Contributions of South Korean Registered Nurses in Anesthesia Practice

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Discussion: *RNAs are an integral part of anesthesia services in Korea, although they are not certified and lack clear scope of practice. The authors recommend a pathway for RNAs to obtain advanced degrees and certification as anesthesia providers.*

KEYWORDS: Certified Registered Nurse Anesthetist (CRNA), Registered Nurse in Anesthesia (RNA), Scope of Practice, Elements of Anesthesia Care

Abstract

Introduction: Certified Registered Nurse Anesthetists (CRNAs) were recognized by law as legitimate anesthesia providers in Korea 44 years ago. Since 2005, CRNAs have been educated at the graduate level and certified by national examination. In recent years, the number of graduate educational programs has decreased and the number of practicing CRNAs has declined correspondingly. To meet the shortfall, hospitals train registered nurses to perform anesthesia. This study examined registered nurses in anesthesia (RNAs) and CRNAs in anesthesia care in South Korea.
Materials and Methods: A confidential survey was administered to a sample of 308 nurses in anesthesia practice. The chi-square independent test and independent two-sample *t*-test for continuous variables were used for comparison.
Results: While all were involved in anesthesia, RNAs were more likely to work under supervision. Almost 34% of the participants planned to leave anesthesia practice within the next 5 years, and nearly 20% of participants indicated that they planned to retire within 5 years.

INTRODUCTION

Globally, nurses today are involved in a variety of anesthesia practices.[1] South Korea is not an exception; however, there are currently not enough certified registered nurse anesthetists (CRNAs) to meet the country's need. To overcome the shortfall, registered nurses (RNs) are trained by anesthesiologists in their hospital workplace to provide anesthesia-related services. However, these trained RNs lack certification by national examination.[2] This study assessed RN and CRNA involvement in providing anesthesia care in South Korea, the degree of autonomy of these nurse anesthesia providers, and the presence of a scope of practice or guidelines for providing anesthesia.

A previous study examined the contributions of both CRNAs and uncertified RNs in South Korea. Several startling facts were revealed regarding South Korean nurse anesthesia practice.[2] The authors noticed that the number of practicing CRNAs was declining in the country. Only one university in the country currently offered a graduate CRNA program. The authors also discovered that, to meet the provider shortfall, hospitals often trained RNs in-house to provide anesthesia services.[2]

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Nurse anesthesia practice in South Korea has its roots in the aftermath of the Korean War. At that time there was a critical need for anesthesia services due to the many military and civilian war injuries, as well as from refugees flooding the country from the north.[2-4] There were only a limited number of anesthesiologists in the country, and the Korean military trained the first nurse anesthetists in 1961 to help meet the shortfall.[2-5]

One of the most influential advocates for nurse anesthesia in the country at that time was an American woman named Sister Margaret Kollmer. She arrived in the country in 1964 as a young CRNA assigned to Maryknoll Hospital in Pusan, South Korea. Recognizing a lack of anesthesia providers in country, she decided to create a program to train RNs as anesthetists. In 1969 she implemented a training program in hospitals. The programs were based on the American educational model and consisted of 18 months of training and supervised practice.[2] The CRNAs were certified by the hospital where they trained.

For the next 29 years Sister Margaret was the most ardent promoter of nurse anesthesia in Korea.[2] But the journey has not always been smooth and there are still many bumps along the road. Her efforts were rewarded in 1973 when the Ministry of Health and Welfare formally recognized anesthesia practice by CRNAs. At that time, a total of 13 hospitals trained CRNAs. However, the number of hospital-based CRNA training programs gradually declined over the years.[2,3,5]

In 2003, South Korean national law recognized CRNAs as legitimate advanced practice nurses. The same year, 2 graduate-level university CRNA education programs were established. However, one university CRNA program closed soon afterward. In 2005, the Ministry of Health and Welfare required all new CRNAs to earn a master's degree from an accredited university and to pass a national certification examination.[2,4,5]

Now, 45 years after the Ministry of Health and Welfare recognized the practice, the number of graduate-level CRNA educational programs has declined sharply and the number of practicing CRNAs has decreased correspondingly.[2-6] Today, only one university offers a graduate degree in nurse anesthesia and that program produces about only 10 CRNAs each year.[2-5] In a country of 51 million citizens, that is hardly enough to meet the need. Since the demand for anesthesia services has not diminished, hospitals in Korea have looked for an alternate way to meet the shortage of CRNAs and medical residents. RNs are often trained on the job as anesthesia providers. Although these nurses are trained by the anesthesiologists at the hospital where they work, there are no standard training guidelines or established scope of practice. Most importantly, these RNs are not certified as anesthesia providers by a national examination.[4,5]

