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Engineering of Physics

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REPUBLIC OF TURKEY

GAZİANTEP UNIVERSITY

GRADUATE SCHOOL OF NATURAL & APPLIED SCIENCES

A STUDY ON THE COMPUTURIZED TOMOGRAPHIC X-RAY RADIATION ON DURATION AND RAMSAY SCALE OF SEDATION

M. Sc. THESIS

IN

ENGINEERING OF PHYSICS

BY

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Supervisor

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Erdem KALMIŞ

ABSTRACT

A STUDY ON THE COMPUTURIZED TOMOGRAPHIC X-RAY RADIATION ON DURATION AND RAMSAY SCALE OF SEDATION

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Many adult patients undergoing computerized tomography receive sedation for various reasons. The aim of our study is to determine the effects of radiation emitted by CT on sedation.

A total of 20 patients were admitted to our study. The patients were divided equally into two groups and sedation was applied to each group for 20 minutes. Group B had a CT scan but Group K CT was not performed. Oxygen saturation, heart rate and blood pressures (systolic arterial pressure, diastolic arterial pressure and mean arterial pressure) were monitored. The Ramsey sedation scale score of 9 volunteers was recorded.

After the start of sedation, group B and group K (15,5±0,84; 15,6±0,96) (p:0,62) were observed. Since the beginning of sedation, the Aldrete score was 9 (30,3±1,3; 31,9±1,1) (p:0,3). We observed that there ise no significant correlation effect of radiation on patient who is under sedation while imaging of CT. But this study has got some limitation like as the number of patiens and we used propofol and alfentanil. New sedation agents should use for this correlation.

Key Words: Radiation, Ramsay, Sedation, Tomography

ÖZET

BİLGİSAYARLI TOMOGRAFİ SÜRESİNCE SEDASYON DEĞİŞİMİNİN RAMSAY ÖLÇEKLEMESİ

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66 sayfa

Bilgisayarlı tomografi (BT/CT) çekilen birçok erişkin hastaya değişik nedenlerden (klostrofobi vb) dolayı sedasyon verilmektedir. Verilen sedasyonda BT nin yaydığı radyasyonun sedasyon üzerine etkilerini belirlemek çalışmamızın amacıdır.

Çalışmamıza toplam 20 hasta kabul edildi. Hastalar eşit olarak 2 gruba ayrıldı ve sedasyon her iki gruba 20 şer dakika uygulandı. Grup B BT çekimi yapılırken grup K ya BT çekimi yapılmadı. Gönüllülerin oksijen satürasyonu, kalp tepe atım sayıları ve kan basınçları (sistolik arter basıncı, diastolik arter basıncı ve ortalama arter basıncı) kontrol edilerek monitörize edildi. Her iki grup gönüllülerin Ramsey sedasyon skala puanının 9 olma süresi kayda alındı**.**

Gruplar arası Aldrete skoru nun 3 olma süresi sedayona başlandıktan sonra grup B vegrup K da (15,5±0,84; 15,6±0,96) (p:0,62) olarak gözlenmiştir. Sedasyonun uygulanmaya başlanmasından itibaren Aldrete skorunun 9 olma süresi ise (30,3±1,3; 31,9±1,1) (p:0,3) olarak gerçekleşmiştir. BT görüntülerken sedasyon altında olan hasta üzerinde radyasyonun anlamlı bir korelasyon etkisi olmadığını gözlemledik. Ancak bu çalışmanın, hasta sayısı gibi bazı kısıtlamaları var ve biz propofol ve alfentanil kullandık. Yeni sedasyon ajanları bu korelasyon için kullanmalıdır.

Anahtar Kelimeler: Radyasyon, sedasyon, Ramsey

To My Parents

ACKNOWLEDGEMENTS

I would like to thanks my supervisor Assoc. Prof. Dr. Mustafa YILMAZ for his guidance, advice, criticism, encouragements and insight throughout this research.

I would also thanks to my family for their understanding and patience.

