ISSN: 2717-8161

REVIEW ARTICLE

New Trends in Medicine Sciences

New Trend Med Sci 2024; 5(Supplement Issue):161-167 https://dergipark.org.tr/tr/pub/ntms

# Capnography in Outpatient Anesthesia

Abdullah Özdemir[1*]

[1]Department of Anesthesiology, Kanuni Training and Research Hospital, University of Health Sciences, Trabzon, Türkiye

***Article History***
Received 20 Nov 2023
Accepted 23 July 2024
Published Online 28 July 2024

[*]***Corresponding Author***
Abdullah Özdemir
Department of Anesthesiology
Kanuni Training and Research Hospital
University of Health Sciences
Trabzon, Türkiye
Phone: +90 5052174167
E-mail: abdullah.1565@gmail.com

***Doi:***10.56766/ntms.1393238

***Authors' ORCIDs***
Abdullah Özdemir
https://orcid.org/0000-0002-4778-9622



**Abstract:** The concept of outpatient anesthesia first came up in the 1970s. Performing planned surgery of patients on the same day and then being discharged is called outpatient surgery, and the anesthesia applied in the same session is called outpatient anesthesia. Outpatient surgery is not performed for every patient. There are many factors that determine whether patient population scheduled for outpatient surgery is suitable for outpatient surgery. End-tidal carbon dioxide (ETCO2) is the CO level released at the end of expiration. ETCO2 reflects the adequacy of ventilation and perfusion. ETCO2 measurement can be performed with many techniques. Infrared spectrography is the most common technique. It can be used in intubated and tracheostomized patients who are provided with respiratory support with a mechanical ventilator, as well as in patients who are not intubated and undergo sedoanalgesia, allowing the monitoring of respiration by measuring. The capnogram consists of two main components, inspiration and expiration, and these components point to four separate phases. It is known that drugs used in sedation and analgesia can often have negative effects on respiratory system. Therefore, patients' oxygenation and hemodynamic status should be closely monitored. It can continuously monitor frequency and depth of patients' breathing using a capnograph. An increase in amount of ETCO2 or a decrease in respiratory pattern is interpreted as respiratory depression. In addition to capnography, a parameter showing respiratory status, defined as "Integrated Pulmonary Index" (IPI), consisting of capnography, pulse oximetry, respiratory rate, and mathematical analysis of heart rate, is also used in cases where outpatient sedation is applied. Capnography has been shown to detect hypoxemia and apnea earlier. Use of IPI index and capnography is useful in the respiratory follow-up of patients with comorbid diseases (COPD, OSAS, Obesity.) who underwent moderate and deep sedation. ©2024 NTMS.

**Keywords:** Outpatient Anesthesia; Capnography; Integrated Pulmonary Index.

## 1. Introduction

The outpatient intervention was first applied in Scotland in 1909. The concept of [1] outpatient anesthesia first came to the fore in the 1970s. Along with technological advances, TARD (Turkish Anesthesiology and Reanimation Society) has published guidelines on the subject in Turkey.

Performing the planned surgery of the patient on the same day and then being discharged is called outpatient

**Cite this article as:** Özdemir A. Capnography in Outpatient Anesthesia. *New Trend Med Sci.* 2024; 5(Supplement Issue):161-167.Doi:10.56766/ntms.1393238

surgery, and the anesthesia applied in the same session is called outpatient anesthesia [2].

It is derived from the Greek word ‘kapnos’, which means smoke. Instantaneous measurement of end-tidal carbon dioxide (ETCO2) concentration or partial pressure is called "Capnometry", and the device that makes this measurement is called "Capnometer". The change of end-tidal carbon dioxide concentration or partial pressure in the expiratory volume over time is called "Capnography".

In the literature, $CO_2$ analysis was first discovered in the 20th century and then started to be used in anesthesia in the 1950s [3].

*1.1 Outpatient Anesthesia*

One of the most important reasons why outpatient surgery is becoming increasingly common is its many advantages. These advantages can be listed as low risk of nosocomial infection, early discharge, patient/surgeon satisfaction, low cost, higher efficiency [2, 1].

Outpatient surgery is not performed for every patient.