Here we will refer to these uncertified anesthesia providers as *registered nurses in anesthesia* (RNAs) to differentiate them from CRNAs. Depending on the level of training they receive and the location of their practice, these RNAs practice under many different job titles. Generally, these nurses are referred to as either specialty nurses (Jeon Dam nurses) or as peri-anesthesia department nurses.[7]

Specialty Nurse (Jeon Dam Nurse)
Nurses commonly known as specialty nurses (Jeon Dam in Korea) practice a medical specialty or delegated medical tasks or services under a physician's license.[7,8] Most of these specialty nurses are not advanced practice nurses and they are not required to pass a certification examination by the Ministry of Health and Welfare. In 2014, there were an estimated 2220 specialty nurses working in different specialties at hospitals throughout the country. Since there are no standard guidelines for training and scope of practice, the roles of specialty nurses are often confused by the medical community. Only 14% of specialty nurses are advanced practice nurses.[7,8] The result is a unique situation that fosters confusion about the identity of these nurses as health care providers, as well as their level of training and scope of practice.[7] We will refer here to specialty nurses who practice anesthesia as *anesthesia specialty nurses* (ASNs).

Peri-Anesthesia Department Nurses
In addition to ASNs, *peri-anesthesia department nurses* are also trained in the hospital where they practice. Like the ASNs, the peri-anesthesia department nurse is also deeply involved in anesthesia practice. Depending on the location of their practice, they may be referred to as anesthesia department nurses, operating room nurses, or recovery room nurses.[7] Like the specialty nurses, these nurses do not receive formal university anesthesia training and are not required to pass a certification examination. They practice various levels of anesthesia under physician supervision.

The Korean Association of Nurse Anesthetists
There is a professional organization in place for nurse anesthetists in Korea. Shortly after successfully lobbying of the Ministry of Health and Welfare for recognition of CRNAs, Sister Margaret Kollmer realized the need for a professional organization.[2-5] She was the catalyst in the formation of the Korean Association of Nurse Anesthetists (KANA). Modeled after the American Association of Nurse Anesthetists (AANA), KANA is an advocate for the advancement of nurse anesthetists and for patient safety. Today, KANA membership is open to both CRNAs and RNAs.[2] It is easy to understand the confusion regarding RNAs in Korea, with so many different job titles and the absence of specific guidelines for training and practice. Although there are many Korean studies examining the role of specialty nurses, there are no current studies that have focused specifically on anesthesia practice by ASNs or peri-anesthesia department nurses.[7-10] Depending on level of training and location of employment, RNAs are involved in various levels of anesthesia services, including administering anesthesia. However, unlike CRNAs, the exact number of RNAs is not known and their scope of practice is not clear. This leads to confusion between roles of RNAs and CRNAs.

Purpose of Research
The purpose of this study was to assess the involvement of RNs including RNAs and CRNAs in anesthesia care in South Korea. To achieve this purpose, we sought to determine which elements of anesthesia practice these RNAs and CRNAs are performing. Additionally, we examined whether these nurse anesthesia providers are engaging under direct supervision by anesthesiologists and surgeons or whether they practice with some degree of autonomy. The other desired outcome was to determine whether there is a defined scope of practice for these 2 levels of nurse anesthesia providers.

Finally, this study highlights the contributions of nurses to anesthesia practice in Korea. The aim was to provide information

that may help to establish guidelines to develop the scope of practice for the different levels of nurse anesthesia providers. We also advocate for reestablishing and strengthening graduate-level education for CRNAs so they may reach their full potential as advanced practice nurses.