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LIST OF SYMBOLS/ABREVIATIONS

GCS	Glasgow Coma Scale
EDs	Emergency departments
MAAS	Motor Activity Assessment Scale
SAS	Sedation Agitation Scale
RAS	Richmond Agitation Scale
ICU	Intensive Care Unit
EEG	Electroencephalograms
BIS	Bispectral index
CNS	Central Nervous system
MRI	Magnetic Resonance Imaging
CT	Computed Tomography
CJD	Creutzfeldt-Jakob diseases
NCCT	Non Contrast Computed Tomography
BMI	Body Mass Index
ASA	American Society of Anesthesiologists
NSAID	Non-Steroid Anti-İnflamatuar Drug
VAS	Visual Analog Scale
FESC	Fellow of the European Society of Cardiology
NRS	Numerical Rating Scale
PET	Positron Emission Tomography
FDA	Food and Drug Administration
BEIR	Biological Effects of Ionizing Radiotion
LNT	Linear no-threshold
α	Alpha waves
μ	Mu waves
β	Beta waves

θ	Theta waves
δ	Delta waves
γ	Gamma waves

CHAPTER I
INTRODUCTION

1.1 Sedation in the ICU

1.1.1 Principles about Sedation

Sedation is a sleep-like condition created in order to ensure that patients do not hear pain, disturbing sensations or sounds during interventions to be performed for diagnosis or treatment purposes, and then remain inactive during the procedure.
Sedation causes a decrease in the response of patients to the environment and external stimulation. Intensive care also plays a very important duty in the upkeep of the sick person. Until recently, severe sedation was used routinely in intensive care. Because of this, the endotracheal cylinder acceptance and the respirator bringing together, which is regularly delivered by neuromuscular stalling causes, be there facilitated.

The amount of medication applied and the duration of drug administration for sedation are less than general anesthesia. Although patients vary according to the depth of the sedation, they can easily respond to verbal orders during the procedure, their respiratory functions are not affected and they do not completely lose consciousness. Sedation can be performed by injecting intravenous or intramuscular medication into a patient or by anesthetizing the anesthetic gas through a mask. In modern intensive care units, ventilators are prepared by a wide variability of methods. By these methods, automatic current producing and management difficulties have been mainly disregarded. Through swapping the endotracheal cylinder by the tracheostomy cannula, an artificial airway-related discomfort decreases and can usually completely eliminate the need for sedation. For this reason, today's sedation involves more than the tube, focusing on the patient's multifactorial individual needs. Some critical diseases can be dangerous in place of a variation of details; however adequate restfulness can decrease this result. Aching is a often faced difficult plus can be worsened by around bad and worrying events. It is supposed that in more than 70 % of patients in intensive care units, agitation occurs at least once.

1.1.2 Monitoring Sedation

The amount of sedation and how much time is given in the time is important. Because of both excessive and low sedation may cause potentially harmful consequences. This is important in decisive the result of the patient. When excessive sedation is applied, the ventilator may increase the life time and the length of stopover in the intensive care unit (ICU) may be prolonged. Low sedation may lead to hyper catabolism, immunosuppression, hypercoagulation and lesser sensitive action. Hemodynamic replies as a measure of sedation are undependable in analytically sick patients. Therefore, there is a need for official sedation scoring.

1.1.3 Scoring Systems

There are several clinical counting methods used in the UK. For sample the Ramsay and Bloomsbury scales. They all give a numerical number to a clinical finding in a patient who does not sleep or sleeps. Doubts about these systems involve a lack of clear distinction between interpreter variation and deeper sedation levels.

1.1.4 Instrumental Measures of Sedation

Instrumental tools provide another approach to monitoring sedation and avoid the interpreter variability of clinical scoring systems. There are two main methods: First is Electroencephalograms (EEG). This requires specifically trained personnel and tools and is thus not useful in the ICU atmosphere. Bispectral index is an other one. This method is commonly used to display depth of operating anaesthesia in the operating theatre; it provides a quantitative value from 0 to 99. If a bispectral index value of 0 equals that means EEG silence, if a bispectral index value nearby 100 is the probable rate in a totally awake adult. However, if there is a value between 40 and 60, general anesthesia is recommended. A bispectral index has also been investigated in critical care, and several studies have shown a good correlation between bispectral index and Ramsay scoring for a Ramsay Score of 1 to 5. Yet, at the profounder stages of sedation the bispectral index value showed greater variability.

