The effect of COVID-19 pandemic on anesthesiology and reanimation residents’ airway training and practice: a mannequin study

COVID-19 PANDEMİSİ’NİN ANESTEZİYOLOJİ VE REANİMASYON ASİSTANLARININ HAVAYOLU EĞİTİMİ VE PRATİĞİ ÜZERİNE ETKİSİ: BİR MANKEN ÇALIŞMASI

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ABSTRACT

Objective: We predicted that, due to the changing clinical practices and theoretical education, which gave rise to disturbances in the training program, the residents who started during the pandemic will be inadequate in terms of gaining the necessary knowledge and skills about airway approaches and airway management compared to residents with equivalent duration of residency who began before pandemic. The primary aim was to compare the successful endotracheal intubation rates and duration of tracheal intubation attempts on mannequin applications.

Materials and Methods: The study included 13 residents (“pre pandemic” PreP) who started the residency training program before March 11th 2020 when the pandemic precautions were begun to be taken in our hospital and 12 residents (“post pandemic” PostP) who started between March 11th 2020 and June 6th 2020 when normalization has begun and compared their knowledge and skills on intubation with different laryngoscopes. The residents beginning training before the pandemic period were divided into two groups; those with short working period before the pandemic as “pre pandemic novice” (n=6) (PrePN) and those with longer working period as “pre pandemic senior” (n=7) (PrePS). Each resident was requested to intubate an anatomically accurate intubation mannequin with Macintosh, McCoy, and Miller blades and a video laryngoscope (VL).

Results: The first attempt duration with the Macintosh blade was significantly different between all groups with PrePS having shorter durations. The shortest time for intubation completed with VL was also recorded for the PrePS group, though there were no significant differences.

Conclusion: Changes in anesthesia induction practice due to the pandemic will require special attention to the topic of airway management in the future for residents beginning their training program after the pandemic.

Keywords: laryngoscopy, endotracheal intubation, COVID-19 pandemic, anesthesia resident training, mannequin
ÖZ

Amaç: Pandemi döneminde görevi olan yeteneklilik öğrencilerinin (TUÖ) hem değişen pratik uygulamalar hem de değişen teorik eğitim nedeniyle eğitimlerini belli bir sırada düzeneli olarak, havayoluna ulaşım ve hava yolu yönetiminin normal dönemde gerekliliği ve becerileri kazanması eylemde bir TUÖ görev yetersiz olacağı öngörülmüştür. Ana amaç manken üzerindeki uygulamada başarılı entübasyon oranları ve trakeal entübasyon denemelerinin sürelerinin karşılaştırılması

Gereç ve Yöntem: Dokuz Eylül Üniversitesi Tip Fakültesi Anesteziyoloji ve Reanimasyon Anabilim Dalı‘na, Türkiye’de ve hastanemizde pandemi önlemlerinin alındığı 11 Mart 2020’den önce başlayan 13 TUÖ ve 11 Mart 2020 ile yeniden normalleşmenin başladığı 1 Haziran 2020 tarihi arasında başlayan 12 tpt uzmanlık öğrencisi (TUÖ)‘nin farklı laryngoskoplar ile entübasyon bilgi ve becerileri karşılaştırılmıştır. Pandemi Öncesi dönemde eğitme oluşan hava yolu yönetiminin entübasyon ŞUÖ’leri, pandemi öncesi dönemde çalışan süreleri pandemi sonrası dönemde entübasyon ŞUÖ’lerine yakın olan “pandemi öncesi kilimiz” (n=6) ve daha uzun çalışma süresine sahip “pandemi öncesi kilim” (n=7) olarak ikiye ayrıldı.

Her TUÖ’nün, anatomik olarak uygun bir manken üzerinde Macintosh, McCoy, Miller bleydlar ve video laryngoskop ile entübasyon gerçekleştirilmiş istendi.

