Difficult Intubation in the Adult Patients Undergoing Oropharygolaryngeal, Neck, and Maxillofacial Procedures: Thai Anesthesia Incident Monitoring Study (Thai AIMS)

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Background: *Difficult intubation is one of the common anesthetic related complications during the perioperative period. In the patients with pathology or disease involving the oropharyngolarynx, neck, or maxillo-facial region, they might have a potentially higher risk than the general population.*
Objective: *To determine the characteristics and the contributing factors of difficult intubation in the adult patients undergoing oropharyngolaryngeal, neck, and maxillofacial procedures, and the factors minimizing this incidence and the suggested corrective strategies.*
Material and Method: *All incident reports of difficult intubation in the adult patients who received general anesthesia for the procedure involving the oropharyngolarynx, neck, and maxillofacial region from the Thai Anesthesia Incident Monitoring Study (Thai AIMS) database were identified. The details of the reports, the contributing factors, the factors those minimizing the incident, and the suggestive corrective strategies were studied.*
Results: *There were 26 (1.3%) incident reports of difficult intubation from the database. This occurred in 35%, 58%, and 15% of the patients with Mallampati class 1-2, thyromental distance equal or more than 5 cm or 3 fingerbreadths, and combined both parameters, respectively. Forty two percent of cases were judged as an unplanned difficult intubation. Twenty-seven, 23, and 19 percent of the patients had tumor or carcinoma at the oropharyngolarynx, deep neck infection, and maxillofacial fracture, respectively. Nearly half of the adverse events accompanied with difficult intubation were desaturation. No immediate fatally and late outcome was reported. Patients' disease/anatomy was the major contributing factor that might relate to the incidence. Previous experience, experienced assistance, and high vigilance were the factors minimizing incidence. Suggestive corrective strategies were guideline practices, additional training, and improved supervision.*
Conclusion: *Carefully preoperative airway assessment and additional attention focused on the pathology or disease were the principle tasks. Algorithms for both anticipated and unanticipated difficult airway as well as alternative airway equipments should be implemented.*

Keywords: *Difficult intubation, Oropharyngeal, Neck, Maxillofacial procedure, Thai AIMS*

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Despite improvement in our clinical practices, difficult intubation has remained one of the common causes of anesthetic related morbidity and mortality during the perioperative period[1]. Nowadays, there is no such bedside screening tests whish could accurately predict the difficulty with endotracheal intubation[2-6]. Careful preoperative history taking and thoroughly airway assessment using a combination of the individual tests have remained the standard tools for prediction of this critical event, even though they might have limitation. In the general population, this occurrence was estimated to be 0.2-8.5%[2,3,7,8]. However,

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in some patient populations such as the obese patients, this prevalence might be as high as 15.8%[2].

In the patients with pathology or disease involving the oropharyngolarynx, neck, or maxillo-facial region, they also had a high-risk for potential difficult intubation as the result of distortion of anatomy, impossibility to visualize the glottis, and others[9]. However, few literatures focused on this population. Therefore, the objectives of this present study were to determine (1) the characteristics and the contributing factors of difficult intubation in the adult patients receiving general anesthesia with endotracheal intubation for the oropharygolaryngeal, neck and maxillofacial procedures and (2) the factors minimizing this incidence and the suggested corrective strategies.

Material and Method

This prospective descriptive multi-centered study was a part of the Thai Anesthesia Incident Monitoring Study (Thai AIMS), which was conducted by the Royal College of Anesthesiologists of Thailand from January to June 2007[10]. After being approved by each institutional ethical committee, the anesthesiologists and nurse-anesthetists from the fifty-one hospitals ranging from primary to tertiary ones were asked to report the adverse events detected during the perioperative periods. The patient's, anesthetic and surgical profiles, as well as the contributing factors and the narrative of the incidents were recorded.

In the present study, the authors identified and selected all incident reports of difficult intubation in the adult patients who received general anesthesia requiring endotracheal intubation for the procedure involving the oropharygolarynx, neck and maxillofacial region, both elective and emergency cases. The definition of *'difficult intubation'* in the present study was the difficulty in endotracheal intubation by the conventional laryngoscopy and required at least three times or more than ten minutes for intubation by well-trained anesthetic personnel (*e.g.* anesthesiologists, nurse-anesthetists, or interns/residents with more than two years of anesthetic experience). The demographic data, Mallampati score, thyromental distance, and laryngoscopic view were recorded. The described details of all the reports, the adverse events and the outcome following difficult intubation were reviewed. The contributing factors, the factors those minimizing the incident and the suggestive corrective strategies were also determined. The descriptive statistics were used to analyze the data, using SPSS software for window version 11.5, and demonstrated in number and percentage.