Patient selection criteria in outpatient surgery:

1-The surgical intervention to be performed should be completed in an appropriate time. The average duration of a one-day case is 3.5 hours or half a working day. This covers the entire perioperative period. This process should be constant and should be included in the anesthesiologist's work plan.

2- The operation should not cause fluid and blood loss.

3- There should be minimal risk for postoperative bleeding.

4- There should be minimal risk in postoperative airway safety.

5- Postoperative pain should be easily controlled by the patient at home.

6- There should be nopostoperative nausea and vomiting.

7- There should be no intervention that requires the use of a resistor or catheter.

8- Patients should be able to provide postoperative care on their own. It should be an intervention that does not restrict patient movement, or it should be with a reliable adult, or a nurse providing postoperative care should be able to be provided.

9- Hydration and eating functions should be able to return quickly.

10-The procedure should be schedule to an earlier time in the operation list. In this way, the postoperative care period should be long [2].

Cases where outpatient surgery can be performed are shown in Table 1 [2].

There are many factors that determine whether the patient population scheduled for outpatient surgery is suitable for outpatient surgery. These can be classified as titles depending on surgical procedure, comorbid diseases, social factors [4].

Procedural factors that may affect perioperative and postoperative outcomes include the invasiveness of the surgical procedure, the duration of surgery, potential blood loss and the need for blood transfusion (intraoperative and postoperative), and the ability to control post-discharge pain with oral analgesics and/or local [5].

It has been shown that various comorbid conditions affect postoperative outcomes after outpatient treatment and therefore play an important role in patient selection. Independent factors identified in many studies include ASA (American Society of Anesthesiologists) physical status classification, advanced age, obesity (body mass index [BMI]), obstructive sleep apnea (OSA), heart disease, chronic obstructive pulmonary disease (COPD), diabetes (DM), end-stage renal disease (ESRD), transient ischemic attack (TIA)/stroke, chronic opioid use or opioid use disorder, and malignant hyperthermia (MH) [4].

Another factor that plays a role in outpatient selection is social factors. Social factors include the location of post-discharge patient care being close to the hospital, the presence of responsible persons providing patient care, and the availability of facilities to reach the nearest health center in case of any complications.

As a result, patients who will undergo outpatient surgery:

-General Anesthesia

-Neuroaxial Anesthesia

-Peripheral Nerve Blocks

-Sedo Analgesia is applied.

Each technique has its own advantages and disadvantages. In terms of tissue oxygenation follow-up, patients receiving general anesthesia are included in the standard monitoring (ECG, Pulse Oximeter, Invasive/non-invasive arterial blood pressure, capnography). In addition to standard monitoring, capnography follow-up should be performed for the early detection of apnea in patients receiving neuromuscular monitoring and BIS monitoring and sedation in the follow-up and transfer of patients who have undergone other methods [2].

*1.2 Capnography*

End-tidal carbon dioxide (ETCO2)is the carbon dioxide level released at the end of expiration. ETCO2 reflects the adequacy of ventilation and perfusion. Non-invasive methods for ETCO2 measurement include capnometry and capnography. Capnometry provides a numerical value for ETCO2. In contrast, capnography offers a more comprehensive measurement, displayed in both graphical and numerical form. Therefore, capnography is currently the most commonly recommended method for monitoring $ETCO_2$ [6].

$ETCO_2$ measurement can be performed with many techniques. A few of these are Raman spectrography, mass spectrography, molecular correlation spectrography, infrared spectrography. The most commonly used method is infrared spectrography [7].

Like every wave in the electromagnetic spectrum, infrared light has a wavelength range (0.7 μm – 1 mm). Gases absorb infrared light over a range of wavelengths. This wavelength range is different for each gas in the exhaled gas mixture. Thanks to photodetectors, capnography measures the $CO_2$ molecules in the expirium by the mechanism of absorption of infrared rays [8].

