate increased in all age groups during the COVID-19 period.

Conclusions: The FBI rate in children did not differ during the COVID-19 period compared to that in the pre-COVID-19 period. The occurrence of FBI in boys, the number of foreign bodies located in the post-pyloric region, and the number of hospitalizations due to FBI increased during the COVID-19 period.

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Introduction

A novel coronavirus outbreak occurred in December 2019. In South Korea, the first patient was detected in February 2020. The Daegu-Kyungpook Province was the source of the first wave of the coronavirus disease 2019 (COVID-19) in South Korea, which occurred in March 2020. Social distancing was implemented to prevent the spread of COVID-19, which also led to significant changes in lifestyle.

Foreign body ingestion (FBI) is a serious public health problem, resulting in several hospital visits by children annually. Most cases of FBI occur at home (1), and the majority of cases involve the unintentional swallowing of household items. Such items are sometimes discharged spontaneously without complications after swallowing. However, endoscopic removal or even surgery may be required, depending on the presence of symptoms or the type or location of the foreign body (2-4). Not all hospitals have endoscopists, and in particular, there is a shortage of pediatric endoscopists, which may necessitate transfer of

pediatric patients to other hospitals to remove ingested foreign bodies.

Several previous studies have shown that the rate of visiting the emergency due to illness during the COVID-19 period decreased, whereas the rate of accidents at home increased (5-7). Although the time spent at home, where most pediatric FBI occurs, increased during the COVID-19 period (8-10), studies related to changes in the pattern and occurrence rate of foreign body swallowing remain insufficient. While the United States (1) and Spain (11) use an electronic national surveillance system to identify trends in poisoning and FBI and use these as basic data for accident prevention, there are no regional or national statistical surveys on FBI in South Korea.

Therefore, we compared the occurrence rate of FBI in children in the Daegu-Kyungpook Province of South Korea and compared and analyzed the characteristics of the COVID-19 and the 2-year pre-COVID-19 period. We present this article in accordance with the STROBE reporting checklist (available at <https://tp.amegroups.com/article/view/10.21037/tp-23-21/rc>).

Methods

Study design

The period from January 2020 to December 2020, when COVID-19 spread rapidly in the Daegu-Kyungpook Province, was set as the COVID-19 period, and the same periods in the years 2018 and 2019 were set as the pre-COVID-19 period. Electronic medical records were compared retrospectively for pediatric patients aged 0–15 years who visited outpatient and emergency rooms at seven tertiary referral hospitals in Daegu-Kyungpook Province.

Foreign bodies were classified into eight categories according to their type: fish bones, foods, coins, button batteries, magnets, superabsorbent polymers, toys, and household items. Food is defined as a visit to the hospital for consideration of removal due to a persistent foreign body sensation except fishbone (for example, peach pits, plum pits, chicken bones, blue crab, or shrimp shells, etc.)

Highlight box

Key findings

- The foreign body ingestion (FBI) rate in children did not differ during the coronavirus disease 2019 (COVID-19) period compared to the rate during the pre-COVID-19 period. However, the proportion of patients visiting the hospital due to FBI increased.

What is known and what is new?

- FBI mostly occurs at home, and children spent more time at home during the COVID-19 period.
- FBI rate in children remained unchanged pre- and during COVID-19. The occurrence of FBI in boys, the number of foreign bodies located in the post-pyloric region, and hospitalizations due to FBI increased during the COVID-19 period.

What is the implication, and what should change now?

- COVID-19 has necessitated lifestyle changes, such as additional infection control that includes additional time at home. It is necessary to recognize and prevent the risk of accidental ingestion of dangerous foreign bodies while at home.

The location of the foreign body, symptoms, removal method, route of hospital visit, and patient disposition were investigated. Repeated visits with the same foreign body, hospital visits with multiple foreign bodies, and transfers of the same patient to a participating institution were treated as one case.

