



Endoscopist-Driven Sedation Practices in South Korea: Re-evaluation Considering the Nationwide Survey in 2019

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Background/Aims: This study aimed to determine changes in endoscopist-driven sedation practices 5 years after the first nationwide survey in 2014 by the Korean Society of Gastrointestinal Endoscopy (KSGE).

Methods: A 59-item survey covering current practices was electronically mailed to all members of the KSGE in 2019.

Results: In total, 955 (12.8%) out of 7,486 questionnaires were returned. A total of 738 (77.7%) out of 955 respondents attended dedicated sedation education programs. The American Society of Anesthesiologists class was recorded by 464 (51.2%) out of 907 respondents. The recording rate was higher in respondents who completed sedation education ($p=0.014$) and worked in general or tertiary hospitals ($p<0.001$). Compared to that reported in the previous survey, the reported use of propofol was higher in 2019. The respondents had higher satisfaction scores for propofol-based sedation compared with midazolam monotherapy ($p<0.001$). The rates of oxygen supplementation ($p<0.001$) and oxygen saturation level monitoring ($p<0.001$) during sedative endoscopy were higher in 2019 than in the previous survey. A total of 876 (98.4%) out of 890 respondents reported a separate recovery bay, and 615 (70.5%) out of 872 respondents reported that personnel were assigned solely to the recovery bay.

Conclusions: Endoscopist-driven sedation and monitoring practices in 2019 were significantly different than those in 2014. The respondents favored propofol-based sedation and utilized oxygen supplementation and monitoring of O_2 saturation more frequently in 2019 than in 2014. (**Gut Liver 2022;16:899-906**)

Key Words: Gastrointestinal endoscopy; Sedation; Survey; Propofol

INTRODUCTION

Endoscopist-driven sedation has been widely used to

facilitate effective endoscopic procedures with satisfaction for both patients and endoscopists.¹⁻³ Sedation methods should be tailored to the individual patients, available fa-

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cilities, and their experiences based on the updated guidelines.⁴⁻⁶ There were survey studies to show sedation and monitoring practices in local areas.⁷⁻¹⁰ In South Korea, a nationwide survey was carried out among members of the Korean Society of Gastrointestinal Endoscopy (KSGE) in 2014 for the first time.¹¹ In 2016, the Korean Medical Association stated that an educational program should be performed for every doctor and member of the nursing personnel involved in propofol-based sedation. Recently, the KSGE has updated the Accreditation of Qualified Endoscopy Unit (AQEU) program to enhance the quality of endoscopy units, which emphasizes the facilities, personnel, and education programs related to endoscopic sedation.^{12,13} Since the introduction of mandatory education program by the Korean Medical Association and reinforcement of the AQEU program related to endoscopic sedation by the KSGE, change of facilities or personnel involved to endoscopic sedation would be expected. Herein, a survey-based study to determine the changes in sedation and monitoring practice of gastrointestinal endoscopists brought on by reinforcement of educational program and supplementation of regulations since 2014 are presented.

MATERIALS AND METHODS

The survey was electronically mailed to all the members of KSGE via a link to a SurveyMonkey questionnaire, which could be completed in about 15 minutes. No responses up to five attempts were regarded as refusal. The results provided were automatically recorded in the system. The survey questionnaire composed of 59 items were updated from that of the previous survey 11 by the KSGE Task Force on Endoscopic sedation.

Data were expressed as number (percentage), mean± standard deviation, or median (range or interquartile range [IQR]). The satisfaction score with sedation, assessment of patient cooperation, and assessment of examination quality for current sedation pattern range from 1 to 10. Comparisons of data between the results of the year 2014 and that of the year 2019 were performed with the chi-square test for qualitative data or with the t-test or non-parametric test for quantitative tests. A p-value <0.05 was regarded as statistically significant. All statistical analysis was performed with the statistical package IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA).