**Table 1:** Interventions Suitable for Outpatient Surgery.

| | |
|---|---|
| **Dental facial** | Fractures, extraction |
| **Dermatology** | Excision of skin lesions |
| **General Surgery** | Biopsy, endoscopy, mass excision, hemorrhoidectomy, hernia repair, laparoscopic interventions, splenectomy, adrenalectomy, varicose vein surgery |
| **Ophthalmology** | Cataract operations, chalazion excision, nasolacrimal canal operation, strabismus repair, tonometry, intraocular injections |
| **Gynaecology** | Biopsy, curettage, hysteroscopy, laparoscopy, uterine polypectomy, vaginal hysterectomy, tubal ligation |
| **ENT** | Adenectomy, tonsillectomy, tympanoplasty, myringotomy, polypectomy, rhinoplasty, mastoidectomy |
| **Plastic Surgery** | Basal cell cancer excision, cleft lip repair, mammoplasty, liposuction, ear correction, debridement, burn dressing, skin graft, etc. |
| **Urology** | Bladder surgery, circumcision, cystoscopy, varicocele, orchiectomy, laparoscopic nephrectomy, prostatectomy |
| **Orthopedics** | Knee arthroscopy, shoulder reconstruction, carpal tunnel operation, closed reduction, tendon repair, etc. |
| **Pain** | Nerve blocks, radiofrequency, epidural injection, chemical sympathectomy |
| **Physiotherapy** | Botox injection |

According to the placement localization of the $CO_2$ sensor, the capnography device is divided into two groups as *Mainstream* and *Sidestream*. While the sensor is located on the respiratory tract in devices using mainstream, the sensor is located inside the monitor in devices using sidestream (Figure 1) [9].

Normal values of $ETCO_2$ are 35 mmHg to 45 mmHg. In cases of hypoventilation, hyperthermia, sepsis, re-breathing, depleted soda lime, very low fresh gas flow, too much depth of anesthesia, IV bicarbonate administration, the $CO_2$ level in the blood may increase. If the end-tidal carbon dioxide partial pressure value is above 45 mmHg, it is called hypercapnia, and if it is below 35 mmHg, it is called hypocapnia. This condition can be caused by hyperventilation, hypothermia, pain, superficial anesthesia, very high fresh gas flow and a leak in the respiratory system[10]. The reasons for increasing and decreasing $ETCO_2$ are given in Table 2.