BACKGROUND

Anesthesia Providers and Scope of Practice in the United States

In the United States, anesthesia services can be provided by either physician anesthesiologists, CRNAs, or anesthesiology assistants (AAs). These 3 groups are the only professionals qualified to administer anesthesia. Their scopes of practice are clearly defined and all are certified by their governing body after completing graduate-level education. This system is structured and governed to ensure public safety and to protect the profession.[11]

Physician Anesthesiologist

Physician anesthesiologists are medical doctors who specialize in anesthesia practice. After undergraduate school, they complete 4 years of medical school to earn either a Doctor of Medicine (MD) degree or a Doctor of Osteopathic Medicine (DO) degree. Upon completing a 4-year residency, physicians are eligible to sit for the American Board of Anesthesiology (ABA) examination. According to the American Society of Anesthesiologists, about 75% of anesthesiologists are board-certified.[12] In 2017 there were 46,971 anesthesiologists practicing in the United States.[13]

Anesthesiology Assistant

AAs work under direction from licensed anesthesiologists.[12,14] To earn certification, they must complete a 4-year undergraduate degree and satisfactorily complete an accredited AA graduate education program and pass the National Commission for Certification of Anesthesiologist Assistants (NCCAA) examination. The National Board of Medical Examiners (NBME) provides performance information for the test. According to the NCCAA, there are approximately 2300 AAs currently practicing in the United States (NCCAA, email communication, March 27, 2018)

Certified Registered Nurse Anesthetist

Nurse anesthetists have practiced in the United States for more than 150 years, dating back to the American Civil War. They were the first recognized advanced practice nursing specialty and were first credentialed in 1956. When anesthesia is administered by a nurse anesthetist, it is recognized as the practice of nursing, whereas anesthesia administered by a physician anesthesiologist is recognized as the practice of medicine.[15,16] CRNAs administer approximately 43 million anesthetics to patients each year in the United States. There are approximately 52,000 CRNAs practicing in the United States today.[16]

CRNAs in the United States are educated at either the master's or doctoral level under strict guidelines established by the Council on Accreditation of Nurse Anesthesia Educational Programs (COA). After completing a graduate of nurse anesthesia educational program, they must pass the National Certification Examination (NCE). CRNAs are required to recertify every 8 years through the Continued Professional Certification (CPC) Program, which is administered by the National Board of Certification and Recertification for Nurse Anesthetists (NBCRNA).[11,16]

Most importantly, all US anesthesia providers must complete an accredited educational program at either the master's, doctoral, or physician level. All CRNAs, AAs, and most physician anesthesiologists are certified by national examination and all practice under clearly established scopes of practice. The level of autonomous practice may vary from state to state.[16] However, such is not necessarily the case in South Korea. There, anesthesia providers may be either board-certified physicians or CRNAs, but may also be RNAs who have not completed graduate-level anesthesia training or passed a board-administered certifying examination. The disparity between training and practice guidelines for nurse anesthetists in the United States and Korea was the catalyst for this study.

Scope of Practice and Application to this Study

There are 4 essential elements of anesthesia care: pre-anesthetic evaluation and preparation of equipment and anesthetic drugs; anesthesia induction, maintenance, and emergence; post-anesthesia care; and peri-anesthetic support functions.[11] Each element of anesthesia is vital for successful anesthesia performance and positive patient outcomes. A misstep or miscalculation in any area may have detrimental consequences for the patient.[11]

We identified 9 specific anesthesia-related tasks to examine as the basis of the study. The 9 tasks were as follows: pre-anesthetic assessment, prescribing an anesthetic plan, checking the anesthesia machine and required materials, administering or injecting induction agents, inserting an endotracheal tube, managing emergence from anesthesia and deciding when to remove the endotracheal tube, post-anesthetic and pain management, performing regional blocks, and documenting anesthesia notes. All 4 essential elements and all 9 anesthesia tasks were evaluated during this study.

MATERIALS AND METHODS

Data Collection and Procedures

This study was conducted with approval from the University of Southern Mississippi Institutional Review Board and with support from the KANA. It was a follow-up to a similar study conducted by surveying KANA members in 2015.[2] The survey questions were adapted from a 2014 membership profile survey developed and administered by the AANA. With a few modifications, a total of 17 revised survey questions were designed to obtain sociodemographic information and detailed status of the level of anesthesia practice by RNs in South Korea. The survey questions were translated into the Korean language. The translation and cultural accommodations were validated by South Korean CRNAs currently practicing in the United States, as well as by CRNAs and RNAs in South Korea (Table 1).[2]

The survey was administered confidentially via both email and post mail to RNAs and CRNAs in 3 cities (Seoul, Incheon, and Kawang-Ju) and 3 different provinces (Kyong-gi province, Kyoung-sang province, and Jeol-ra province) from March 18 to September 30, 2017. Participation was voluntary and informed consent was verified when respondents completed and submitted the survey. Respondents submitting the survey with 50% or more of the questions unanswered were considered to have withdrawn their consent to participate, and their responses were removed from the study. A total of 325 surveys were returned, and among those, 308 surveys were included in the study. All data collected and used for this study remained anonymous.