Results

There were twenty-six incident reports of difficult intubation in the adult patients undergoing the oropharygolaryngeal, neck and maxillofacial procedures that required general anesthesia with endotracheal intubation from the database of 1996 incident reports of the Thai AIMS[1]. The characteristics of these patients are shown in Table 1. The mean patients' age was 47 years (range 17-80 years) and males had more incidence than females (17 versus 9). The mean patients' body weight, height and body mass index were 60.10 kg, 162.61 cm and 22.97, respectively (range 38-103 kg, 145-180 cm and 14.84-31.79, respectively). Most of the patients had the American Society of Anesthesiologists Physical Status of I-II (76.92%) and underwent an elective surgery (69.23%).

As shown in Table 2, difficult intubation occurred in 34.62% and 57.69% of the patients with the Mallampati class 1-2 and the thyromental distance equal or more than 5 cm or 3 fingerbreadths, respectively. When combining these two parameters, the incidence was 15.38%. About one quarter of all patients had tumor or carcinoma at the oropharyngolarynx, another quarter had deep neck infection, and one-fifth had maxillofacial fracture. Sixteen patients (61.54%) had the laryngoscopic view of grade 3-4. Eleven cases

Table 1. The characteristics of the patients

	No. of reports (n = 26)
Age (year)	47 (17-80)*
Sex	
Female	9 (34.62%)
Male	17 (65.38%)
Body Weight (kg)	60.10 (38-103)*
Height (cm)	162.61 (145-180)*
Body Mass Index	22.97 (14.84-31.79)*
ASA physical status	
I	4 (15.38%)
II	16 (61.54%)
III	6 (23.08%)
IV	0 (0.00%)
Elective Case	18 (69.23%)
Emergency Case	8 (30.77%)

* Represent as mean (range)

Table 2. The airway assessments and diagnosis

	No. of reports (n = 26)
Mallampati Classification	
Cannot be evaluated	6 (23.08%)
1-2	9 (34.62%)
3-4	9 (34.62%)
Not evaluated	2 (7.68%)
Thyromental distance (TMD)	
<5 cm or <3 finger breadth	8 (30.77%)
≥ 5 cm or ≥ 3 finger breadth	15 (57.69%)
Not evaluated	3 (11.54%)
Combined Mallampati score 1-2 and TMD ≥ 5 cm or ≥ 3 finger breadth	4 (15.38%)
Laryngoscopic view	
1-2	8 (30.77%)
3-4	16 (61.54%)
Not evaluated	2 (7.695)
Planed/expected difficult intubation	
Yes	15 (57.69%)
No	11 (42.31%)
Diagnosis	
Tumor/carcinoma at the orophayngolarynx	7 (26.92%)
Deep neck infection	6 (23.08%)
Maxillofacial fracture	5 (19.23%)
Thyroid diseases	2 (7.69%)
Other	6 (23.08%)

Table 3. The adverse events accompanying difficult intubation

Adverse events	No. of reports (n = 15)
Desaturation	7 (46.67%)
Failed intubation	2 (13.33%)
Esophageal intubation	2 (13.33%)
Dental injuries	2 (13.33%)
Cannot ventilate	1 (6.67%)
Cancelling the procedure	1 (6.67%)

Table 4. The outcome after difficult intubation

Immediate outcome (within 24 hr) (n = 26)	
Cancellation of the procedure	1 (3.85%)
Unplanned ICU admission	1 (3.85%)
Complete recovery	14 (53.85%)
None	10 (38.46%)
Late outcome (within 7 days) (n = 26)	
Complete recovery	5 (19.23%)
None	21 (80.77%)

(42.31%) were judged as an unplanned or unexpected difficult intubation.