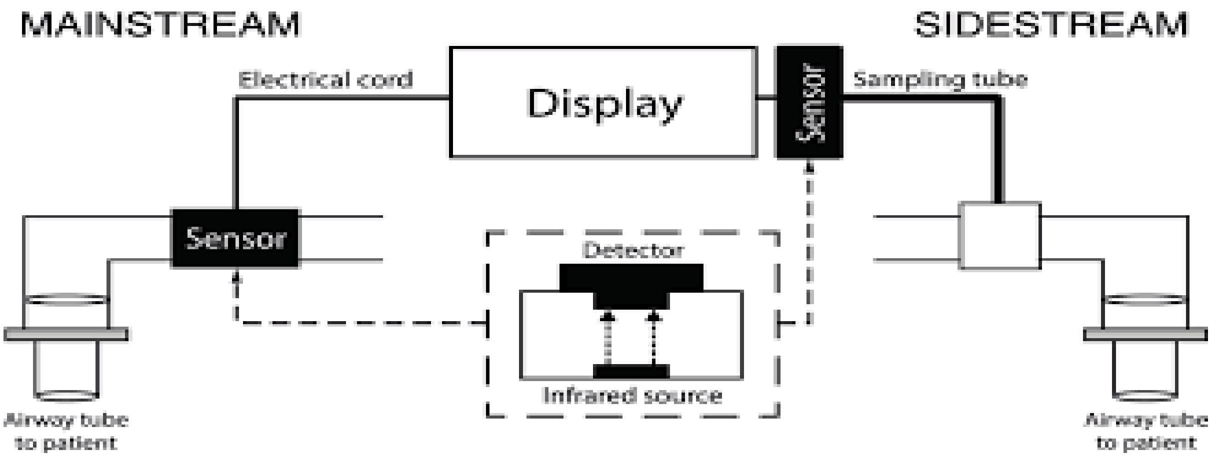



**Figure 1:** Capnography device types [9].

**Table 2:** $ETCO_2$ Changes [8].

| Increased $ETCO_2$ | Decreased $ETCO_2$ |
|---|---|
| Decreased alveolar ventilation<br>• Increased respiratory rate<br>• Increased tidal volume<br>• Increased equipment dead space | Increased alveolar ventilation<br>• Increased respiratory rate<br>• Increased tidal volume |
| Increased $CO_2$ production<br>• Temperature<br>• Hypermetabolic state | Decreased $ETCO_2$ production<br>• Hypothermia<br>• Hypocatabolic state |
| Increased inspire $Pco_2$<br>• Re-breathing<br>• Depletion of $CO_2$ absorbent<br>• External $CO_2$ source | Increased alveolar dead distance<br>• Increased cardiac output<br>• Pulmonary embolism<br>• High end-expiratory pressure during intermittent positive ventilation<br>Sampling Error<br>• Insufficient tidal volume<br>• Water plugs in the breathing line<br>• Air intake to the breathing line |

In people with normal respiratory functions, a pressure difference of 2-5 mmHg is observed between $PaCO_2$ and $EtCO_2$, reflecting the physiological dead space. In cases of shock, cardiac output and decreased lung perfusion, an increase in pressure difference between $PaCO_2$ and $EtCO_2$ may be observed due to ventilation/perfusion (V/P) incompatibility [11].

Capnography is a non-invasive method that provides monitoring of respiration. It can be used in intubated and tracheostomized patients who are provided with respiratory support with a mechanical ventilator, as well as in patients who are not intubated and undergo sedoanalgesia, allowing the monitoring of respiration by measuring. In this way, it is used in the operating room, intensive care units, emergency services and units where sedoanalgesia is applied. In addition, $ETCO_2$ usage monitoring can be used as the earliest indicator of spontaneous return to ensure the accuracy of the location of the intubation tube, to quickly detect common respiratory system problems associated with sedation such as respiratory depression, apnea, upper airway obstruction, laryngospasm, bronchospasm, to indicate cardiac output when ventilation is kept constant in the circulatory system, and finally in cardiopulmonary resuscitation [12-14].

Especially in non-operating room applications, the recommendation of the Turkish Society of Anesthesiology and Reanimation (TARD) in the anesthesia practice guide is as follows: Pulse oximeter or plethysmography, capnograph (must be present even in sedation applications), oxygen analyzer, gas analyzers if old anesthesia devices that are not available are used as respiratory monitors, observation of chest movements, listening to respiratory sounds with a precordial stethoscope, observation or feeling of the movement of the reservoir balloon are required. $SpO_2$ monitoring alone is not adequate. Apnea or hypoventilation is noticed later because additional oxygen is administered, in which case capnography is stimulating. It is recommended that $EtCO_2$ monitoring should be performed not only in moderate and deep sedation, but also in mild sedation.[15] Capnography has previously been shown to detect hypoxemia and apnea earlier in numerous randomized controlled trials [16]. The capnogram consists of two main components, inspiration and expiration, and these components point to four separate phases (Figure 2).

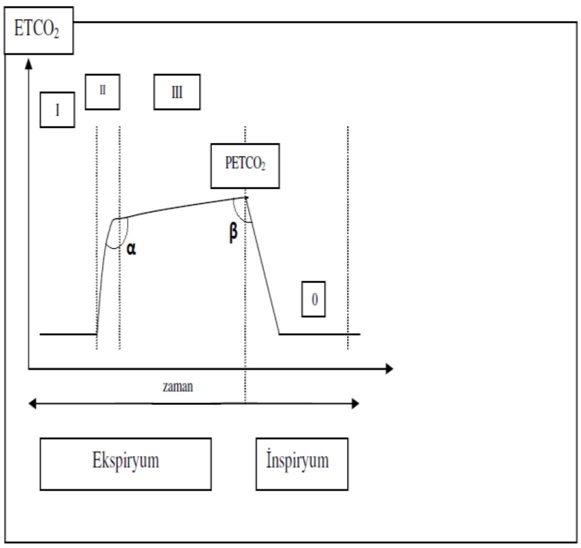



**Figure 2:** Normal Capnogram Waveform [17].

The first phase (Phase I) starts with the start of expiration and ends as soon as $CO_2$ is detected. This phase indicates gas elimination in the conductor airways, the 'anatomical dead space'. The anatomical dead space consists of the upper respiratory tract and the branching of the bronchial tree. In normal adults, 150- 180 ml of the 500 ml tidal volume is located in this region. The amount of space is affected by the person's height, body weight, posture, position of the neck and jaw, tracheostomy, or the presence of an endotracheal tube. Anatomical dead space does not play a role in gas exchange. $CO_2$ cannot be detected in Phase I.