CHAPTER II

MEASUREMENT SEDATION TECHNIQUES

2.1 Bispectral Index

2.1.1 A Review and Technology Assessment

The ability to assess the depth of anesthesia was a constant pursuit after Snow reported the first 5 parts of ether anesthesia in 1847 [1]. These 5 steps extra developed on the Guedel side in the 1920s. Guedel's neuromuscular blocking agents were the basis for the evaluation of the depth of anesthesia until they were widely accepted. Neuromuscular relaxants and other ancillary products were introduced. Many of the classical signs and levels mentioned by Snow and Guedel have been disproved.

The rate of recall in general anesthesia was 0.2% and maximum 1.6% [2]. A lot of academics supposed that the percentage of remember was not adequately reported. Because of patients may have difficulty reporting the states of consciousness in anesthesia. Again, clinicians may find it difficult to ask for evidence of intraoperative awareness. When this condition is determined during the operation, the patient may be under destructive, psychological and cognitive effects. Consider a patient who is in such a situation during surgery: This patient may have thoughts. I've been having horrible dreams all the time since my surgery. I can never sleep if there is no light in the room. Curtains should be open. Sometimes I even have to remember my ways and find my way. Driving at night sounds like a nightmare to me. I will forget how the words were written [4].

For many years, clinicians have been in a difficult position for many years because of the lack of a device to accurately measure the anesthetic effect of the brain [5-6]. Doctors are generally founded on dynamic signs as an signal of the patient's anesthetic station. But, lifecycle symbols may be affected by various factors not related to the depth of anesthesia. Therefore, it can be misleading [7]. In spite of the recognized dependability and efficiency of the Bispectral index monitor, many clinicians are resilient to the submission of such a scheme, which considers that the rate of alertness does not explain the value or that its present applies are satisfactory

without totaling extra screen? Though, fresh devotion to media concentrating on intraoperative alertness may reason many clinicians to reconsideration their opinions on the use of the Bispectral index monitor.

2.1.2 Yesterday and Today of Bispectral Index Monitor

At the time of the 1870s, physiologists knew that there were electrical effects in the cortical areas of the brain [8]. After 1939, doctors recognized the EEG waves due to anesthetic agents. In general, they used EEG to monitor the drug. There are 3 cases to use of EEG. One of them is for measuring the state of the drug and the state of the Central Nervous system (CNS). Other one is for metabolic cessation of the pharmacological effects of the CNS, and the last one is for the monitoring of cerebral ischemia if the carotid artery is crosslinked. Multiple EEG variables were evaluated in terms of their relationship with depth of anesthesia.

A power spectrum can be digitized that integrates data from the standard EEG signal, the EEG frequency and amplitude [9]. In this case, the spectral edge frequency and the median power frequency were facilitated. However, these values are formulated based on EEG in natural alertness and sleeper conditions. Therefore, these parameters do not take into account the anesthetic induced EEG changes. None of the patients had consistently demonstrated the depth of anesthesia. In addition, the power spectrum determines the power distribution as a function of the frequency, and the phase-related states are not calculated. The power spectrum is also thought to be a linear process of EEG signal formation and the potential for interactions between the various factors of this signal, a process known as phase coupling, which is likely to occur in the CNS.

The bispectrum is derived from the analog EEG. This is a high-grade statistical calculation. Bispectra measures the effects between the sinusoidal components of the EEG. A sinusoid consists of 3 important sections. These are frequency, phase angle and amplitude [10]. However, changes in frequency and power were found to be unstable when trying to measure the depth of sleep. Bispectral analysis includes information on power and frequency with phase matching information indicative of the depth of anesthetic [11]. The BIS uses a combination of EEG parameters determined after analysis of a wide range of EEG information to show specific ranges for the varying stages of anesthetic effect shown in figure 1. These parameters were then combined to form ideal matches for monitoring the hypnotic state. Bispectral Index is shown in later figures corresponding to low hypnosis levels.

These numbers are shown as a number between 0 and 100 shown in figure 2. A clinician using Bispectral Index Monitor should know that the Bispectral Index does not have the concentration of any drug. He should remember that the CNS evaluates the outcome of the drugs. It should be noted that the anesthetic status is indicated by a triad of analgesia, amnesia and muscle relaxation [12].