RESULTS

1. Characteristics of respondents

Among 7,486 KSGE members, a total of 955 (12.8%) responded to the survey, comprised of 768 (80.4%) men and 187 (19.6%) women. The mean age of the respondents was 42.6±7.6 years (range, 22 to 85 years). Among 949 respondents, 354 (37.3%) worked in private clinics, 133 (14.0%) in hospitals, 243 (26.5%) in general hospitals, and 219 (23.1%) in tertiary hospitals. There were 354 (37.2%) out of 952 respondents who had >10 years of endoscopic practice (Table 1). The median numbers (IQR) of esophagogastroduodenoscopies and colonoscopies per day were 10 (range, 5 to 15) and 4 (range, 2 to 5), respectively. Only 90 of respondents (9.4%) performed endoscopic retrograde cholangiopancreatography procedures.

2. Education and training in endoscopist-driven sedation

While 738 (77.7%) out of 955 respondents received dedicated sedation education programs, 721 (77.7%) out of 928 responded that it would be necessary to develop clinical practice guidelines for sedation in gastrointestinal endoscopy by the authorized organization, especially for selection and use of sedative agents. Also 432 (46.6%) out of 928 respondents received dedicated training for sedation during their fellowship. Among 928 respondents, 542 (58.4%) received continuing medical education for basic life support techniques.

3. Pre-procedural preparation and assessment: risk assessment of endoscopic sedation

Among 955 respondents, 907 answered about the recording of American Society of Anesthesiologists (ASA)

Table 1. Demographic Characteristics of the 955 Respondents

Characteristics	No. [%]
Sex (n=955)	
Men	768 (80.4)
Women	187 (19.6)
Age, mean±SD, yr	42.6±7.6
Level of institutions (n=949)	
Private clinic	354 (37.3)
Hospital	133 (14.0)
General hospital	243 (25.6)
Tertiary hospital	219 (23.1)
Years of experience as an endoscopist (n=952)	
<5 yr	298 (31.3)
5–10 yr	300 (31.5)
11–15 yr	140 (14.7)
16–20 yr	112 (11.8)
>20 yr	102 (10.7)

class and Mallampati score. Among them, 464 respondents (51.2%) recorded ASA class and 218 (24.0%) the Mallampati score for risk stratification prior to providing sedation. The recording rate of ASA class was higher in respondents who completed the sedation education ($p=0.014$) and worked in general hospitals or tertiary hospitals ($p<0.001$) (Table 2).

4. Intra-procedure assessment

1) Monitoring practices

Four hundred eighty-seven (53.7%) out of 907 respondents administered oxygen before sedative endoscopy and 624 (69.8%) out of 894 administered supplemental oxygen during sedative endoscopy. Eight hundred and eighty-seven (99.2%) out of 894 respondents monitored pulse oximetry during endoscopic sedation. Regular automated blood pressure (BP) monitoring was performed by 370 (41.4%) out of 894 respondents, regular or intermittent electrocardiographic monitoring was performed by 57.8% (517/894) of respondents and the level of consciousness was assessed by 774 (86.6%) out of 894 respondents (Table 3). There were significant differences in oxygen administration and monitoring of pulse oximetry during sedative endoscopy between the survey by the KSGE in 2014 and the survey by the KSGE in 2019 (Table 3).

Equipment for cardiopulmonary resuscitation was available in the endoscopy room of 877 (98.1%) out of 894 respondents. There were significant differences in pattern of monitoring practices and equipment for cardiopulmonary resuscitation between the private clinics/the hospitals and general hospitals/tertiary hospitals ($p<0.05$) (Table 4).

2) Sedation practices

For patients undergoing diagnostic procedures with endoscopist-driven sedation, 869 (97.2%) of 894 respondents answered that there was at least one endoscopy staff member (an assistant physician, a nurse, an endoscopy technician, or an unlicensed personnel) in the endoscopy room. Eight hundred and seventy-eight (98.3%) out of 893 responded that the types, an initial and additional doses and dosing intervals of sedatives were decided by an endoscopist. Administration of the sedatives was mostly performed by trained nurses 759 (84.9%) out of 894 respondents.