South Korea is experiencing a steep decline in its population due to a reduced fertility rate (12). Thus, the frequency of FBI in patients visiting seven tertiary referral hospitals during the COVID-19 period was compared by investigating the rate per 100,000 people in Daegu-Kyungpook Province of the relevant age (13). Thus, the study population included pediatric patients aged 0–15 years in this study, based on population census data obtained from Statistics Korea, which is a government organization for statistics under the Ministry of Economy and Finance.

Study participants

We included pediatric patients aged 0–15 years, who visited the outpatient and emergency room for FBI, who had been observed swallowing a foreign body, or in whom a foreign body was identified using radiography or endoscopy. In the Daegu-Kyungpook Province, most pediatric departments are in charge of children up to 15 years old, so the data was collected up to 15 years old. We excluded duplicate patients who were transferred within 7 institutions and cases where there was a suspicion of FBI, such as when a choking sign was observed or when a small object around the child was missing but the foreign body was not identified through physical or imaging examinations.

Statistical analysis

For statistical comparison of categorical variables between the two groups, the chi-square test or Fisher's exact test was used. Comparative data for continuous variables are expressed as medians with interquartile range (IQR). Age was compared using the Wilcoxon rank-sum test, a non-parametric test method. The data were considered statistically significant at $P < 0.05$. Statistical analyses were performed using the SPSS[®] v. 25 (IBM SPSS Inc., Armonk, NY, USA).

Ethical statement

The study protocol was reviewed and approved by the

Institutional Review Board (IRB) of Daegu Joint which is an agreement between the six hospitals participating in the study (IRB No. 2020-06-005-001). And this study protocol was also approved by Dongguk University Gyeongju Hospital (IRB No. 110757-202204-HR-04-02). Individual consent for this retrospective analysis was waived. This study was conducted in compliance with the principles of the Declaration of Helsinki (as revised in 2013).

Results

Demographic characteristics of FBI patients

In the participating institutions, 878 FBI cases occurred in the 2-year period before COVID-19 [2018–2019] and 417 cases occurred during the COVID-19 period [2020], totaling 1,295 cases. The annual occurrence rate, per 100,000 persons, of FBI in children under the age of 15 years in the Daegu-Kyungpook Province during the COVID-19 period was not different from that in the pre-COVID-19 period (66.7 per 100,000 persons, $P = 0.999$).

The median age of pediatric patients with FBI during the pre-COVID-19 period was 4.1 years (IQR, 1.8–7.6 years), which was not different from the age of 4.2 years (IQR, 1.9–7.2 years) in the COVID-19 period ($P = 0.96$). More boys than girls ingested foreign bodies in both periods, and the proportion of boys also increased significantly during the COVID-19 period ($P = 0.01$) (*Table 1*).

Most of the patients visited the hospital via the emergency room, even during the COVID-19 period. No deaths were noted, and no patients had COVID-19. The number of inpatients hospitalized due to FBI significantly increased during the COVID-19 period ($P = 0.01$) (*Table 1*).

In both periods, the location of the foreign bodies was most often undetermined through physical examination or radiography, followed by foreign bodies located in the neck and stomach. Post-pyloric foreign body ratios, in both the small and large intestines, increased during the COVID-19 period ($P = 0.02$). The most frequent symptom was a foreign body sensation in the neck, with no difference between the two periods ($P = 0.97$) (*Table 1*).

There was no significant difference in the foreign body removal methods used between the two periods ($P = 0.13$), and endoscopic removal increased from 7.4 before to 10.4 cases per 100,000 persons during the COVID-19 period (*Table 1*).