During the phase II period, $CO_2$ from the alveoli and $CO_2$ in the anatomical dead space are mixed. In this phase, the $CO_2$ in the expiratory air rises rapidly. The $CO_2$ rise rate in Phase II gives information about ventilation-perfusion (V/P). The rise in this phase indicates alveolar dead space. Sudden increase of alveolar dead space indicates V/P disorder.

In the capnogram, the transition between Phase II and Phase III, that is, the point where the alveolar gas is detected, is called the “alpha (α) angle”. Normally, this angle is around 100- 110° and is an indirect indicator of the V/P of the lung. Airway obstruction, capnograph response time, print speed, and respirator cycle time cause a change in angle.

In Phase III, the air in the anatomical dead space is completely discharged and only air from the alveoli is present. The level of $CO_2$ in Phase III is usually characterized by a slight increase, or it can also be fixed in the form of a plateau. The alveolar gas at the end of expiration is richer in $CO_2$ than at the beginning of expiration because $CO_2$ excretion from the pulmonary capillaries into the alveoli continues at almost constant levels throughout expiration. At the end of expiration, $CO_2$ is measured more concentrated than the volume. In Phase III, the point where $CO_2$ is measured as the highest at the end of expiration is called "end tidal $CO_2$ partial pressure", that is, $PETCO_2$. The $PaCO_2$-$PetCO_2$ difference in healthy subjects is usually less than 6 mmHg [17].

The region where inspiration starts and CO2 decreases rapidly with Phase III is called Phase 0. The angle of about 90° between Phase 0 and Phase III is called the “beta (β) angle”. Beta angle is used to evaluate rebreathing [18].

Abnormal Wave Patterns:

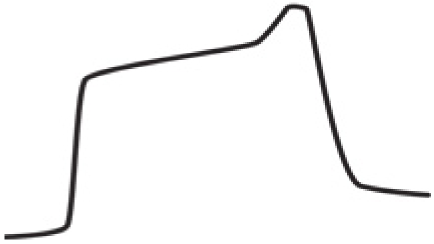
Hypoxia: (Asthma)

Hypoxia: (Mechanical abstraction, Asthma, bronchial construction)

*The shark fin:*

Pneumothorax and alveolar leak:

Obese patient with decreased lung compliance:



Sudden drop: Airway vehicle misplacement, Cardiac arrest

Restoration of spontaneous breathing after resuscitation

## 2. Discussion

It is known that drugs used in sedation and analgesia can often have negative effects on the respiratory system. Therefore, the patient's oxygenation and hemodynamic status should be closely monitored. With the side flow measurement method, $CO_2$ measurement can be easily performed even when the patient is not intubated with the nasal cannula or face mask to be placed in the patient's airway. It can continuously monitor the frequency and depth of the patient's breathing using a capnograph. An increase in the amount of $ETCO_2$ or a decrease in the respiratory pattern is interpreted as respiratory depression.

It has been shown that capnography used during endoscopy of morbid patients detects respiratory depression in the early period and instantly detects changes in respiratory pattern [19].

In a study comparing the monitoring used in sedations given to 154 children in the emergency department, Langhan et al. showed that hypoventilation was less common and timely intervention was performed in cases followed up with capnography. They stated that children in the capnography group were exposed to less hypoventilation and oxygen desaturation [20].

In addition to capnography, a parameter showing respiratory status, defined as "Integrated Pulmonary Index" (IPI), consisting of capnography, pulse oximetry, respiratory rate, and mathematical analysis of heart rate, is also used in cases where outpatient sedation is applied. IPI values are 1-2: Red area( Emergency response), 3-4: Yellow area (Requires intervention.), 5-6:Green area (May require attention and intervention), 7: Green area (Close to normal limit but requires attention) 8-10: Normal limits [21].