(1) Esophagogastroduodenoscopy

Among 916 respondents 734 respondents (80.1%) performed endoscopic sedation for more than 50% of cases (Table 5). Propofol-based sedation, as monotherapy or in combination with midazolam, was the preferred method. Moreover, propofol-based sedation during endoscopy

Table 2. Reported ASA Class and Mallampati Score

Variable	Recording ASA class			Recording Mallampati score		
	No (n=443)	Yes (n=464)	p-value	No (n=689)	Yes (n=218)	p-value
Sedation education program			0.014			0.748
No	111/196 [56.6]	85/196 [43.4]		154/205 [75.1]	51/205 [24.9]	
Yes	332/711 [46.7]	379/711 [53.3]		535/702 [76.2]	167/702 [23.8]	
Level of complexity of clinics			<0.001			0.193
Clinic	214/335 [63.9]	121/335 [36.1]		244/339 [72.0]	95/339 [28.0]	
Hospital	70/132 [53.0]	62/132 [47.0]		100/128 [78.1]	28/128 [21.9]	
General hospital	90/233 [38.6]	143/233 [61.4]		182/232 [78.4]	50/232 [21.6]	
Tertiary hospital	69/207 [33.3]	138/207 [66.7]		163/208 [78.4]	45/208 [21.6]	

Data are presented as number/number (%).
ASA, American society of Anesthesiologists.

Table 3. Change in Patient Monitoring Practices after Dedicated Sedation Education

Patient monitoring practices	2014 (Lee <i>et al.</i> ¹¹)	2019 (current study)	p-value
O ₂ supply before sedative endoscopy	NA	53.7 [487/907]	
O ₂ supply during sedative endoscopy	42.5 [560/1,318]	69.8 [624/894]	<0.001
Monitoring of O ₂ saturation during sedative endoscopy	94.1 [1,240/1,318]	99.2 [887/894]	<0.001
Monitoring of BP during sedative endoscopy	NA	41.4 [370/894]	
Monitoring of ECG during sedative endoscopy	NA	57.8 [517/894]	
Regular assessment of level of consciousness	NA	86.6 [774/894]	

Data are presented as % (number/number).
BP, blood pressure; ECG, electrocardiography; NA, not available.

Table 4. Differences in Patient Monitoring Practices According to the Level of Complexity of Clinics

Patient monitoring practices	Clinics and hospitals (n=467)	General and tertiary hospitals (n=440)	p-value
O ₂ supply before sedative endoscopy	221/467 (47.3)	266/440 (60.5)	<0.001
O ₂ supply during sedative endoscopy	292/460 (63.5)	332/434 (76.5)	<0.001
Monitoring of O ₂ saturation during sedative endoscopy	453/460 (98.5)	434/434 (100)	0.016*
Monitoring of BP during sedative endoscopy	110/460 (23.9)	260/434 (59.9)	<0.001
Monitoring of ECG during sedative endoscopy			<0.001
Intermittent	77/460 (16.7)	140/460 (30.4)	
Always	101/434 (23.3)	199/434 (45.9)	
Regular assessment of level of consciousness	386/460 (83.9)	388/434 (89.4)	0.016
Equipment for CPR in endoscopy room	444/460 (96.5)	433/434 (99.8)	<0.001

Data are presented as number/number (%).

BP, blood pressure; ECG, electrocardiography; CPR, cardiopulmonary resuscitation.

*Fisher exact test.