Among 15 patients with planned or expected difficult intubation, the endotracheal intubation technique used was conventional laryngoscopy in nine cases and was successful in five cases. The remainders were achieved with awake fiberoptic intubation. Awake direct laryngoscopy technique was used in three cases and was successful in one case. In the other two cases, one was intubated by awake fiberoptic intubation and the other one had to undergo tracheostomy under local anesthesia. Awake fiberoptic intubation was used in the other three patients and was successful in one case. The remainders were achieved by direct laryngoscopy with the stylet-guided technique.

Eleven patients with unplanned or unexpected difficult intubation after conventional laryngoscopy. Most of these were successfully intubated by alternating more experienced personnel, reducing the size of the endotracheal tube, using stylet-guided technique, using McCoy laryngoscopic blade, repositioning, and cricoids pressure maneuver. There was one patient with tonsillar carcinoma whose intubation was successful by switching to blind nasal technique and another one with adenocystic carcinoma at sublingual gland whose subsequently successful intubation was achieved with awake fiberoptic technique.

Nearly half of adverse events accompanied with difficult intubation was desaturation (defined as SpO_2 less than 85% or less than 90% for more than 3 minutes) (Table 3). The other serious one was that 'cannot ventilate', which was reported in one patient (6.67%). Two cases who failed to intubate, one had to undergo tracheostomy and with the other the procedure was cancelled. Other adverse events reported were esophageal intubation and dental injuries, which occurred in two (13.33%) and two (13.33%) cases, respectively. One patient had unplanned ICU admission, which was the surgeon's request. All of the patients had no fatal immediate and long-term outcome (Table 4).

The patients' disease and anatomy were the majority of the contributing factors that might relate to difficult intubation, which accounted for 42% of the reports (Table 5). Poor preoperative evaluation, inexperience, inappropriate decision, emergency, lack of the equipments, communication failure, and fatigue from long working hours were other common contributing factors, respectively. As shown in

Table 5. The contributing factors those might relate to difficult intubation

Contributing factors	No. of reports (n = 50)
Patients' diseases/anatomy	21 (42.00%)
Poor preoperative evaluation	9 (18.00%)
Inexperience	7 (14.00%)
Inappropriate decision	5 (10.00%)
Emergency	3 (6.00%)
Lack of the equipments	2 (4.00%)
Communication failure	2 (4.00%)
Fatigue from long working	1 (2.00%)

Table 6. The factors minimizing incidence and the suggestive corrective strategies

	No. of reports (n = 45)
Factors minimizing incident	
Previous experience	15 (33.33%)
Experienced assistance	12 (26.67%)
High vigilance	9 (20.00%)
Adequate equipments	5 (11.11%)
Following practice guideline	3 (6.67%)
Consultation	1 (2.22%)
Suggested cpractices	9 (20.00%)
Additional training	9 (20.00%)
Improved supervision	9 (20.00%)
More equipments	7 (15.56%)
Quality assurance activity	5 (11.11%)
Improved communication	3 (6.67%)
More manpower	3 (6.67%)

Table 6, previous experience, experienced assistance, high vigilance, and adequate equipments were reported as the major factors that minimized the incidence. The important suggested corrective strategies were the guideline practices, the additional training, improved supervision, and more equipment.

Discussion

From this present study, difficult intubation in the adult patients undergoing oropharyngo-laryngeal, neck and maxillofacial procedures were accounted for 1.3% of all the incident reports from the Thai AIMS. It should be realized that this was not actually calculated from the all operative cases but from the reported adverse incidences. In general, the incidence of difficult intubation was estimated to be 0.2-8.5%[2,3,7,8]. This wide variation may be according to no standard definition of difficult intubation[4,5]. The authors definition was following the original practice guidelines for management of the difficult airway by the American Society of Anesthesiologists Task Force[11]. The latest one defined difficult intubation as when 'tracheal intubation required multiple attempts in the presence or absence of tracheal pathology' and difficult laryngoscopy as when 'it was not possible to visualize any portion of the vocal cords after multiple attempts at conventional laryngoscopy[12]'. Alternatively, difficult intubation might be defined as the Cormack and Lehane equal or more than grade 3[6,8,9,13,14], the requirement to use a device other than a conventional laryngoscope[15], or high intubation difficulty scale score[16,17].