Bulgular: Macintosh bleyd ile geçileceklikler ilk entübasyon süreleri açısından gruplar arasında anlamlı farklılık vardı. Pandemi öncesi kilim grupsu arasında entübasyon süreleri en kısa saptandı. Video laryngoskop ile kayıtlı edilen en kısa süreler de pandemi öncesi kilim grubunda saptandı, ancak gruplar arasında anlamlı farklılık yoktu.

Sonuç: Pandemiye bağlı anestezi indüksiyonundaki değişikliklere bağlı olarak pandemiden sonra eğitme oluşan hava yolu yönetimi konusu özel dikkat gerektirecektir.

Anahtar Sözcüklar: laryngoskop, endotrakeal entübasyon, COVID-19 pandemisi, anestezi asistan eğitimi, manken

The novel beta coronavirus called SARS-CoV-2 causing COVID-19 was officially named by the World Health Organization (WHO) in February 2020 (1). The WHO reported COVID-19 was a pandemic on 11 March 2020 (2). In Turkey, the first COVID-19 case was observed on 11 March 2020.

Laryngoscopy, endotracheal intubation, bronchoscopy, gastroscopy and head-neck surgeries cause high rates of droplet formation. Therefore, these interventions increase the risk of health personnel getting infected (3). Especially during these procedures, keeping the minimum number of people in the room is important in terms of reducing the risk of infection (4). A variety of precautions was taken in line with scientific guidelines and publications in our operating rooms. Changes related to intubation practices may be listed as; avoiding mask ventilation, intubation with rapid serial induction with a variety of video laryngoscopes, avoiding Macintosh laryngoscope, use of aerosol boxes and wearing personal protective equipment (PPE). PPE mostly causes limited vision and movement ability. Additionally, residents’ training hours were canceled during the pandemic and could not be performed due to transition to a shift system with the aim of shortening adaptation to new practice.

Due to the changing clinical practices and theoretical education, anesthesia and reanimation residency training could not be performed with a certain order and pattern. Thus, individuals beginning residency during the pandemic would be inadequate in terms of gaining the necessary knowledge and skills about airway
approaches, and airway management compared to normal periods before the COVID-19 pandemic, was our hypothesis for this study.

With the aim of testing this hypothesis, we used a Trucorp AirSim Combo Bronchi X intubation mannequin to compare the success rates and durations for intubation performed with different laryngoscopes and blades by residents beginning at various periods and with various experience levels.

MATERIALS AND METHODS

After receiving permission from Dokuz Eylül University Faculty of Medicine non-interventional research ethics committee (31.08.2020, no. 2020/20-05) and written consent from participant residents, the study was conducted in Dokuz Eylül University Faculty of Medicine Anesthesiology and Reanimation Department. The study included 13 residents who started the residency training before March 11th 2020 (prepandemic, PreP) when the pandemic precautions were began to be taken in our hospital, and 12 residents beginning between March 11th 2020 and June 1st 2020 (post pandemic, PostP) when normalization began and compared their intubation knowledge and skills with different laryngoscopes. In the practical stage of this study, precautions were taken about pandemic transmission risks and each participant consented separately.

The PreP residents who started the training program before the pandemic period were divided into two groups; those with short working period before the pandemic as “pre-pandemic novice” (n=6) (PrePN) and those with longer working period as “pre-pandemic senior” (n=7) (PrePS).

Participants’ duration of residency were noted. Then participants were requested to name the Macintosh, Miller, and McCoy laryngoscope blades and video laryngoscope. Additionally, they were asked to name the stylet and features of use. The aim of use and the need for the tip should not protrude from the endotracheal tube, were two parameters that were expected to be mentioned. They were asked to define the correct use of the stylet. Then, the participant residents were requested to explain anesthesia induction characteristics in the periods before and after the pandemic. Expected accurate information about preoxygenation, medications and doses, neuromuscular blockers’ doses, mask ventilation form and duration, and intubation were recorded.