Data Analysis

Descriptive statistics were used to identify the characteristics of the participants. The chi-square independent test for categorical variables and the independent two-sample t-test for continuous variables were performed using SAS 9.3 (SAS Institute Inc) to compare components of practice between CRNAs and RNAs.

RESULTS

A total of 308 respondents were included in the study. The respondents' mean age was 33.53 years (SD = 7.95 years), and the average years of experience was 8.34 years (SD = 7.2 years). More than 85% of the respondents had bachelor's degrees or less (n=267; 86.69%), while only 21 (6.81%) had master's degrees or higher. Almost all of them worked full-time (n=302; 98.05%). Around 67% of the participants (n=193) were working in a university hospital with more than 300 beds, whereas only about 10% (n=29) worked in hospitals with fewer than 100 beds.

From the total sample, only 42 respondents identified themselves as CRNAs (13.64%), whereas 266 identified themselves as RNAs (86.36%). The RNAs worked under a number of different job titles, such as anesthesia department nurse (n=152), anesthesia specialty nurse (n=14), recovery room nurse (n=89), and operating room nurse (n=11). Among RNAs, more than half indicated they would like to pursue graduate-level education to become CRNAs (n=171; 55.52%). Interestingly, almost 34% of the participants planned to leave anesthesia practice within the next 5 years, before they are eligible for retirement (n=104; 33.76%). In addition, almost 20 % of participants indicated they plan to retire within 5 years (n=60; 19.49%) (Table 2).

Table 3 shows the chi-square test results between CRNAs and RNAs for 4 separate variables: hospital size, education level, age, and years of experience. According to the chi-square test results, the 2 groups had different percentages in each category (x^2 = 37.86; p < 0.001). RNAs were working mostly in the larger hospital (92.8%), while more than half of the CRNAs were working in mid-size hospitals or hospitals with fewer than 100 beds (73.8%). Almost half of the CRNAs had at least a master's degree, whereas the majority of the RNAs had bachelor's degrees or less (92.2%). For the continuous variables such as age and years of experience, t-tests were performed. As expected, the CRNAs were older and more experienced (42.3 years old and 15.8 years of experience) than were the RNAs (32.1 years old and 7.2 years of experience). Satterthwaite t-tests were done in case the equal variance assumption was violated (Table 3).

Table 4 compares jobs and tasks between the 2 groups. There were no significant differences between the 2 groups in the percentage of time spent on clinical activities, education, management/administration, research, and consultation. The variable labeled "anesthesia practice" looked at 9 anesthesia tasks selected by the authors. CRNAs were significantly more involved in 5 of the 9 tasks (prescribe anesthetic plan, insert endotracheal tube and laryngeal mask airway, manage emergence from anesthesia and decision to remove endotracheal tube, post-anesthetic management, and perform regional blocks). The other tasks that were not statistically significant also had more percentages of CRNAs involved.

There was a statistically significant difference in the level of physician supervision between the 2 groups (x^2 = 9.548; p = 0.002). RNAs were more likely to work under supervision (n=224;

84.2%) than were CRNAs (n=27; 64.3%). For most of the anesthesia activities, RNAs were supervised by the anesthesiologist more often, except for performing post-anesthetic assessment and periodically monitoring anesthetic course. Surgeon involvement in anesthesia practice was not statistically significant, regardless of whether they were certified (x^2 = 0.877; p =0.349) (Table 4).

Table 5 highlights the lack of standardized scope of practice for RNAs. In this table, the RNAs are separated depending on the job title they worked under. These job titles are anesthesia department nurse (n=152), anesthesia specialty nurse (n=14), recovery room nurse (n=89), and operating room nurse (n=11). This table makes it clear that the RNAs, by any title, were involved in the same 9 anesthesia tasks as the CRNAs. For example, 13 of the 14 (92.6%) respondents who identified as ASNs routinely injected induction drugs. Interestingly, of the 89 respondents who identified as recovery room nurses, 78 (87.6%) injected induction drugs, 19 (21.3%) performed intubation, and 4 (4.5%) personally performed regional blocks. Clearly, these 4 categories of RNAs were involved in a wide range of anesthesia tasks, but without a standardized scope of practice (Table 5).