Continuous oxygen saturation, as measured by pulse oximetry, provides information about heart rate as well as arterial oxygenation but does not fully reflect ventilation. It has been shown that cutaneous capnography placed on the auricle is useful in the titration of nocturnal non-invasive positive pressure ventilation (NPPV) used in the treatment of hypercapnia as a result of hypoventilation due to OSAS. In conclusion, cutaneous capnography using a digital earlobe sensor can be used to optimize NPPV settings in patients with hypoventilation-induced chronic hypercapnic respiratory failure [22].

Capnography is an indicator of ventilation. It is indirectly correlated with tissue perfusion and oxygenation. Shock models have shown that the sublingual tissue bed is damaged, and microcirculatory changes in this region may indicate recent changes in other important organs. Measurement of sublingual mucosal pCO2 (Pslco2) by sublingual capnography is technically simple, non-invasive, and yields almost instant results. Sublingual capnography is useful for assessing the severity of shock conditions and adequacy of tissue perfusion [23].

While there are many studies in the literature on the advantage of the use of capnography in early respiratory depression and respiratory complications in cases undergoing sedation, there are also studies stating that the use of routine capnography is necessary. In a 2016 review, routine measurement of EtCO2 levels during procedure-related sedation was shown to be too costly for five years of preventable catastrophic events [24].

In addition to the mentioned applications, a case-based example of the use of capnography is provided. Initially, moderate sedation with midazolam was administered to a 43-year-old male patient undergoing dental surgery with airway obstruction due to squamous cell polyp. Periodically, the patient experienced desaturation and apnea, and interventions were carried out by stimulating respiration through verbal prompts. During periods of irregular respiratory patterns, there were observed decreases in EtCO2 initially, followed by increases during apneic episodes. The importance of capnography was emphasized in the early detection of hypoxia [25].

In a 2019 review, the use of colonoscopy using moderate sedation is not routinely recommended in low-risk patients (ASA I/II, BMI <30, young patients with no history of heart or lung disease) [16].

## 3. Conclusions

Capnography has previously been shown to detect hypoxemia and apnea better in numerous randomized controlled trials. The use of IPI index and capnography is useful in the respiratory follow-up of patients with comorbid diseases (COPD, OSAS, Obesity…) who underwent moderate and deep sedation.

**Limitations of the Study**

The studies conducted by different surgical procedures, hospital settings, and surgical teams may make comparability of results difficult. This heterogeneity can make it difficult to draw generally valid conclusions.

**Acknowledgement**

None.

**Conflict of Interests**

The author declare that they have no conflict of interest.

**Financial Support**

No financial support was received for this study.

**Author Contributions**

Conception and Design of the study, Collection and/or Processing and Literature review, Writing Original Manuscript, Analysis and/or interpretation and final version and is responsible for final approval of the submitted manuscript; AÖ.

**Ethical Approval**

None.

**Data sharing statement**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

**Consent to participate**

None.

**Informed Statement**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## References

1. Sarihasan B, Kelsaka E, Tafi N. Günübirlik Anestezi Uygulaması. *O.M.Ü. Tıp Dergisi.* 2008; 25(3):111-15.
2. Özbilgin Ş, Kılıç Y, Aycan İ, Çağlar T. Günübirlik Uygulama KlavuzuTürk Anesteziyoloji ve Reanimasyon Derneği (TARD). 2012;1-56.
3. Elam Jo, Brown Es, Ten Pas Rh. Carbon dioxide homeostasis during anesthesia. I. Instrumentation. *Anesthesiol.* 1955; 16(6):876-85.
4. Rajan N, Rosero EB, Joshi GP. Patient Selection for Adult Ambulatory Surgery: A Narrative Review. *Anesth Analg.* 2021; 133(6):1415-30.
5. Joshi GP. Enhanced recovery pathways for ambulatory surgery. Curr Opin *Anaesthesiol*. 2020; 33(6):711-17.
6. Richardson M, Moulton K, Rabb D, Kindopp S, Pishe T, Yan C, Akpinar I, Tsoi B, Chuck A. Capnography for Monitoring End-Tidal CO2 in Hospital and Pre-hospital Settings: A Health Technology Assessment [Internet]. Ottawa (ON): Canadian Agency for Drugs and Technologies in Health; 2016; PMID: 27227208.
7. Jaffe MB. Infrared measurement of carbon dioxide in the human breath: "breathe-through" devices from tyndall to the present day. *Anesth Analg*. 2008;

107(3):890-904.