Table 5. Sedation Practices in 2014 and 2019

Variable	EGD		Colon	
	2014 [Lee <i>et al.</i> ¹¹]	2019 [current study]	2014 [Lee <i>et al.</i> ¹¹]	2019 [current study]
Current use of sedation, if any	1,305 (99.0)	916 (95.9)	1,205 (91.4)	916 (95.9)
Proportion of sedative endoscopy				
≤25% of cases	124/1,305 (9.5)	42/916 (4.6)	19/1,205 (1.6)	20/916 (2.2)
26%–50% of cases	298/1,305 (22.8)	140/916 (15.3)	57/1,205 (4.7)	37/916 (4.0)
51%–75% of cases	474/1,305 (36.3)	314/916 (34.3)	188/1,205 (15.6)	136/916 (14.9)
≥76% of cases	409/1,305 (31.3)	420/916 (45.9)	941/1,205 (78.1)	723/916 (78.9)
Sedation pattern				
Midazolam only	537/1,305 (41.2)	278/916 (30.4)	545/1,205 (45.2)	323/916 (35.3)
Propofol only	380/1,305 (29.1)	332/916 (36.2)	85/1,205 (7.1)	77/916 (8.4)
Midazolam + propofol	345/1,305 (26.4)	286/916 (31.2)	550/1,205 (45.6)	491/916 (53.6)
Etc.	43/1,305 (3.3)	20/916 (2.2)	25/1,205 (2.1)	25/916 (2.7)
Use of analgesic medication	NA	55/916 (6.0)	NA	529/953 (55.5)
Meperidine	NA	33/916 (3.6)	NA	381/953 (40.0)
Fentanyl	NA	11/916 (1.2)	NA	81/953 (8.5)
Etc.	NA	11/916 (1.2)	NA	67/953 (7.0)
Overall endoscopists' satisfaction with sedation				
9–10	339/1,305 (26.0)	231/916 (24.2)	457/1,205 (37.9)	NA
7–8	688/1,305 (52.7)	498/916 (52.1)	577/1,205 (47.9)	NA
5–6	191/1,305 (14.6)	153/916 (16.7)	129/1,205 (10.7)	NA
≤4	87/1,305 (6.7)	34/916 (3.7)	42/1,205 (3.5)	NA

Data are presented as number/number (%).

EGD, esophagogastroduodenoscopy; NA, not available.

were more frequently used in the survey in 2019 (67.5%), compared to in the survey in 2014 (55.6%, $p<0.001$). Analgesics were combined by 55 (6.0%) out of 916 respondents. There was no difference in sedation pattern according to the completion of education programs ($p=0.543$). The mean satisfaction score for current sedation pattern was 7.52 ± 1.52 . There was a significant difference in endoscopists' satisfaction score according to their sedation pattern ($p<0.001$). Mean satisfaction score of "midazolam monotherapy," "propofol monotherapy," "balanced propofol therapy (propofol plus midazolam)," and "others" was 6.9 ± 1.5 , 7.9 ± 1.4 , 7.7 ± 1.4 , and 8.2 ± 1.6 , respectively. The higher satisfaction scores were reported with propofol monotherapy

and balanced propofol therapy compared with midazolam monotherapy ($p<0.001$, respectively). There was no difference in satisfaction scores between propofol monotherapy and balanced propofol therapy ($p=0.481$).

(2) Colonoscopy

Among 916 respondents who performed sedative colonoscopies, 859 (93.8%) performed endoscopic sedation for more than 50% of cases (Table 5). In colonoscopy procedures, 35.3% of respondents used midazolam monotherapy and 62.0% of respondents used propofol-based sedation. Propofol-based sedation during colonoscopy were more frequently used in the survey in 2019 (62.0%), compared

Table 6. Sedation-Related Complications

Complications	Clinic (n=339)	Hospital (n=132)	General hospital (n=235)	Tertiary hospital (n=137)	p-value
Bag-mask ventilation	174 (51.3)	70 (53.0)	132 (56.2)	137 (65.2)	0.013
Endotracheal intubation	24 (7.1)	11 (8.3)	35 (14.9)	45 (21.4)	<0.001
Permanent injury	0	0	3 (1.3)	4 (1.9)	0.045
Death	1 (0.3)	1 (0.8)	8 (3.4)	11 (5.2)	0.001

Data are presented as number (%).

to in the survey in 2014 (52.7%, $p < 0.001$). Analgesics were combined by 496 (54.1%) out of 916 respondents.

3) Sedation-related complications

Among 916 respondents, 581 (63.4%) experienced sedation-related complications; 513 (56.0%) experienced of mask-bag ventilation and 115 (12.6%) endotracheal intubation during sedative endoscopy. Seven (0.8%) respondents had experience of permanent injury of patients and 21 (2.3%) respondents had experience of their patient's death because of sedation-related complications. Respondents working in general hospitals or tertiary hospitals had more frequent experiences of sedation-related complications (0.8 ± 0.7 times) than respondents working in clinics and hospitals (0.6 ± 0.6 , $p < 0.001$) (Table 6).