As stated in several strategies and guidelines for management of the difficult airway[4,12,18-20] careful preoperative evaluation of the airway including history and physical examination was essential for prediction of the potentially difficult endotracheal intubation. Although the bedside screening tests such as the Mallampati score, the anatomical distance (*e.g.* thyromental or interincisive distance), the neck movement, or the mouth opening yielded moderate sensitivity and specificity when used alone[2-6]. Toshiya et al[2] found that the combination of the Mallampati score and thyromental distance might be the most accurately predicted difficult intubation in apparently normal patients. In the present study, the authors found that one third and more than half of difficult intubation occurred in the patients with the Mallampati class 1-2 and the thyromental distance equal or more than 5 cm or 3 fingerbreadths, respectively. When combining both of these parameters, only 15% of difficult intubation was encountered. These findings emphasized the importance of the thorough preoperative airway assessment for prediction of difficulty with endotracheal intubation, even though they might have some limitation.

Interestingly, the outstanding contributing factor that might relate to difficult intubation reported in the present study (Table 5) was the patients' diseases/anatomy, which accounted for 42%. When categorized according to the diagnosis, one fourth of the presented patients had tumor or carcinoma involving the oropharyngolarynx. Arne et al[15] reported 12.3% of an incidence of difficult intubation in the patients undergoing ENT cancer surgery. As high as 60% of the incidence was reported in the pharyngolaryngeal neoplastic patients by Ayuso et al[9]. This variation might be caused by the heterogeneity of the definition.

General predictive risk factors of difficult intubation such as Mallapati score, thyromental distance, neck movement or mouth opening, however, might have low reliability in this subgroup of patients[9]. Location of the pathology that was at supraglottic region or base of the tongue and clinical symptoms such as dyspnea, dysphagia, or dysphonia were considered as the independent risk factors[9,13,15].

In the patients with deep neck infection, which involved one fourth of the presented population, securing of the airway was mandated especially in the advanced cases but it was also a challenging task. Tissue edema, distortion of the airway anatomy, limited mouth opening and intolerance to stay supine due to compromised airway; all made the endotracheal intubation technically more difficult. Moreover, loss of airway after induction or rupture of the abscess and aspiration of the pus might be complicated while attempting intubation. Although tracheostomy using local anesthetics had been considered the gold standard of airway management, it might not be easy in these patients. Andranik et al[21] suggested the awake fiberoptic intubation as the first choice for the airway management in these patients, which in the experienced hand, yielded a high success rate without major complications.

About 20% of the presented patients with difficult intubation had maxillofacial fractures, which needed surgical fixation. These patients had potentially obstructed airway caused by hemorrhage, soft tissue edema, hematoma formation, or even anatomy distortion. Emergency endotraceal intubation for securing the airway in this situation might be difficult. Furthermore, other associated injuries such as cervical spine or head injuries and a full stomach might cause more intubation trouble[22,23]. Although some patients might undergo an elective surgical correction, which required general anesthesia, preoperative airway assessment might not be accurate in the presence of disrupted anatomy, muscle spasm, or tissue edema. Anticipation and preparation for possibly difficult intubation was suggested in all cases. Well-planned airway management with the surgeons was crucial.

The occurrence of difficult intubation in the patients scheduled for thyroid surgery was 5.3-11.1%[24,25], compared with 7.69% of the authors' incident reports. The presence of cancerous goiter was found to be a potential risk factor[24]. Nonetheless, Amathieu et al[25] pointed out that the thyroid-related risk factors such as palpable goiter, airway deformity, or compressive symptoms did not increase the risk of difficult intubation but the classical preoperative airway assessment was significantly reliable predicted one.

Besides the patients' factors, poor pre-operative evaluation, inexperience, inappropriate decision, emergency, lack of equipment, communication failure, and fatigue from long working hourswere all reported as the anesthetic contributing factors that might relate to difficult intubation. As discussed earlier, carefully pre-operative airway assessment was essential and should be conducted in every patients requiring anesthesia. In addition, special attention might be required for the disease or pathology that might influence the difficulty with intubation. In case of expected or planned difficult intubation, communication with the patient and all team personnel about the primary and back-up plans for airway management as well as preparation of difficult airway equipments and additional experienced personnel were the key to success. Moreover, supplement oxygenation throughout this period was mandatgry[4,12,18,19]. Awake intubation or general anesthesia with maintenance of spontaneous breathing was considered as the airway technique of choice in these patients[18]. In this present study, conventional laryngoscopy, awake direct laryngoscopy, and awake fiberoptic intubation were used as primary airway techniques in nine, three and three patients with expected difficult intubation, respectively. The decision might depend on the individual preference and experience. Adrin[4] suggested that direct laryngoscopy could be attempted carefully and if it was difficult, early abandoned and turned to the back-up plan.