It is shown in figure 3. In fact, volatile agents can cause serious effects on the spinal cord. However, hypnotic agents such as propofol and thiopental do not have these effects. Bispectral Index Monitor monitors hypnotic status. This explains the difference in early studies that attempted to associate BIS with movement, and noted the diversity with different anesthetic techniques [13]. Most of these studies indicate that higher Bispectral Index numbers are in fact compatible with a higher probability of movement [14]. Recent studies have paid close attention to the relationship between BIS and hypnosis and have shown a very close relationship between these parameters [15]. As we have already said, there is a good agreement between the bispectral Index and the level of hypnosis. However, as shown in Figure 2, there are several variables to consider when monitoring BIS shown in Figure 4 [16]. The index should not be interpreted as a void but should be seen as information that will focus on the entire patient's depth state [17]. There are normal, genetically determined low voltage EEG variables among awake patients that may lead to low values of Bispectral Index. Therefore, it is important to obtain effective values before anesthesia induction [18].

The presence of electromyographic artifacts, low signal quality and electrical fittings such as electrocautery and forced heating and heating units may cause non-realistic values to be displayed by the bispectral index monitor [19]. By the administration of ketamine, BIS may remain excessively due to the stimulatory effects of ketamine. Therefore, Bispectral Index Monitor is not reliable when used for monitoring hypnosis with ketamine [20]. Finally, with this discussion, Bispectral Index Monitor has been shown not to reflect the hypnotic contribution of to anesthesia [21].

The development of the bispectral index monitor required a lot of difficulty and work to be done. One of these difficulties was the use of conventional EEG electrodes. To use the standard EEG electrodes, it is necessary to prepare the skin and use colloid adhesive. Also, the EEG electrodes need to be a low impedance system, so the use of conventional electrocardiogram electrodes can be troublesome.

To solve this problem, a special electrode strip is developed which can be easily applied and applied easily [22]. In recent years, the application of anesthesia has become increasingly safe and smooth. Patient results are now evaluated only for morbidity and mortality [23]. Recent studies have tended to focus on the impact on quality of life, patient preferences and satisfaction, psychological well-being, and financial resources [24].