Later each resident was requested to intubate an anatomically accurate Trucorp AirSim Combo Bronchi X intubation mannequin obtained from the Dokuz Eylül University Faculty of Medicine Occupational Skills Laboratory with Macintosh, McCoy, and Miller blades and a video laryngoscope. The scenario was that anesthesia induction had been performed, the patient had normal airway and was in supine position; a no. 7 portex tube with stylet inserted was used for intubation. The head of the mannequin was adjusted to be at the xiphoid process level of each resident who told us that the head has to be at that level before the intubation attempts.

The primary comparison parameters were the rates of successful endotracheal intubations with each blade and video laryngoscope and the duration of tracheal intubation attempts. The definition of tracheal intubation duration was the time elapsed from the passage of the blade between the teeth to confirmation of insertion of the endotracheal tube by the participant via ventilating the lungs [5]. If the participants were uncertain, the total duration for the intubation intervention included the time spent to attach the endotracheal tube to the balloon valve system and ventilate the lungs (5). The endotracheal tube location was confirmed by the researcher for each intubation attempt at the end (5).

Failed intubation was determined as the trachea not being intubated or as the duration for successful tracheal intubation lasting longer than 120 seconds (5).

Other comparison parameters were the number of intubation attempts, use of airway maneuvers (tracheal compression by a second person, reorganizing the head position), and the ease of use of the type of laryngoscope assessed with a visual analog scale (VAS) by the intubator following every endotracheal intubation (0=very easy, 10=very difficult).
Statistical Analysis

SPSS 22.0 for Windows program was used for the statistical analysis. Descriptive statistics are given as number and percentage for categorical variables and as mean±standard deviation, median (minimum- maximum) for numerical variables. Mann-Whitney U test was applied for the comparison of numerical variables between two independent groups. Comparison of categorical variables in independent groups was performed by the chi-square or Fisher exact test. The means of two or more groups were compared by the Kruskal Wallis test. Statistical significance was accepted as p<0.05.

RESULTS

There were significant differences between the PreP and PostP groups in terms of the length of the residency period, total video laryngoscopy (VL) and direct laryngoscopy (DL) numbers (p<0.05). There were significant differences between the PrePN and PostP groups in terms of DL and VL numbers (p<0.05) (Table 1).

Table 1. The length of the residency period (months), video laryngoscopy numbers and direct laryngoscopy numbers of residents included in the study.

|                        | PrePS (n=7) | PrePN (n=6) | PreP (n=13) | PostP (n=12) |
|------------------------|-------------|-------------|-------------|--------------|
| Total residency period | median±SD   | 19.42±2.57  | 9.33±2.73   | 14.76±5.81   | 2.92±1.71    |
|                        | mean (min-max) | 20 (16-24) | 10 (6-12) | 16(6-24) | 3.5 (0.1-5) |
| Residency period before pandemic | median±SD | 14.42±2.57 | 4.33±2.73 | 9.76±5.81 | - |
|                        | mean (min-max) | 15(11-19) | 5(1-7) | 11(1-19) | - |
| Video laryngoscopy    | median±SD   | 154.28±89.22 | 96.66±35.02 | 127.69±73.38 | 21.58±12.06 |
|                        | mean (min-max) | 130 (50-300) | 100 (30-130) | 100 (30-300) | 20 (0-45) |
| Direct laryngoscopy   | median±SD   | 1314.28±279.45 | 380.00±367.85 | 883.07±574.83 | 1.16±1.69 |
|                        | mean (min-max) | 1300 (1000-1800) | 375 (10-1000) | 1000 (10-1800) | 0 (0-5) |

PrePS: pre pandemic seniors; PrePN: pre pandemic novice; PreP: pre pandemic; PostP: post pandemic

There were significant differences between PrePS and PostP groups as well as between PrePS and PrePN groups in terms of naming the Macintosh blade. However, there was no significant difference between the PrePN and PostP residents for naming (p>0.05). Video laryngoscope was named without problem in all groups. Though differences were not identified for the important points and naming in relation to stylet use, 66.7% of PrePN and 50% of PostP had the necessary information (p>0.05).