Management of patients with paradoxical response was as follows; re-examination under non-sedation state after recovery with or without the use of antidote by 567 (63.5%), administration of additional dose of same sedatives by 132 (14.8%), switch to another sedative by 158 (17.7%) and etc. by 36 out of 893 respondents (4.0%). Antidotes such as flumazenil or naloxone were available in the endoscopy room of 93.8% of respondents (839/894). Seven hundred and fourteen of respondents (79.9%) had experience for use of antidote; 36 respondents (5.0%) used antidotes for every case, 500 respondents (70.0%) had experience of antidotes in case of hypoxia and 400 respondents (56.0%) had experience of antidotes in case of paradoxical reaction.

5. Post-procedural assessment

Out of 890 respondents who responded the questionnaire about presence of separate recovery bay, 876 (98.4%) respondents had a separate recovery bay in endoscopic units. The median size (IQR) of recovery bay was 25 m² (range, 12 to 50 m²). The median number (IQR) of beds in a recovery bay was 8 (range, 4 to 10). Of 858 respondents who responded the questionnaire about facilities including various monitoring equipment, 661 (77.0%) performed the tracking of the oxygen saturation level monitoring for each bed in the recovery bay, 661 (77.0%) respondents had BP/oxygen saturation level monitoring equipment for each bed in the recovery bay and 709 (82.6%) respondents supplied oxygen for patients in the recovery bay.

There were 615 (70.5%) out of 872 respondents who had working personnel assigned solely to the recovery bay. The median number (IQR) of the nursing personnel was 2 (range, 1 to 3). The number of respondents with less than five patients per bed was 310 out of 587 (52.8%). There were 78.6% (463/589) of respondents with the ratio of the number of nursing personnel in a recovery bay to the number of patients greater than 1:10 (Supplementary Table 1).

DISCUSSION

This survey, which was performed as the 5-year follow-up for the first nationwide survey in 2014 by the KSGE, showed the improvements of clinical practice after the reinforcement of regulations and introduction of obligatory education programs for endoscopic sedation. Compared to the previous survey, there was an increased use of propofol during esophagogastroduodenoscopy and colonoscopy. The rates of supplement of oxygen ($p < 0.001$) and tracking of the oxygen saturation level ($p < 0.001$) during sedative endoscopy were increased in 2019 compared to the previous survey.

In South Korea, recently since the scientific societies including Korean Medical Association and KSGE have emphasized the importance of education for endoscopist-driven sedation, 77.7% of respondents received dedicated sedation education program and 58.4% of respondents received continuing medical education for basic life support techniques.

About half of respondents received dedicated training for sedation during their fellowship. In pre-procedural assessment, the ASA classification is important as it was associated with increased risk of adverse events during endoscopic procedures, especially cardiopulmonary complications. The ASA class stratifies the risks of patients for sedation and anesthesia and is recommended as a quality indicator for AQEU program by the KSGE.^{4,14} In our study, the proportion of recording ASA class was higher in respondents in general hospitals or tertiary hospitals accredited for the AQEU by the KSGE. Moreover, it was higher in respondents who received the sedation education

program. On the other hand, recording the Mallampati classification, by which physician can predict the difficulty the airway management, was not different according to the level of clinics or the sedation education.

Monitoring practices during the procedure depend on the level of institution. In this study, respondents working in general and tertiary hospitals perform more monitoring of oxygen saturation and oxygen supply during sedative endoscopy than respondents working in clinics and hospitals. This survey also showed the increased rates of oxygen supply and tracking of oxygen saturation during endoscopic sedation in 2019 compared to in 2014,¹¹ even though survey in 2019 included more respondents in clinics and hospitals than survey in 2014. While the rate of oxygen supply starting before endoscopic sedation was not surveyed in 2014, it was over 50% in 2019. The use of oxygen supply before endoscopic sedation increases the dissolved oxygen level in blood so that it will be helpful to decrease the risk of hypoxic damage by prolonging the protective period.^{15,16} Monitoring of BP and electrocardiography as well as regular assessment of level of consciousness were also not surveyed in 2014. However, these monitoring indices were included on 2019 survey with having affected by obligatory education programs. Monitoring rates of BP and electrocardiography (41.4% and 57.8%) were relatively lower compared with regular assessment rate of level of consciousness (86.6%). We believe that regular and mandatory education programs would keep improving real world practices for endoscopic sedation.