DISCUSSION

The data analysis points to 4 important trends regarding the future of RNAs in Korea's health care system. First, there is a great need for their services. With only one university graduate program producing 10 or fewer CRNAs per year,[4] the country must fill the provider gap, and RNAs help to meet the need. Second, RNAs currently are involved in all 4 anesthesia essential elements to varying degrees. In fact, there was no significant difference in the time spent on clinical practice, education, research, or administrative tasks between the 2 groups, but CRNAs did tend to spend more time on patient consultation. Furthermore, RNAs were also involved in performing all 9 anesthesia tasks, although CRNAs were likely to be more involved in each task. Third, although most RNAs held only a bachelor's degree or less, almost 56% indicated that they would like to pursue an advanced degree as a CRNA. However, graduate opportunities to progress from RNA to CRNA are very limited. The fourth trend is that RNAs worked under different job titles, which may imply they are not recognized properly as anesthesia providers.

Despite the lack of recognition by job title, RNAs are involved in all elements of anesthesia practice. The combination of these trends leads us to conclude that an educational pathway from RNA to CRNA would be beneficial to both individual practitioners and the health care system in Korea.

There are also several interesting trends regarding CRNAs. First, CRNAs describe greater independence in anesthesia practice than do RNAs. As a percentage of the sample, they are also significantly more involved in the 9 anesthesia tasks and the 4 elements of anesthesia practice. This is reasonable because they are certified, tend to be older, have more years of experience, and are more likely to hold advanced degrees. However, the number of practicing CRNAs is declining and the one remaining graduate-level educational program is not likely to replace the numbers lost through attrition.

The RNAs are working mostly in large university hospitals (92.8%) and perform most anesthesia activities under anesthesiologist supervision. More than half of the CRNAs work in mid-sized hospitals or hospitals with fewer than 100 beds (73.8%).

This result mirrors the findings of Bae et al, who compared the job task and task elements of Korean nurse anesthetists by the size of the medical institution.[6] CRNAs are more likely to work without an anesthesiologist's supervision.

Alarmingly, almost 34% of participants plan to leave anesthesia practice before retirement within 5 years (n=104; 33.76%). Also, almost 20% of nurses practicing anesthesia are expected to retire within 5 years (n=60; 19.49%), which exacerbates the critical nurse anesthesia shortage. On the basis of this survey, we could expect tremendous shortages of anesthesia nurses whether they are certified or not within 5 years. We are not sure why one-third of practitioners want to leave anesthesia before their permanent retirement from nursing. One possible reason is the lack of a pathway to advanced education for RNAs.

The results of our study suggest that RNAs are an integral part of anesthesia services in Korea. Our major concerns are that RNAs do not have required certifications for nurse anesthesia and there are no clear standards for their education and scope of practice. As a possible solution, we recommend a university-led effort to provide an educational pathway for RNAs to obtain advanced nursing degrees and certification as anesthesia providers. Any such educational program should provide clear guidelines for training and for the scope of practice. This would require the support of not only the universities, but also the hospitals, anesthesiologists, and possibly the national legislature. As an advocate for patient safety, KANA is the most logical organization to lead the campaign to implement such a program. This would be the first step to ensuring a ready supply of highly qualified nurse anesthetists to meet the country's future need.

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Table 1. Korean Nurse Anesthetist Survey Questionnaire

1. What is your job title in your organization?
    a. Certified Registered Nurse Anesthetist
    b. Anesthesia Department nurse
    c. Anesthesia specialty nurse
    d. Recovery room nurse
    e. Operating room Nurse
2. Indicate your current employment status
    a. Full-time (> 35 hours per week) b. part-time
3. indicate where is your anesthesia practicing setting
    a. university hospital (More than 300 hospital beds)
    b. Middle sized hospital (100-300 hospital beds)
    c. Freestanding surgical center (Outpatient center)
    d. Doctor's office/Clinic
4. Indicate the percentage of time you spend in each of the
    following positions (The total must add to 100%)
    a. Clinical practice   b. Education
    c. Department Management/Administration
    d. Research   e. Consultation
5. What year you were born? (age)
6. Please mark your highest levels of education completed
    a. Associated/Diploma
    b. Baccalaureate in Nursing
    d. Master's in Anesthesia
    e. Doctorate
7. Do you have nurse anesthesia certification? If you do,
where was it obtained?
    a. No, I do not have nurse anesthesia certification
    b. Associated /Diploma
    c. Baccalaureate in Nursing
    d. Master's in Anesthesia
8. Do you like pursue university graduate level education to
be a Certified Registered Nurse Anesthetists?
    a. Yes   b. No
9. How long have you been practicing as a nurse anesthe-
tist?
    a. 1 year or less   b. 2-5 years
    c. 6-10 years   d. 11-20 years
    e. 21-30 years   f. 31 or more years
10. What year do you plan to leave anesthesia practice
before your complete retirement from Nursing Practice?