When residents included in the study were assessed in terms of knowledge of anesthesia induction before the pandemic, though there were no significant differences between PrePN and PostP (p>0.05), there were significant differences between the PreP and PostP (p<0.05). When induction doses of medications used during the pandemic period were examined, the answers of PrePS were significantly different from PostP as well as from PrePN (p<0.05) and there were no difference between PrePN and PostP (p>0.05). For preoxygenation routine used during pandemic period, PreP were more informed than PostP at significant levels (p<0.05). (Table 2).
Table 2. Success rates for laryngoscope naming and anesthesia induction explanation of residents included in the study

|                               | PrePS (n=7) [n (%)] | PrePN (n=6) [n (%)] | PreP (n=13) [n (%)] | PostP (n=12) [n (%)] |
|-------------------------------|---------------------|---------------------|---------------------|---------------------|
| Macintosh                     | 7 (100%)            | 2 (33.3%)           | 9 (69.2%)           | 6 (50%)            |
| Video laryngoscope            | 7 (100%)            | 6 (100%)            | 13 (100%)           | 12 (100%)          |
| Miller                        | 4 (57.1%)           | 0 (0%)              | 4 (30.8%)           | 1 (8.3%)           |
| McCoy                         | 1 (14.3%)           | 0 (0%)              | 1 (7.7%)            | 0 (0%)             |
| Stylet                        | 7 (100%)            | 4 (66.7%)           | 11 (84.6%)          | 6 (50%)            |
| Pre-pandemic preoxygenation    | 6 (85.7%)           | 4 (66.7%)           | 10 (76.9%)          | 4 (33.3%)          |
| Pre-pandemic medication and dose | 7 (100%)        | 3 (50%)             | 10 (76.9%)          | 2 (16.7%)          |
| Pre-pandemic muscle relaxant and dose | 7 (100%) | 6 (100%)            | 13 (100%)           | 8 (66.7%)          |
| Pre-pandemic mask ventilation form and duration | 7 (100%) | 6 (100%)            | 13 (100%)           | 9 (75%)            |
| Pre-pandemic intubation       | 7 (100%)            | 6 (100%)            | 13 (100%)           | 8 (66.7%)          |
| Post-pandemic preoxygenation   | 6 (85.7%)           | 4 (66.7%)           | 10 (76.9%)          | 4 (33.3%)          |
| Post-pandemic drug and dose    | 7 (100%)            | 2 (33.3%)           | 9 (69.2%)           | 4 (33.3%)          |
| Post-pandemic muscle relaxant and dose | 7 (100%) | 6 (100%)            | 13 (100%)           | 10 (83.3%)         |
| Post-pandemic mask ventilation form and duration | 6 (85.7%) | 6 (100%)            | 12 (92.3%)          | 11 (91.7%)         |
| Post-pandemic intubation      | 7 (100%)            | 6 (100%)            | 13 (100%)           | 11 (91.7%)         |

PrePS: pre pandemic seniors; PrePN: pre pandemic novice; PreP: pre pandemic; PostP: post pandemic

The first attempt duration with the Macintosh blade, was different between all groups. PrePS had shorter durations measured. The shortest times recorded for intubation completed with video laryngoscope was also for the PrePS group, though significant differences were not identified. There were no significant differences identified for first attempt duration with the Miller blade (p>0.05) (Table 3, Table 4).

For the McCoy blade, there were significant differences for the first attempt duration between the PreP and PostP groups (p<0.05) (Table 3, Table 4).

While there were no significant differences between the PrePN and PostP groups in terms of Macintosh first attempt duration, McCoy first attempt duration and McCoy total attempt durations (p>0.05), the PrePS residents showed significantly shorter duration in comparison to PostP (p<0.05). There were no significant differences between PrePS and PrePN for the same parameters (p>0.05). The PostP group could perform endotracheal intubation as fast as the PreP groups with video laryngoscope (Table 3, Table 4).

Significant differences were not determined between the groups for attempt numbers and airway maneuvers (p>0.05) (Table 3, Table 4).