In this study, sedation-related complication rates were higher in general hospitals and tertiary hospitals despite of better monitoring practices pattern. The reasons might be that there are more patients with higher morbidity and high-risk procedures are usually performed in general and tertiary hospitals.

Propofol-based sedation was the most preferred method for endoscopist with better satisfaction, which was similar with the results of other surveys.^{3,7-9} Recent meta-analysis about the use of propofol for endoscopic sedation demonstrated that propofol had benefits regarding better sedation level, shorter recovery time and better patient satisfaction without increasing the risk of cardiopulmonary complications.¹⁷ Compared to the survey by the KSGE in 2014, more respondents used propofol when performing esophagogastroduodenoscopy and colonoscopy. It seems that there is no more issue for safety regarding the use of propofol by non-anesthesiologists in South Korea.¹⁸

In this survey, about 55% of respondents added opioid to achieve sedation and analgesia during colonoscopy. Fentanyl is known to be associated with faster recovery time and better quality of procedures.^{19,20} However, a ma-

jority of endoscopists in South Korea preferred meperidine rather than fentanyl, which should be changed according to recommendation by other guidelines.^{4,21} There is room for change of opioids selection for endoscopic sedation through education program.

In this survey, we included the questionnaire about post-procedural assessment and environment of recovery bay in endoscopic units, as it is important to monitor and care the patients regarding vital sign, consciousness and the risk of fall. Especially, in high volume endoscopy unit, identification of risks for patient falls and small efforts such as close observation and assistance by health staffs in recovery bay could prevent sedation-related adverse events and patient falls.²² According to our results, about 30% of respondents still did not have working personnel assigned to recovery bay although dedicated personnel is necessary. As the facilities and working personnel in procedural rooms of most endoscopic units improved, more efforts are needed for appropriate monitoring and caring of recovering patients in South Korea.

This study has several limitations. First, the response rate of 12.8% was relatively lower compared with previous studies.⁸⁻¹¹ It might be because the questionnaire had more survey items than the previous and we sent the questionnaire to all the members of KSGE including members working at non-educational centers. However, this survey had more responses from the endoscopists in clinics and hospitals compared to survey 2014. Therefore, this survey would reflect real-world clinical practices. Second, methods of oxygen supply (e.g., nasal cannula, face mask, or other high-flow methods) and the equipment and accessories for emergency airway support were not surveyed. Third, capnographic monitoring was not surveyed. A recent meta-analysis suggested that ventilation adequacy should be assessed by continuous capnographic monitoring.²³ If more studies confirm the beneficial effect of capnographic monitoring in the near future, the application of capnographic monitoring will be included in next survey. Fourth, this study conducted the survey from different group, not in the same group in the survey 2014.

In conclusion, endoscopist-driven sedation endoscopy and monitoring practices in 2019 underwent significant changes compared to status quo ante 2014. The respondents favored propofol-based sedation, and use of oxygen supplementation and monitoring of oxygen saturation more frequently.

CONFLICTS OF INTEREST

B.W.K. is an editorial board member of the journal but

was not involved in the peer reviewer selection, evaluation, or decision process of this article. No other potential conflicts of interest relevant to this article were reported.

AUTHOR CONTRIBUTIONS

Study concept and design: C.H.P., B.W.K. Data acquisition: J.K.L., S.Y.P., C.K.L., H.J.P., B.I.J., D.U.K., J.M.P., J.M.L., Y.S.C., H.K.C., S.Y.S., W.H.P., the Committees of Quality Management and Conscious Sedation of Korean Society of Gastrointestinal Endoscopy (KSGE). Data analysis and interpretation: J.K.L., S.Y.P., C.H.P. Drafting of the manuscript; critical revision of the manuscript for important intellectual content: J.K.L., S.Y.P., C.H.P. Statistical analysis: S.Y.P. Administrative, technical, or material support; study supervision: C.H.P., B.W.K., the Committees of Quality Management and Conscious Sedation of KSGE.

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SUPPLEMENTARY MATERIALS

Supplementary materials can be accessed at <https://doi.org/10.5009/gnl210466>.

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