Fishbones were the most common type of foreign bodies ingested during both periods. During the COVID-19

Table 1 Characteristics of pediatric foreign body ingestion patients in the Daegu-Kyungpook Province comparing the pre-COVID-19 and COVID-19 periods

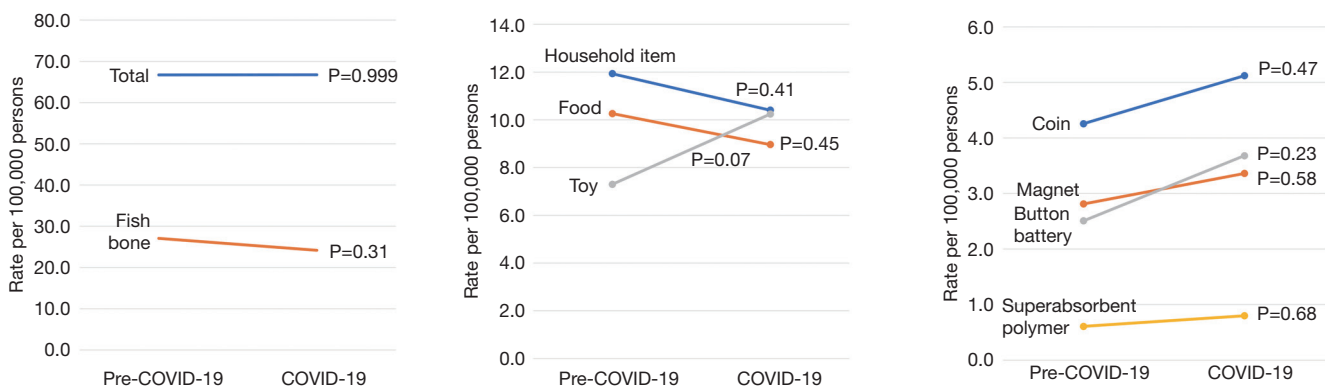
Variables	Pre-COVID-19 period [2018–2019] (N=878)		COVID-19 period [2020] (N=417)		P value
	Values	Rate*	Values	Rate*	
Age (years), median (IQR)	4.1 (1.8–7.6)		4.2 (1.9–7.2)		0.96
Age (years), n (%)					0.20
0–3	431 (49.1)	156.5	193 (46.3)	167.1	
4–6	196 (22.3)	77.1	112 (26.9)	92.5	
7–15	251 (28.6)	32.1	112 (26.9)	28.9	
Sex, n (%)					0.01
Male	471 (53.6)	35.8	256 (61.4)	41.0	
Female	407 (46.4)	30.9	161 (38.6)	25.8	
Route of hospital visit, n (%)					0.52
Emergency room	817 (93.0)	62.1	392 (94.0)	62.7	
Outpatient	61 (7.0)	4.6	25 (6.0)	4.0	
Disposition, n (%)					0.01
Discharge	813 (92.6)	61.8	374 (89.7)	59.9	
Admission	30 (3.4)	2.3	30 (7.2)	4.8	
Transfer	35 (4.0)	2.7	13 (3.1)	2.1	
Location, n (%)					0.02
Throat	195 (22.2)	14.8	90 (21.6)	14.1	
Esophagus	46 (5.2)	3.5	21 (5.0)	3.4	
Stomach	116 (13.2)	8.8	49 (11.8)	7.8	
Small intestine	43 (4.9)	3.3	43 (10.3)	6.9	
Large intestine	12 (1.4)	0.9	7 (1.7)	1.1	
Others	466 (53.1)	35.4	207 (49.6)	33.1	
Symptoms, n (%)					0.97
Asymptomatic	238 (27.1)	18.1	111 (26.6)	17.8	
Dyspnea	24 (2.7)	1.8	11 (2.6)	1.8	
Foreign body sensation and neck pain	508 (57.9)	38.6	240 (57.6)	38.4	
Drooling	9 (1.0)	0.7	3 (0.7)	0.5	
Chest discomfort and pain	12 (1.4)	0.9	7 (1.7)	1.1	
Vomiting and abdominal pain	80 (9.1)	6.1	43 (10.3)	6.9	
Others	7 (0.8)	0.5	2 (0.5)	0.3	
Removal method, n (%)					0.13
Observation	282 (32.1)	21.4	119 (28.5)	19.0	
Foley's catheter	9 (1.0)	0.7	6 (1.4)	1.0	
Laryngoscope	463 (52.7)	35.2	208 (49.9)	33.3	
EGD	97 (11.1)	7.4	65 (15.6)	10.4	
Operation	11 (1.3)	0.8	7 (1.7)	1.1	
Others	16 (1.8)	1.2	12 (2.9)	1.9	

*, rates expressed per 100,000 persons. COVID-19, coronavirus disease 2019; IQR, interquartile range; EGD, esophagogastroduodenoscopy.