When Visual Analog Scale values (VAS) used to assess the difficulty in use of laryngoscope blades by residents are examined, all groups found the use of the video laryngoscope as easiest. The PreP groups found the use of the Miller blade most difficult, while the Macintosh blade was the most difficult for the PostP. The PrePS group found the use of the Macintosh blade easy. There were no significant differences between the PrePS and PrePN groups in terms of assessment of the difficulty of use of Macintosh and McCoy blades (p>0.05) (Table 4).
Table 3. Intubation durations in seconds and intubation attempt numbers with various laryngoscopes. The values are presented as median±SD and mean (min-max).

| GROUPS          | PrePS (n=7)       | PrePN (n=6)       | PreP (n=13)      | PostP (n=12)     |
|-----------------|-------------------|-------------------|------------------|------------------|
|                 | Intubation duration (first attempt) |                   |                  |                  |
| Macintosh       | 33.83±10.00       | 54.71±24.10       | 43.47±20.24      | 64.10±27.78      |
|                 | 27.02 (24.95-48.09) | 51.61 (30.84-41)  | 42.00 (24.95-84.41) | 58.84 (31.18-120.00) |
| Video laryngoscope | 27.47±9.29       | 35.53±9.70        | 31.19±9.99       | 46.71±27.54      |
|                 | 27.54 (15.66-37.85) | 33.28 (27.32-52.32) | 28.33 (15.66-52.32) | 39.86 (20.00-198.10) |
| Miller          | 30.36±10.39       | 33.22±6.08        | 31.68±8.46       | 41.22±12.36      |
|                 | 25.18 (19.81-49.63) | 35.74 (23.58-38.74) | 34.18 (19.81-49.63) | 39.17 (22.98-57.88) |
| McCoy           | 29.68±13.63       | 33.98±8.10        | 31.67±11.19      | 42.30±11.05      |
|                 | 25.39 (18.79-58.82) | 35.79 (21.92-42.21) | 27.81 (18.79-58.82) | 39.83 (26.60-60.02) |
|                 | Intubation duration (total duration) |                   |                  |                  |
| Macintosh       | 54.44±37.86       | 75.62±39.80       | 64.21±38.70      | 97.38±65.03      |
|                 | 27.02 (24.95-118.15) | 70.57 (30.76-137.64) | 61.22 (24.95-137.64) | 68.69 (34.30-240.00) |
| Video laryngoscope | 27.47±9.29       | 35.53±9.70        | 31.19±9.99       | 56.78±49.03      |
|                 | 27.54 (15.66-37.85) | 33.28 (27.32-52.32) | 28.33 (15.66-52.32) | 39.86 (20.00-198.10) |
| Miller          | 37.21±23.03       | 39.22±17.75       | 38.14±19.94      | 57.75±30.76      |
|                 | 25.18 (19.81-84.20) | 35.74 (23.58-73.55) | 34.18 (19.81-84.20) | 55.24 (22.98-137.55) |
| McCoy           | 29.68±13.63       | 33.98±8.10        | 31.67±11.19      | 57.61±39.83      |
|                 | 25.39 (18.79-58.82) | 35.79 (21.92-42.21) | 27.81 (18.79-58.82) | 43.41 (26.60-169.78) |
|                 | Number of attempts |                   |                  |                  |
| Macintosh       | 1.42±0.53         | 1.50±0.83         | 1.46±0.66        | 1.58±0.90        |
|                 | 1 (1-2)           | 1 (1-3)           | 1 (1-3)          | 1 (1-3)          |
| Video laryngoscope | 1               | 1                 | 1                 | 1.16±0.38       |
|                 | 1 (1-1)           | 1 (1-1)           | 1 (1-1)          | 1 (1-2)          |
| Miller          | 1.14±0.37         | 1.16±0.40         | 1.15±0.37        | 1.50±0.79        |
|                 | 1 (1-2)           | 1 (1-2)           | 1 (1-2)          | 1 (1-3)          |
| McCoy           | 1                 | 1                 | 1                 | 1.25±0.62       |
|                 | 1 (1-1)           | 1 (1-1)           | 1 (1-1)          | 1 (1-3)          |
|                 | Number of airway maneuvers |          |                  |                  |
| Macintosh       | 0.57±0.78         | 1.00±0.63         | 0.76±0.72        | 1.16±0.71        |
|                 | 0 (0-2)           | 1 (0-2)           | 1 (0-2)          | 1 (0-2)          |
| Video laryngoscope | 0.14±0.37        | 0.33±0.51         | 0.23±0.43        | 0.50±0.67        |
|                 | 0 (0-1)           | 0 (0-1)           | 0 (0-1)          | 0 (0-2)          |
| Miller          | 0.28±0.48         | 0.50±0.54         | 0.38±0.50        | 0.58±0.66        |
|                 | 0 (0-1)           | 0 (0-1)           | 0 (0-1)          | 0.50 (0-2)       |
| McCoy           | 0.57±0.53         | 0.66±0.51         | 0.61±0.50        | 0.91±0.66        |
|                 | 1 (0-1)           | 1 (0-1)           | 1 (0-1)          | 1 (0-2)          |