11. What year do you expect to retire completely from Nursing
practice?
12. Check ALL that you do following anesthesia hand on prac-
tice:
    a. Pre-anesthetic assessment
    b. Prescribe anesthetic plan
    c. Prepare anesthetic material and check anesthesia machine
    d. Injections anesthetic drugs during induction
    e. Insertion endotracheal tube and laryngeal mask airway
    f. Managing of emerging, and decision of removal of airway
    g. Post anesthetic management include pain management
    h. Personally perform regional blocks
    i. Documentation of anesthesia note
13. Check ALL that you do following anesthesia hand on prac-
tice:
    a. Spinal   b. Epidural
    c. Bier   d. Brachial plexus
    e. Femoral   f. Popliteal-Saphenous
    g. Ankle block
14. Do you work in an anesthesia practice, where the anesthesi-
ologist supervises the nurse anesthetist?
15. Of the anesthetics you personally administer, how often is an
anesthesiologist involved in the following anesthesia activities?
    a. Pre-anesthetic assessment
    b. Prescribe anesthetic plan
    c. Present at induction
    d. Present for emergencies or urgent situations
    e. Present for emerging from anesthesia
    f. Perform post-anesthetic assessment
    g. Periodically monitor anesthetic course
16. Do you work in an anesthesia practice, where the surgeon
supervises the nurse anesthetist?
17. Of the anesthetics you personally administer, how often is a
surgeon involved in the following anesthesia activities?
18. Same as 15.

Table 2. Descriptive Statistics (N = 308)		
Variable	**No. (%)**	**Mean (SD)**
CRNA		
Yes	42 (13.64)	
No	266 (86.36)	
Full-time		
Yes	302 (98.05)	
No	6 (1.95)	
Age		33.53 (7.95)
Years of experience		8.34 (7.16)
Education		
Associate	72 (23.38)	
BA in nursing	193 (62.66)	
BA in other fields	2 (0.65)	
MA in nursing	20 (6.49)	
MA in anesthesia	17 (5.52)	
MA in other fields	3 (0.97)	
Doctorate	1 (0.32)	
Job title		
CRNA	42 (13.64)	
Anesthesia department nurse	152 (49.35)	
Anesthesia specialty nurse	14 (4.55)	
Recovery room nurse	89 (28.90)	
Operating room nurse	11 (3.57)	
Working hospital size		
University hospital (>300 beds)	193 (67.25)	
Middle-sized hospital (100–300 beds)	65 (22.65)	
Freestanding surgical center (<100 beds)	23 (8.01)	
Doctor's office/clinic	6 (2.09)	
Would you like to pursue university graduate-level education to be a certified registered nurse anesthetist?		
Yes	171 (55.52)	
No	137 (44.48)	
When do you plan to leave anesthesia practice before your retirement from nursing practice?		
2017 to 2019	31 (10.06)	
2020 to 2022	73 (23.7)	
After 2022	204 (66.23)	
When do you expect to retire completely from nursing practice?		
2017 to 2019	14 (4.55)	
2019 to 2022	46 (14.94)	
After 2022	248 (80.52)	
Abbreviation: CRNA, certified registered nurse anesthetist.		