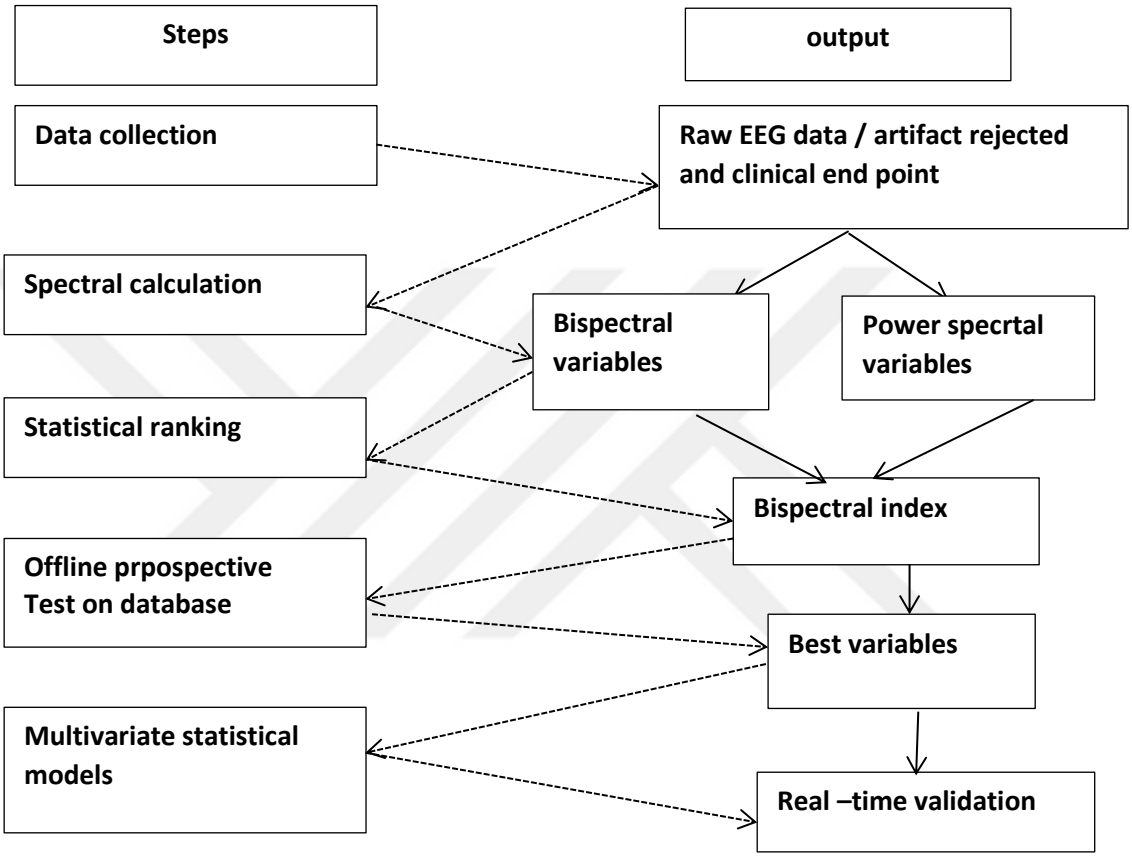


Figure 1: Schematic depiction of the development of the bispectral index [12].

There were many benefits from the frequent use of the bispectral index monitor. The most important of these differences are the reduction of awareness risk, increased titration of anesthetic agents and decrease of recovery chamber. Bispectral index also provides much additional information to the anesthesiologist when selecting medication for interventions.

Using this table, one can examine the general relationship between states and sleep depth values. These important intervals are based on the results of the studies of the application of specific anesthetic drugs. In no study, bispectral index monitor values and ranges show that the EEG is not capable of affecting its performance. The BIS value ranges of anesthetics should depend on the individual goals created for

each patient. These targets and associated sleep depth values may change over time and patient status and treatment practices.

BIS Index Range	**100**	**Alert** • Hear the normal voice
	80	**middle sedation / Light** • Can answer loud commands or light prodding / shaking
	60	**Moderate Hypnotic state**
	40	**Deep Hypnotic state**
	20	**Burst Suppression**
	0	**Cortical electrical silence**

Figure 2: BIS Index Choice of bispectral index monitor

Bispectral index monitoring systems allow physicians to access certain EEG documents of certain anesthetic drugs during the care of patients they want to monitor. The clinical impact of bispectral index monitoring facilitates, accelerates, and provides serious benefits for patient safety in intensive care. There are some randomly selected controlled studies that include the potential for monitoring the bispectral index monitor. BIS monitoring is a new method for some anesthesiologist. It is important to recognize the basic elements of BIS technology and to read the links between the patient's clinical status and the information on the Bispectral index monitor.

To guide the treatment of anesthesia, one should observe bispectral index monitor monitoring information. Bispectral index monitor should carefully monitor important moments and limitations that may affect the tracking number. The sleep depth index is an assessed EEG parameter with extensive validation and proven clinical benefits. These measures were activated by an algorithm to optimize the correlation between EEG and clinical effects. Bispectral index monitor was measured using the index range. In 1996, the FDA in the USA announced the bispectral index to help see the reactions of some anesthetic drugs. In 2003, the Food and Drug Administration (FDA) abolished the use of BIS monitoring to guide anesthesia practices, thinking that there might be difficulties with reducing the incidence of awareness about adults during general anesthesia and sedation. Because of watching

the depth is a clinical decision. It is the physician's authority to make clinical practice decisions for the benefit of the patient.

Today, bispectral index remains the most verified brain function used in anesthesia and sedation care. These values are the result of two special developments. These are bispectral analysis and bispectral algorithm.

Bispectral analysis evaluates the relationships between signal components. Therefore, it is a signal processing methodology that captures the mapping in signals such as EEG. By measuring the correlation between all frequencies within the signal, bispectral analysis gives an additional EEG brain activity facet [25].

The second, the BIS algorithm, was developed to combine the EEG properties that are highly associated with sedation / hypnosis in more than 5,000 adult subjects in EEGs. There are four basic EEG features that characterize the full spectrum of anesthetic-induced changes. These include high frequency activation degree, low frequency synchronization amount, presence of almost suppressed periods in the EEG and the presence of fully suppressed periods in the EEG [26]. The algorithm makes it possible to provide the optimal combination of these EEG properties and the EEG parameter of the anesthetized and calming effect to be reliably processed. It is shown in Figure 3.