PrePS: pre pandemic seniors; PrePN: pre pandemic novice; PreP: pre pandemic; PostP: post pandemic.
Table 4. Intubation success rates with various laryngoscopes and Visual Analog Scale evaluation of residents included in the study.

| Group          | PrePS (n=7) | PrePN (n=6) | PreP (n=13) | PostP (n=12) |
|----------------|-------------|-------------|-------------|--------------|
| Intubation success rate n (%) |             |             |             |              |
| Macintosh      | 7 (100%)    | 6 (100%)    | 13 (100%)   | 10 (83.3%)   |
| Video laryngoscope | 7 (100%)    | 6 (100%)    | 13 (100%)   | 12 (100%)    |
| Miller         | 7 (100%)    | 6 (100%)    | 13 (100%)   | 11 (91.7%)   |
| McCoy          | 7 (100%)    | 6 (100%)    | 13 (100%)   | 11 (91.7%)   |
| Visual Analog Scale median±SD mean (min-max) |             |             |             |              |
| Macintosh      | 3.00±1.15   | 4.16±1.60   | 3.53±1.45   | 5.25±1.95    |
|                | 3 (2-5)     | 5 (1-5)     | 4 (1-5)     | 6 (2-8)      |
| Video laryngoscope | 2.00±1.73   | 2.50±1.64   | 2.23±1.64   | 3.00±2.37    |
|                | 1 (1-5)     | 2 (1-5)     | 1 (1-5)     | 2 (1-8)      |
| Miller         | 4.14±2.67   | 4.83±2.40   | 4.46±2.47   | 4.91±2.10    |
|                | 4 (1-8)     | 5 (2-9)     | 5 (1-9)     | 5 (1-8)      |
| McCoy          | 2.42±0.53   | 3.83±1.83   | 3.07±1.44   | 4.66±1.96    |
|                | 2 (2-3)     | 4 (1-6)     | 3 (1-6)     | 4.5 (2-9)    |

PrePS: pre pandemic seniors; PrePN: pre pandemic novice; PreP: pre pandemic; PostP: post pandemic

When the groups were compared in terms of maneuvers/intubation success, there was no significant difference for intubation with the Macintosh blade, though 16.7% of the PostP group could not perform intubation with this blade. Although no statistically significant differences could be detected between the groups, possibly due to the low number of participants, the difference in the percentage rates observed in our study are clinically important (Table 4).

DISCUSSION

This study was performed with the aim of evaluating the effects of the COVID-19 pandemic on airway management training, skills and knowledge of anesthesiology and reanimation residents and included participants beginning residency in different periods before and after the pandemic. The target was to compare anesthesia induction and basic airway knowledge levels based on intubation success rates and duration, performed with different laryngoscopes and blades using a Trucorp AirSim Combo Bronchi X intubation mannequin. It was determined that 16.3% of participants beginning residency after the pandemic failed at intubation with direct laryngoscopy using a Macintosh blade. In addition, significant differences were determined for first attempt intubation durations between all groups.