Table 3. Bivariate Analyses Between CRNAs and RNAs

Variable	Certified Group (CRNAs)	Non-certi-fied Group (RNAs)	Test	Test Statistic	p
Working hospital size, No. (%)			χ^2 *	37.856	< 0.0001
University hospital (>300 beds)	11 (26.2)	186 (69.9)			
Middle-sized hospital (100–300 beds)	16 (38.1)	61 (22.9)			
Freestanding surgical center (<100 beds)	12 (28.6)	14 (5.3)			
Doctor's office/clinic	3 (7.1)	5 (1.9)			
Education, No. (%)			χ^2 *	43.299	< 0.0001
Associate	8 (19.1)	64 (24.1)			
BA in nursing	14 (33.3)	179 (67.3)			
BA in other fields	0 (0.0)	2 (0.8)			
MA in nursing	5 (11.9)	15 (5.6)			
MA in anesthesia	14 (33.3)	3 (1.1)			
MA in other fields	0 (0.0)	3 (1.1)			
Doctorate	1 (2.4)	0			
Age, y, mean (SD)	42.31 (8.28)	32.14 (6.97)	t-test	8.56	< 0.0001
Years of experience, mean (SD)	15.76 (8.34)	7.16 (6.20)	t-test**	6.41	< 0.0001

Abbreviations: CRNA, certified registered nurse anesthetist; RNA, registered nurse in anesthesia.
*Due to the lack of cell frequencies, Cochran-Mantel-Haenszel (CMH) chi-square test was done.
**Due to the equal variance assumption violation, Satterthwaite t-test statistic was applied.

Table 4. Comparison of Jobs and Tasks Between CRNAs and RNAs

Variable	CRNAs	RNAs	Test	Test Statistic	p
Percentage of time spent, %, mean (SD)					
Clinical practice	77.3 (23.5)	81.2 (20.5)	t-test	1.14	0.25
Education	7.3 (6.7)	7.4 (9.2)	t-test*	0.02	0.98
Management/administration	11.6 (16.4)	8.5 (15.0)	t-test	1.24	0.21
Research	1.31 (3.1)	0.73 (2.4)	t-test*	1.14	0.26
Consultation	1.31 (3.1)	0.72 (2.2)	t-test*	1.18	0.24
Other	1.19 (3.1)	1.34 (3.4)	t-test	0.27	0.79
Anesthesia practice, No. (%)					
Pre-anesthetic assessment	31 (73.8)	165 (62.0)	χ^2	2.18	0.14
Prescribe anesthetic plan	22 (52.4)	54 (20.3)	χ^2	20.08	**< 0.001**
Check anesthesia machine and material	40 (95.2)	254 (95.5)	χ^2	0.005	0.94
Injections of induction drugs	40 (95.2)	243 (91.4)	χ^2	0.734	0.39
Insertion endotracheal tube	23 (54.8)	59 (22.2)	χ^2	19.71	**< 0.001**
Managing of emergence and decision of removal of endotracheal tube	22 (52.4%)	41 (15.4%)	χ^2	30.47	**< 0.001**
Post-anesthetic and pain management	39 (92.9%)	213 (80.1%)	χ^2	3.98	**0.046**
Perform regional blocks	17 (40.5%)	12 (4.5%)	χ^2	55.01	**< 0.001**
Documentation of anesthesia note	39 (92.9%)	223 (83.8%)	χ^2	2.32	0.13
Do you work in an anesthesia practice, where the anesthesiologist supervises the nurse anesthetist? No.(%)					
Yes	27 (64.3)	224 (84.2)	χ^2	9.548	**0.002**
No	15 (35.7)	42 (15.8)			
Of the anesthetics you personally administer, how often is an anesthesiologist involved in the following anesthesia activities? Mean (SD)				1.62	
Pre-anesthetic assessment	3.29 (1.81)	3.71 (1.55)	t-test	1.52	0.105
Prescribe anesthetic plan	3.47 (1.77)	3.87 (1.52)	t-test	3.05	0.129
Present at induction	3.50 (1.76)	4.36 (1.22)	t-test**	2.52	**0.004**
Present for emergencies & urgent situations	3.79 (1.65)	4.45 (1.15)	t-test**	2.62	**0.015**
Present for emergence from anesthesia	3.79 (1.68)	4.49 (1.17)	t-test**	1.51	**0.012**
Perform post-anesthetic assessment	3.33 (1.66)	3.69 (1.39)	t-test	1.34	0.132
Periodically monitor anesthetic course	2.98 (1.69)	3.34 (1.32)	t-test**		0.186
Do you work in an anesthesia practice where the surgeons supervise the nurse anesthetist? No. (%)					
Yes	23 (54.8)	125 (47.0)	χ^2	0.877	0.349
No	19 (45.2)	141 (53.0)			
Of the anesthetics you personally administer, how often is a surgeon involved in the following anesthesia activities? Mean (SD)					
Pre-anesthetic assessment	2.43 (1.65)	2.08 (1.64)	t-test	1.27	0.205
Prescribe anesthetic plan	2.45 (1.86)	2.12 (1.70)	t-test	1.17	0.241
Present at induction	2.38 (1.83)	2.11 (1.58)	t-test	1.00	0.318
Present for emergencies or urgent situations	2.83 (1.65)	2.80 (1.55)	t-test	0.14	0.889
Present for emergence from anesthesia	2.19 (1.64)	1.97 (1.40)	t-test	0.93	0.354
Perform post-anesthetic assessment	2.14 (1.72)	1.95 (1.45)	t-test	0.76	0.448
Periodically monitor anesthetic course	2.19 (1.60)	2.09 (1.35)	t-test	0.45	0.652