As shown in Table 2, 42.31% of the incidence was judged as an unplanned or unexpected situation. In this case, one should distinguish whether difficult mask ventilation, difficult intubation, or both. Call for help and maintain the patient's oxygenation was the main principle task[3,18]. If difficult intubation was encountered, guidelines[12,18] suggested limited intubation attempts, using alternative approaches (such as laryngeal mask airway; light stylet, gum elastic introducer, backward, upward and right lateral displacement of the thyroid cartilage or BURP maneuver, fiberoptic intubation), and awakening the patient. Our successful techniques reported in this circumstance were alternating more experienced personnel, reducing the size of the endotracheal tube, using stylet-guided technique, using McCoy laryngoscopic blade, repositioning, and cricoids pressure maneuver.

The important consideration was that each institute should have their algorithms for both anticipated and unanticipated difficult airway management, which were clearly available and as simple to follow as possible. Anesthetic providers should be familiar with their own difficult airway cart. Regular use in the elective case might be considered. This might be more important than having many types of airway equipment.

The sequelae of difficult intubation ranged from the non-fatal physiologic changes such as desaturation, broncho-laryngospasm, aspiration pneumonitis, cardiac arrhythmias, awareness or even dental damage, to brain death or death[26,27]. The data from the American Society of Anesthesiologists Closed Claim database[26] found that repeated attempts of intubation might increase both respiratory and hemodynamic complications and affect the patient outcome. Moreover, in case of airway emergency that was when could not ventilate and could not intubate, brain death and death rate were significantly raised. So they recommended limiting just only three times for conventional intubation attempts before changing to other strategies in case of failed intubation. Fortunately, there was no seriously immediate and long-term outcome in this present study. The most common adverse events accompanying the difficult intubation that reported were desaturation, esophageal intubation, and dental injuries, respectively, which was similar to the finding by Paix et al[27]. Two cases of esophageal intubation could be early detected. The capnograph was monitored in both; however, one had desaturation as measured by pulse oximeter. The special concern was the report of 'cannot ventilate' in one patient. She had carcinoma of the buccal mucosa and was scheduled for debridement. No preoperative airway assessment was documented. After intravenous induction, she was unable to be ventilated and endotracheal intubation was unexpectedly difficult but was subsequently successful achieved after the third attempt. Emergency tracheostomy was performed in one patient who had a large multinodular goiter with tracheal deviation and obesity (BMI 32.4). Six attempts of intubation were tried but were not successful. So emergency tracheostomy was then performed by the ENT surgeon and there was no subsequently major complication.

Conclusion

The incidence of difficult intubation in the patients undergoing oropharygolaryngeal, neck, and maxillofacial procedures was 1.3%. The adverse events accompanying this occurrence were only minor physiologic changes. There was no immediate and late fatal outcome in the present study. Although carefully preoperative airway assessment for predicting this critical event might have some limitation in accuracy, it remained the most important task. Additional attention should focus on their pathology or disease. Both anticipated and unanticipated difficult airway algorithms should be implemented and all anesthetic personnel should get used to these as well as alternative airway equipment.

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ภาวะแทรกซ้อนการสอดท่อช่วยหายใจลำบากในผู้ป่วยผู้ใหญ่ที่มารับการผ่าตัดบริเวณช่องปากและกล่องเสียง, บริเวณลำคอ, และบริเวณใบหน้าภายใต้การให้การระงับความรู้สึก: การศึกษาแบบสหสถาบันของภาวะแทรกซ้อนทางวิสัญญีในประเทศไทยโดยการรายงานอุบัติการณ์

อรรณพ พิริยะแพทย์สม, ธารทิพย์ ประณุทนรพาล, เกศชาดา เอื้อไพโรจน์กิจ, ยอดยิ่ง ปัญจสวัสดิ์วงศ์, ศิริลักษณ์ ชำนาญเวช, สุรศักดิ์ ถนัดศีลธรรม