Dedeilia et al. screened 1288 publications from the MEDLINE and EMBASE databases on 18 April 2020. They stated that during the COVID pandemic, the inadequacies in PPE, stopping of clinical observations and reporting, and cessation of elective surgeries affected medical and surgical training. Approaches like virtual learning, video conferences, social media and telemedicine may be a solution to the sudden pause in medical education, but they emphasized the need to protect the mental health of students and include them in clinical treatment of COVID-19 (6).

Training in surgical clinics normally involves residents gaining some experience by creating senior-
novice relationships, acquiring a variety of habits with serious hand skills and routine practice in operating rooms apart from theory, and frequently communicating and using practical information with patients. The pandemic has influenced medical education in surgical specialities more than in other medical areas. (7, 8). Due to lack of feedback or warnings at points requiring attention when completing the sequential stages of anesthesia induction especially, PostP couldn’t gain habits related to what they should pay attention to in relation to this topic or couldn’t pay attention to the steps in the sequence.

Gwad et al. restructured the education program for residents during the pandemic in a surgery clinic. They created “on and off” weeks, creating a healthy population against unknown exposure. Teams were created to preserve physical distance and prevent contact between residents with the pathogen. Oncology cases were assessed by senior teaching staff. Non-oncology cases were postponed. A small ‘brain’ team adapted, which directed and monitored these changes and adaptations, was the key to problem-free fast transition between planning and implementation of broad changes (9).

Studies stated that elective surgeries linked to the most benign diseases were affected during the COVID pandemic and again these cases were stated to have operations performed by residents without a senior partner, contrary to cases with life-threatening diseases where senior staff or lecturers performed operations (10). The entry of only necessary personnel into operating rooms affected this process (11, 12). Due to inadequacy of personal protective equipment, participation, observation and assisting chances reduced for residents (13). In terms of reducing the operation duration and COVID-19 risk, senior staff performed simple surgical procedures. Additionally, all conferences, congresses and symposia stopped (14). Ward visits were completed only by necessary personnel (13). Case discussions and department meetings were stopped due to social distancing (10, 14, 15).

The COVID-19 pandemic caused a clear reduction in the clinical volume for anesthesia (65-80%) (16). Another study found that, instead of meetings where residents learned interventional skills about epidural and obstetric difficult airway intervention in the clinical field with a mannequin, webcast lessons were given; however, it was emphasized that the desired success could not be obtained. To solve this problem, a pilot application was trialed teaching accurate decision-making at crucial points in a difficult airway scenario with virtual reality (17, 18). A study emphasized the need to disinfect virtual reality sets after every use (19).

In our new operating room arrangement due to COVID-19 pandemic, only emergency surgery was performed and patients were assumed as COVID-19 positive. In that period, only one experienced anesthesiologist and one anesthesia technician wearing all PPE was present in the operating room from beginning to end. Serious adaptation problems were experienced with ventilation in operating rooms, transport of patients, anesthesia induction with high transmission risk, endotracheal intubation and extubation to prevent transmission of the virus. People employed in the clinic were placed in teams to work in shifts in an attempt to reduce exposure. These conditions were an excess burden for clinicians at all levels in branches on the frontlines, especially for anesthesiology and reanimation. Only senior residents and specialists attended ‘high risk patients’ in the intraoperative period to reduce the number of “anesthesia staff” in the operating room (20).

In our department, twelve PostP residents began clinical education at the time when training and practical implementations in clinics changed all around the world. Thirteen residents (PreP) who began a few months or less than a year before March 2020 had information about “what’s going on in the operating room?” and participated in theoretical education in the period before the pandemic.