Abbreviations: CRNA, certified registered nurse anesthetist; RNA, registered nurse in anesthesia.

Table 5. Anesthesia Hands-on Practice of the Participants (N = 308)

	CRNAs, No. (%) (n=42)		Anesthesia Dept. Nurse, No. (%) (n=152)		Anesthesia Specialty Nurse, No. (%) (n=14)		Recovery Room Nurse, No. (%) (n=89)		Operating Room Nurse, No. (%) (n=11)	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Pre-anesthetic assessment	36 (85.7)	6 (14.3)	95 (62.5)	57 (37.5)	5 (35.7)	9 (64.3)	52 (58.4)	37 (41.6)	8 (72.7)	3 (27.3)
Prescribe anesthetic plan	25 (59.5)	17 (40.5)	29 (19.1)	123 (80.9)	1 (7.1)	13 (92.9)	20 (22.5)	69 (77.5)	1 (9.1)	10 (90.9)
Prepare anesthetic material and check anesthesia machine	42 (100.0)	0 (0.0)	146 (96.1)	6 (3.9)	14 (100.0)	0 (0.0)	81 (91.0)	8 (9.0)	11 (100.0)	0 (0.0)
Inject anesthetic drugs during induction	41 (97.6)	1 (2.4)	140 (92.1)	12 (7.9)	13 (92.6)	1 (7.1)	78 (87.6)	11 (12.4)	11 (100.0)	0 (0.0)
Insert endotracheal tube and laryngeal mask airway	27 (64.3)	15 (35.7)	34 (20.9)	118 (77.6)	2 (14.3)	12 (85.7)	19 (21.3)	70 (78.7)	0 (0.0)	11 (100.0)
Manage emergence and decision of removal of endotracheal tube	26 (61.9)	16 (38.1)	22 (14.5)	130 (85.5)	7 (50.0)	7 (50.0)	7 (7.9)	82 (92.1)	1 (9.1)	10 (90.9)
Post-anesthetic management including pain management	41 (97.6)	1 (2.4)	122 (80.3)	30 (19.7)	10 (71.4)	4 (28.6)	72 (80.9)	17 (19.1)	7 (63.6)	4 (36.4)
Personally perform regional blocks: spinal, epidural, Bier etc	21 (50.0)	21 (50.0)	4 (2.6)	148 (97.4)	0 (0.0)	14 (100.0)	4 (4.5)	85 (95.5)	0 (0.0)	11 (100.0)
Documentation of anesthesia notes	40 (95.2)	2 (4.8)	139 (91.4)	13 (8.6)	12 (85.7)	2 (14.3)	62 (69.7)	27 (30.3)	9 (81.8)	2 (18.2)

Summary of Key Points

- In the South Korean health care system, RNs are an integral part of anesthesia services. These nurses work under different job titles, which may imply that they are not recognized properly as anesthesia providers.

- Depending on the hospital in which these nurses practice, they may be referred to by a number of different job titles, including anesthesia department nurse, anesthesia specialty nurse, operating room nurse, or even recovery room nurse. Regardless of job title, all are involved in providing anesthesia to some degree.

- This study revealed that a significant number of both RNAs and CRNAs plan to retire within 5 years. This will likely result in a future shortage of nurse anesthesia providers in the country.

- The authors are concerned that the RNAs are not required to pass a national certifying examination and that there are no clear standards for their education and scope of practice.