ภูมิหลัง: *การสอดท่อช่วยหายใจลำบากเป็นหนึ่งในภาวะแทรกซ้อนทางวิสัญญี ที่พบได้บ่อยในระหว่างการให้การระงับความรู้สึก ในผู้ป่วยที่มีพยาธิสภาพ หรือ โรคที่เกี่ยวข้องกับบริเวณช่องปากและกล่องเสียง, บริเวณลำคอ, หรือบริเวณใบหน้า จะมีความเสี่ยงมากกว่ากลุ่มผู้ป่วยทั่วไป*

วัตถุประสงค์: *เพื่อศึกษาลักษณะและปัจจัยที่เกี่ยวข้องกับการสอดท่อช่วยหายใจลำบากในผู้ป่วยผู้ใหญ่ ที่มารับการผ่าตัดบริเวณช่องปากและกล่องเสียง, บริเวณลำคอ, และบริเวณใบหน้ารวมถึงปัจจัยที่ช่วยลดอุบัติการณ์และยุทธวิธีแก้ไขอุบัติการณ์ที่แนะนำ*

วัสดุและวิธีการ: *รายงานอุบัติการณ์ที่เกี่ยวข้องกับการสอดท่อหายใจลำบากในผู้ป่วยผู้ใหญ่ ที่มารับการผ่าตัดบริเวณช่องปากและกล่องเสียง, บริเวณลำคอ, และบริเวณใบหน้า จะได้รับการศึกษาข้อมูลเกี่ยวกับรายงานอุบัติการณ์, ปัจจัยที่เกี่ยวข้อง, ปัจจัยที่ช่วยลดอุบัติการณ์ และกลยุทธ์สำหรับแก้ไขอุบัติการณ์จะถูกนำมาวิเคราะห์*

ผลการศึกษา: *มีรายงานอุบัติการณ์การสอดท่อหายใจลำบากมีจำนวน 26 (1.3%) รายจากฐานข้อมูล 35%, 58% และ 15% ของผู้ป่วยมี Mallampati class 1-2, ระยะระหว่างกระดูกไทรอยด์ถึงคางมากกว่าหรือเท่ากับ 5 ซม. หรือ 3 นิ้วมือ, และเมื่อมีทั้ง 2 ปัจจัยร่วมกันตามลำดับ 42% ของผู้ป่วยมีภาวะการสอดท่อหายใจลำบากอย่างไม่คาดถึง 27%, 23% และ 19% ของผู้ป่วยมีเนื้องอกหรือเนื้อร้ายบริเวณช่องปากและกล่องเสียง, มีการติดเชื้อของเนื้อเยื่อชั้นลึกบริเวณลำคอ, และกระดูกหักบริเวณใบหน้าตามลำดับเกือบครึ่งหนึ่งของภาวะแทรกซ้อน ที่เกิดร่วมกับการสอดท่อหายใจลำบาก คือ การลดลงของความอิ่มตัวของออกซิเจนของเม็ดเลือดแดงไม่มีรายงาน การเกิดผลลัพธ์ที่รุนแรงทั้งภายใน 24 ชม. และ 7 วัน โรค/กายวิภาคของผู้ป่วยเป็นปัจจัยสำคัญที่เกี่ยวข้องกับการเกิดอุบัติการณ์ การเคยมีประสบการณ์มาก่อน, ผู้ช่วยที่มีประสบการณ์, และความระแวดระวังที่ดีเป็นปัจจัยที่ช่วยลดอุบัติการณ์ กลยุทธ์วิธีแก้ไขอุบัติการณ์ที่แนะนำคือ การมีแนวทางเวชปฏิบัติ, การฝึกอบรมเพิ่มเติม และการให้คำปรึกษาที่ดีขึ้น*

สรุป: *การประเมินทางเดินหายใจที่ดีก่อนการให้การระงับความรู้สึก และการให้ความสนใจเกี่ยวกับ พยาธิสภาพ หรือโรคเป็นหลักที่สำคัญ ควรมีแนวทางปฏิบัติสำหรับภาวะการสอดท่อช่วยหายใจลำบากทั้งแบบคาดการณ์และไม่คาดการณ์รวมถึงอุปกรณ์ช่วยหายใจต่าง ๆ ที่พร้อมใช้*