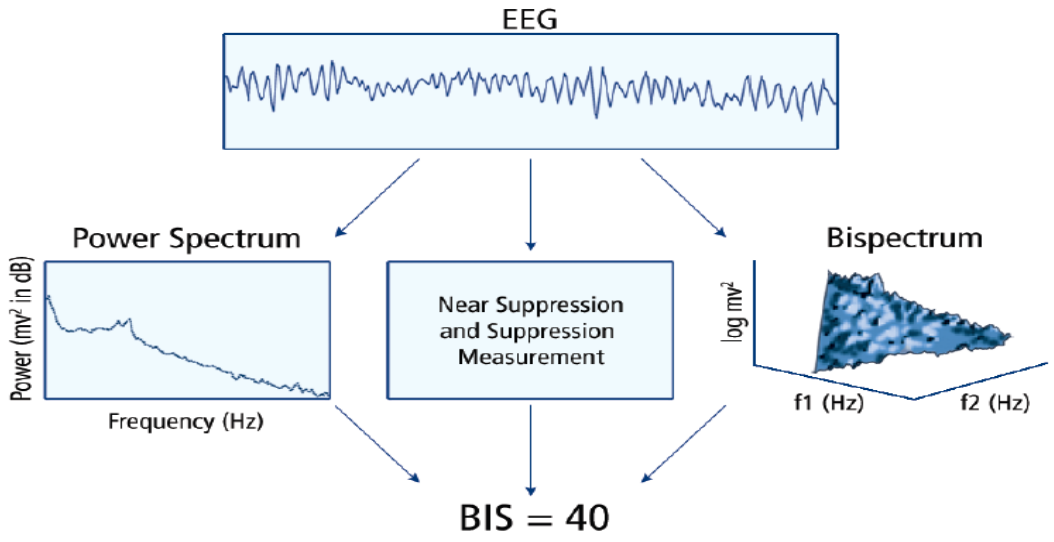


Figure 3: The BIS process, advanced with numerical demonstrating [26].

2.1.3 The BIS index: A continuum

The bispectral index is a number ranging from 0 to 100 that is shown in figure 2. The clinical endpoints indicate the EEG states that are important during the administration of anesthetic agents. The bispectral index value represents a vigilant

clinical case as the value approaches 100. If this value is close to 0, it shows the effect of cortical electrical silence.