Table 2 Occurrence rates for pediatric foreign body ingestions in the Daegu-Kyungpook Province comparing the pre-COVID-19 and COVID-19 periods

Type	Pre-COVID-19 period [2018–2019] (N=878)		COVID-19 period [2020] (N=417)		P value
	Values	Rate*	Values	Rate*	
Fishbone	356 (40.5)	27.1	151 (36.2)	24.2	0.31
Food	135 (15.4)	10.3	56 (13.4)	9.0	0.45
Coin	56 (6.4)	4.3	32 (7.7)	5.1	0.47
Button battery	33 (3.8)	2.5	23 (5.5)	3.7	0.23
Magnet	37 (4.2)	2.8	21 (5.0)	3.4	0.57
Superabsorbent polymer	8 (0.9)	0.6	5 (1.2)	0.8	0.68
Toy	96 (10.9)	7.3	64 (15.4)	10.2	0.07
Household items	157 (17.9)	11.9	65 (15.6)	10.4	0.41
Total	878 (100.0)	66.7	417 (100.0)	66.7	0.999

*, rates expressed per 100,000 persons. COVID-19, coronavirus disease 2019.

**Figure 1** Occurrence rates of pediatric foreign body ingestion according to foreign body type in the Daegu-Kyungpook Province, comparing the pre-COVID-19 and COVID-19 periods. COVID-19, coronavirus disease 2019.

period, the occurrence rates of ingestion of toys, coins, magnets, button batteries, and superabsorbent polymers increased, and the occurrence rates of ingestion of fishbones, foods, and household items decreased, but there was no statistically significant difference between the two periods (Table 2, Figure 1).

Occurrence rates per 100,000 persons were divided into three age groups (0–3, 4–6, and 7–15 years) for comparison. Compared to the pre-COVID-19 period, there were no statistically significant differences in the FBI in the all groups during the COVID-19 period (0–3, 4–6, 7–15 years; $P=0.45$, 0.13, 0.35). In addition, when compared according to age and dividing ingested items into food (fishbone

+ food) and non-food items, there were no statistically significant differences in the proportion of cases in the COVID period in all age groups (food; non-food $P=0.15$; $P=0.12$) (Figure 2).

Discussion

To the best of our knowledge, this study is the first to identify the rate of FBI in children in the Daegu-Kyungpook Province during COVID-19 as compared to the 2 years pre-COVID-19.

The COVID-19 has led to marked lifestyle changes. The United Nations International Children's Emergency

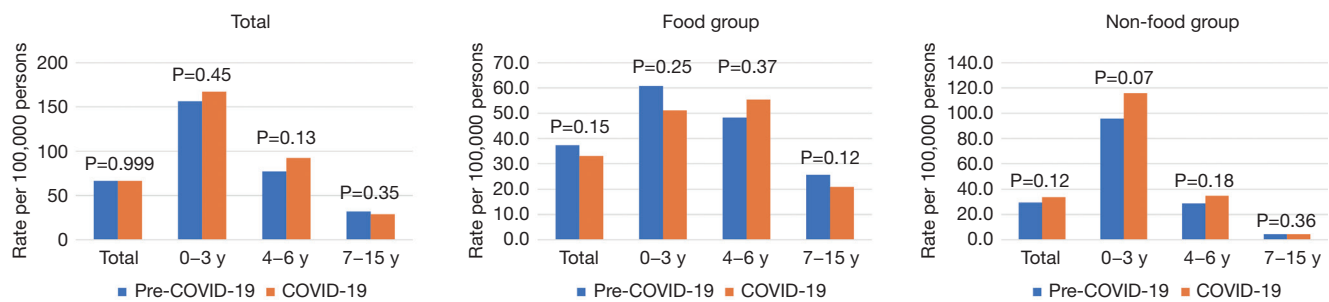


Figure 2 Occurrence rates of pediatric foreign body ingestion by age group in the Daegu-Kyungpook Province, comparing the pre-COVID-19 and COVID-19 periods. y, years; COVID-19, coronavirus disease 2019.