**8.** Patil J. J., Maloney D.G. Measurement of pulse oximetry, capnography and pH. *Anaesth Intensive Care Med.* 2014; 15(11):522-25.

**9.** Hochwald O, Borenstein-Levin L, Dınur G, Jubran H, Ben-David S, Kugelman A. Continuous noninvasive carbon dioxide monitoring in neonates: From theory to standard of care. *Pediatrics*. 2019; 144(1):1-12.

**10.** Maclennan T, McCurry R. Capnography-what is it all about? *Vet Nurs J.* 2020; 35(8):231-34.

**11.** Satoh K, Ohashi A, Kumagai M, Sato M, Kuji A, Joh S. Evaluation of Differences between PaCO 2 and ETCO 2 by Age as Measured during General Anesthesia with Patients in a Supine Position . *J Anesthesiol*. 2015; 2015:1-5.

**12.** Genç Moralar D, Kesici S. Anestezi doktorlarının peroperatif end-tidal karbondioksit monitörizasyon uygulamaları. *SDÜ Tıp Fakültesi Derg.* 2019; 26(3):312-18.

**13.** Koyama T, Kobayashi M, Ichikawa T, Wakabayashi Y, Abe H. Technology Applications of Capnography Waveform Analytics for Evaluation of Heart Failure Severity. *J Cardiovasc Transl Res.* 2020; 13(6):1044-54.

**14.** Karcioğlu Ö. Kritik Hasta Bakımında Kapnografinin Rolü . Cerrahpaşa *J Med*. 2014: 1-12.

**15.** İyilikçi İ, Ökesli SE, Erdost HA. Ameliyathane Dışı Uygulamaları Klavuzu. Türk Anesteziyoloji ve Reanimasyon Derneği (TARD) 2015;1-35.

**16.** Wadhwa V, Gupta K, Vargo JJ. Monitoring standards in sedation and analgesia: The odyssey of capnography in sedation for gastroenterology procedures. Curr Opin *Anaesthesiol*. 2019; 32(4):453-56.

**17.** Özyılmaz E. Derleme / Review Kapnografi ve Yoğun Bakım Ünitesinde Kullanımı. *Solunum Hastalıkları*. 2009; 20(3):126-130.

**18.** Thompson JE, Jaffe MB. Capnographic waveforms in the mechanically ventilated patient. *Respir Care*. 2005; 50(1):100-108.

**19.** Prathanvanich P, Chand B. The role of capnography during upper endoscopy in morbidly obese patients: A prospective study. *Surg Obes Relat Dis.* 2015; 11(1):193-98.

**20.** Langhan Melissa L, Shabanova Veronika, Li Fang-Yong, Bernstein Steven L SED. A Randomized Controlled Trial of Capnography During Sedation in a Pediatric Emergency Setting. *Am J Emerg Med.* 2015; 33(1):515-525.

**21.** Turan G, Taş BA, Demiroluk Ö, et al. Endoskopik Girişimlerde Sedasyon Uygulamasında "Integrated Pulmonary Index." *Boğaziçi Tıp Dergisi*. 2015; 2(3)3-6.

**22.** Chhajed PN, Gehrer S, Pandey K V., et al. Utility of transcutaneous capnography for optimization of non-invasive ventilation pressures. *J Clin Diagnostic Res.* 2016; 10(9):OC06-OC09.

**23.** Mallat J, Vallet B. Mucosal and cutaneous capnometry for the assessment of tissue hypoperfusion. *Minerva Anestesiol.* 2018; 84(1):68-80.

**24.** Mohr NM, Stoltze A, Ahmed A, Kiscaden E, Shane D. Using continuous quantitative capnography for emergency department procedural sedation: a systematic review and cost-effectiveness analysis. *Intern Emerg Med.* 2018; 13(1):75-85.

**25.** Brady P, McCreary C, O'Halloran KD, Gallagher C. Squamous Papilloma Causing Airway Obstruction During Conscious Sedation. *Anesth Prog.* 2017; 64(3):168-70.

NTMS New Trends in Medicine Sciences
https://dergipark.org.tr/tr/pub/ntms