If we need to think in more detail in identifying the problems, the pandemic had different effects on the education of senior and novice residents in every clinic. From this aspect, we first decided to compare the PrePN group beginning immediately before the pandemic with the PostP group. The PrePN had mean working duration of 4.33±2.73 months, median 5 (1-7), before the pandemic. However, with no differences in some parameters compared between the two groups, we included the PrePS
group in the study. There were significant differences between the PrePN and PostP for DL and VL numbers. Among these three groups, pandemic precautions continued for PrePN and PostP groups from 11 March 2020 to 1 June 2020 and similarly, they could not attend cases. Though PrePN had performed intubation with video laryngoscope and other blades for a short time period before the pandemic, they could not receive sufficient feedback from senior staff and returned to preoperative patient assessment stage of residency program instead of attending cases due to the reasons explained above. After June 2020, the three groups began to perform endotracheal intubation with video laryngoscope and rapid serial anesthesia induction. The video laryngoscope was named without problems in all groups.

In our study, all residents beginning education after the pandemic appeared to have low practice numbers for both DL and VL. This group very successfully identified and named the video laryngoscope, but experienced problems in identifying and naming direct laryngoscopes. As for Macintosh blade, although statistically insignificant, the 16.7% rate of failure for intubation in the PostP group was notable. We think these findings are due to the effects of the pandemic on resident training.

When the VAS values of residents to assess the difficulty in using the laryngoscope blades are examined, all groups found video laryngoscope use easiest. Video laryngoscopes ensure high quality visualization of the glottis without requiring alignment of the oral, pharyngeal and tracheal axes (17). While images are provided easily, skill is only required when advancing the tracheal tube as the axes do not require alignment. When using the Macintosh blade with DL, insertion of a stylet in the endotracheal tube is not required for every endotracheal intubation, using a video laryngoscope is definitely required for ease of orientation and to reduce attempt numbers. We used a stylet for all intubation interventions as the mannequin used for trials was standard and the hard material of the mannequin is different from a normal patient. Not all groups experienced problems using this technique as they had performed intubations of patients with video laryngoscope in the pandemic period before. However, the PostP group assessed the use of direct laryngoscopy with Macintosh blade as ‘difficult’. We think this assessment is due to not knowing the technical requirements for use of this laryngoscope and the effect of not having adequate experience of the technical details like positioning the patient’s head to provide vocal cord and epiglottis visualization, the need for placing the patient’s head at the anesthesiologist’s xyphoid level and aligning the airway axis on a single line.

There is a range of limitations to our study. Learning airway management in practical workshops using cadavers has more advantages compared to practicing on patients (21). In this type of training, oral and nasal airways, laryngeal mask airway insertion, endotracheal intubation, needle and surgical cricothyrotomy may be performed. Additionally, mannequins and cadavers are definitely different to real patients and involve limitations in the learning process (17). Though high accuracy simulators may mimic many features encountered in clinical practice, it should not be forgotten that they involve limitations compared to clinical experience, compared to real patients (22). Additionally, due to limited clinical opportunities, a realistic and accessible environment is provided to gain skills (21). We predicted that residents, who were not used to this mannequin simulation, would score different times in intubation durations and attempt numbers compared to real patients. In addition, residents’ requesting airway maneuvers were thought to be different while working on mannequin.

Literature review for comparisons did not reveal any studies with data about or measuring the intubation skills specifically of residents beginning specialization training in anesthesiology for a similar duration beforehand (3–4 months). Due to the precautions taken for this extraordinary process and global changes in approaches to patients, it was impossible to create a control group receiving normal education. In this situation, we reached important results by comparing with a group who started residency a short time before the pandemic. Here, another aim was to create a control group with historical importance to compare with similar groups receiving normal education for the same duration after the pandemic and to provide data, which can be used to objectively compare the effects of the pandemic in the future.
In conclusion, especially, changes in anesthesia induction due to the pandemic will require special attention to the topic of airway management in the future for residents beginning education after the pandemic. As it is predicted that the effect of COVID-19 will be extended for clinical education especially, it is a condition to provide alternative educational systems for residents. In addition to the negative effects of the pandemic, it led to changes in education and revitalization of educational innovations. Thus, after this urgency and danger has passed, it may leave a legacy for medical education. The long-term effects of the pandemic on education and training of residents and medical faculty students is unknown and there will be a need for retrospective and prospective studies dealing with this topic in the future.

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