Fund has reported that 168 million children were unable to attend school for almost a year because of COVID-19 (10). While the COVID-19 period is still ongoing, studies on the impact of COVID-19 on children's health remain lacking. Changes in lifestyle caused by measures to prevent infection, as well as damage due to the COVID-19 infection itself, have caused secondary problems, such as increases in poor eating habits and obesity in children (6,14), mental illness (15), and accidents at home (5-7,16,17). Although it was plausible that FBI rates would increase due to the increased time spent at home during the COVID-19 period (8-10), we found that these rates among pediatric patients did not differ between the pre-COVID-19 period and during the COVID-19 period. Despite the increase in time spent at home (8-10), where most FBIs occur, there was no significant difference in the rate per 100,000 emergency department (ED) visits for FBI, as well as by type of foreign body, between the pre- and post-COVID-19 periods. This may be related to the fact that children are spending more time at home, which increases their exposure to foreign objects, and parents are spending more time at home with limited outdoor activities. Parents who spend more time at home with their children may have had more time to care for their children and may have had better control of swallowable foreign bodies.

As the number of hospitals providing face-to-face treatment and the number of hospital visits by guardians concerned about infection decreased in the early stages of COVID-19, Jang *et al.* (18) reported the number of patients visiting pediatric emergency rooms in the Daegu-Kyungpook Province decreased sharply, by 62.0%, from an average of 21,815 in 2018–2019 to 8,097 in 2020. Combining data from pediatric ED visits in the same region and period with the number of FBI in this study, 878 cases out of 43,630 patients (2.0%) during the pre-COVID

period and 417 cases out of 8,097 patients (5.2%) during the COVID period resulted in a relative increase of 2.6 folds. A study by Bucci *et al.* (19) also reported that the number of patients visiting the emergency room in Italy decreased by 76%, but that the proportion of patients who ingested foreign bodies doubled, from 1% to 2%. In contrast, Geibel *et al.* (17) reported that there was no change in FBI trends from before to after COVID-19 in the USA, despite a decrease in the rates of overall medical care visits.

In this study, foreign bodies with increased rates of swallowing accidents as compared to the pre-COVID-19 period were toys, button batteries, coins, magnets, and superabsorbent polymers, with the rate of ingestion of toys increasing the most. The frequency of playing with toys may have increased with the increased time spent at home. Swallowing of button batteries, which are widely used in toys and indoor electronic devices, simultaneously increased. A previous study on button battery ingestion identified that more than half of the children who visited hospitals for battery ingestion had swallowed batteries contained in household items (20).

Recent studies (17,20) from other countries also reported a significant increase in the ingestion of button batteries and magnets. Pizzol *et al.* (21) reported that as the time spent at home increased during the COVID-19 period, the use of electronic devices increased, resulting in increased ingestion of button batteries, whereas coin swallowing decreased, as shopping was increasingly conducted online. Bucci *et al.* (19) reported that swallowing rates of batteries and sharp objects were increased during as compared to that before the COVID-19 period, and serious triage codes, endoscopy rates, and hospitalization rates also increased. This may be because children spent more time in less child-friendly places, and guardians may have left dangerous objects unattended with increased housework. Balci

et al. (22) reported an increase in the ingestion of button batteries and food items; however, this was due to the developmental characteristics of the children involved, rather than due to spending more time at home.

Coins are traditionally the most common foreign body ingested in children (23). A recent study (24) also found that coins had the highest frequency of FBI in children during the COVID-19 period. However, in the present study, ingestion of coins did not account for a large proportion of the total, although the frequency of coin ingestion did increase as compared to pre-COVID-19 period rates. This may be due to the sharp decline in the use of coins, as the use of credit cards (25) and electronic payment applications has increased in South Korea. Traditionally, the frequency of fishbone ingestion has been the highest among foreign bodies ingested in Korean adults (26-28); in this pediatric study, the frequency of fishbone ingestion was also the highest among children.

Regarding the location of foreign bodies in this study, the frequency of post-pyloric foreign bodies, that is, foreign bodies in the small and large intestines, increased in the COVID-19 period, except for many foreign bodies in the throat (due to the nature of fishbones, which were the most frequently ingested foreign body). This result was closely related to the time from swallowing the foreign body to visiting the emergency room because the swallowed foreign body moves downward over time. However, our study did not investigate the time taken to reach the hospital after the foreign body was swallowed. Nevertheless, many studies showed that during the COVID-19 period, visits to pediatric emergency rooms decreased markedly (18,29,30), while procedures were added to confirm infection status before classifying patients in the emergency room and treating them in person. In particular, it can be assumed that the time taken to remove the foreign body was increased because of the process of excluding COVID-19 infection prior to the procedure or surgery. This may increase the complications associated with FBI. The guidelines for foreign body removal in children suggest that risks and benefits should be considered depending on the COVID-19 situation (31).

Further, the frequency of foreign body removal with endoscopy and surgery increased, and the frequency of hospitalization also increased significantly during the COVID-19 period, which is thought to be related to an increase in the ingestion of batteries and magnets and an increase in the time from ingestion to hospital visit. A previous study also reported that the severity of the cases

and frequency of hospitalization were higher during than that before COVID-19 (19).

In many cases, most gastrointestinal foreign bodies are discharged spontaneously without intervention. However, ingestions involving button batteries, fidget spinners, neodymium magnets, laundry detergent pods, and superabsorbent polymers should be carefully treated, because they can cause severe damage to the body if swallowed (32).

As revealed in several recent studies, as well as in this study, the increase in the swallowing of button batteries and magnets during the COVID-19 period requires special attention. As changes in lifestyle that occur secondary to COVID-19 lead to accidents that can be fatal, an emergency foreign body removal system that is active at any time should be initiated in the region. Additionally, prevention measures should be enhanced by continuous education.

Limitations

The seven hospitals participating in this study accepted the most pediatric patients with FBI in the Daegu-Kyungpook Province. However, some pediatric patients may have been missed if they were discharged spontaneously after radiography in hospitals other than these seven hospitals, and returned home, or if the children were not transferred to any one of these seven hospitals, because adult endoscopists removed the foreign bodies from the children. In addition, our study may not have included cases that were resolved by calling the emergency number 119 or the hospital or where guardians searched the internet on their own for a solution and did not visit a medical institution for help.

Conclusions

During the COVID-19 period, the occurrence rate of FBI in children did not differ from that in the pre-COVID-19 period. The number of hospitalizations due to FBI has also increased. FBI increased in boys in particular. Additionally, the number of foreign bodies in the post-pyloric region was increased as compared to that in the pre-COVID-19 period. Since COVID-19 has necessitated lifestyle changes, in addition to infection control, it is necessary to recognize the risk for and prevent accidental ingestion of dangerous foreign bodies at home. Moreover, a local emergency foreign body removal system should be established to deal with FBI accidents timeously.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at <https://tp.amegroups.com/article/view/10.21037/tp-23-21/rc>

Data Sharing Statement: Available at <https://tp.amegroups.com/article/view/10.21037/tp-23-21/dss>

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://tp.amegroups.com/article/view/10.21037/tp-23-21/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the principles of the Declaration of Helsinki (as revised in 2013). The study protocol was reviewed and approved by the Institutional Review Board (IRB) of Daegu Joint which is an agreement between the six hospitals participating in the study (IRB No. 2020-06-005-001). And this study protocol was also approved by Dongguk University Gyeongju Hospital (IRB No. 110757-202204-HR-04-02). Individual consent for this retrospective analysis was waived.

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