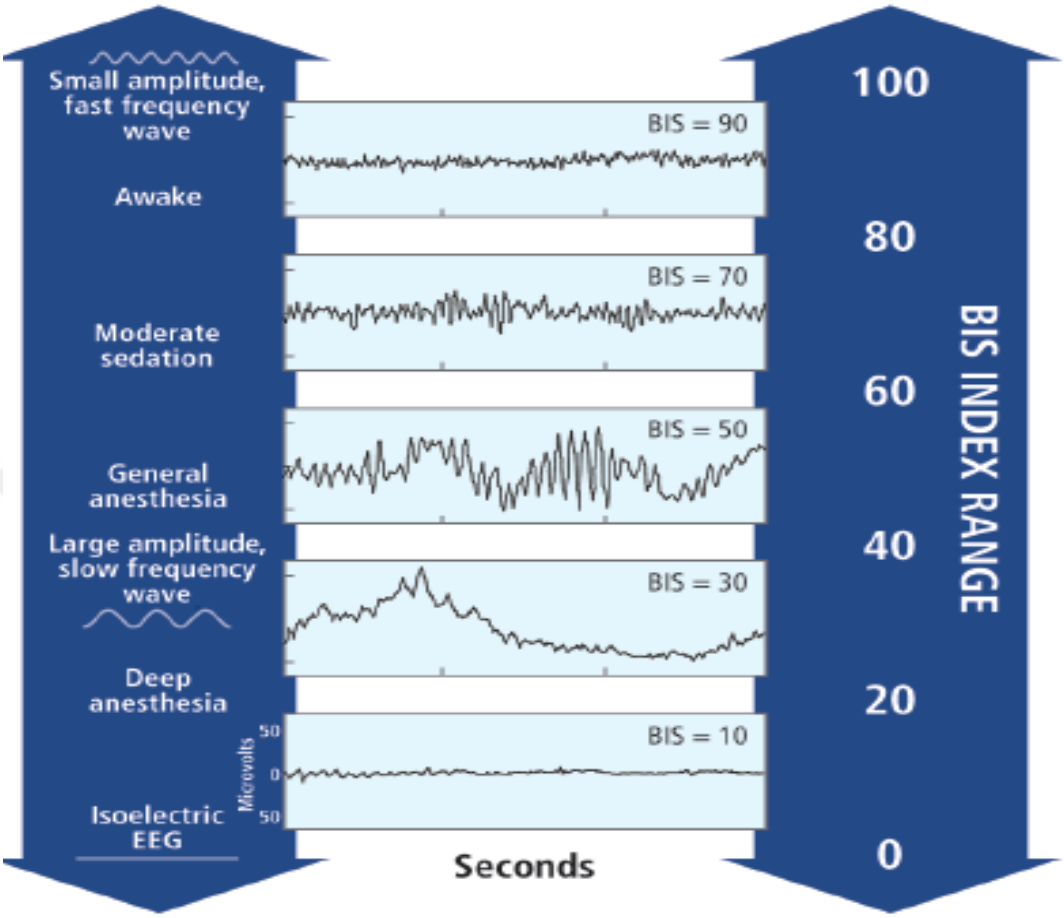


Figure 4: The BIS Index is scaled to relate with the medical [27].

It should be specified that the bispectral range denotes a band associated with the clinical position and projected replies. It is shown in Figure 4.

When the BIS beliefs decrease fewer than 70, the memory function is meaningfully reduced. The probability of recollection is harshly abridged. Throughout sedation upkeep, when the level of sedation is reached, BIS values may be greater than 70. At these stages, there could be a better option of perception and the possible for memory [27].

In studies conducted, a bispectral index of less than 60 is close to reflecting unconsciousness. The anesthesia technique used can be highly dependent on the technique. Although the bispectral index value is around 60, it can indicate a continuity of response. However, prospective clinical studies have shown that keeping bispectral index values in the range of 45 to 60 provides sufficient hypnotic

effect when performing balanced general anesthesia during the healing process. Similarly, in two major studies, keeping a sleep depth value below 60 indicates that it is related to reducing the incidence of awareness [29].

When BIS index values are below 40, it indicates that anesthesia has a stronger effect on EEG [30]. At very low sleep depth values, the EEG rating is the primary determinant of the bispectral index [31]. BIS value responses show similar cases in most cases where anesthetic drugs are given in prolonged amounts. Specifically, in addition, the responses to the administration of BIS, analgesic drugs, depend on the level of simultaneous stimulation. However, BIS values were found to be higher at an equivalent minimum alveolar concentration dose [34]. Furthermore, the results of the BIS value of ketamine production are conventional [35].

Bispectral index values can often determine the reduced cerebral velocity generated by hypnotic. A significant relationship was found between decreased BIS index values and decreased brain activity due to increased anesthesia effect. This relationship was measured using positron emission tomography [36]. (Figure 5)

However, there are reasons further than medicine management that may disturb brain metabolism. These may be changes in temperature or physiological homeostasis. These may also cause changes in the BIS Index.

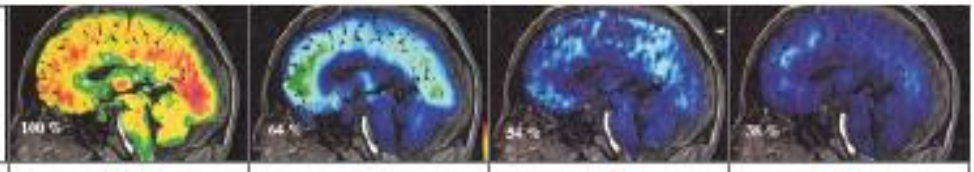
PET				
% BMR	100	64	54	38
BIS	95	66	62	34

Figure 5: There was a significant relationship between decreased metabolic rate of brain and increased anesthetic effect by decreasing BIS value [36].

Finally, the condition we need to topic out is significant here. Bispectral are a degree of the brain state derivative from the EEG rather than the attention of a specific drug. For sample, BIS values fall throughout usual sleep and also throughout an anesthetic agent administration. BIS monitoring provides potentially useful info in each of the three periods of a common anesthetic situation. These stages are as follows.

- Anesthesia induction
- Anesthesia care and Anesthesia

BIS systems show the bispectral Index value as a solo rate, calculated from information updated every second, in the EEG record from the last 15 to 30 seconds. By deriving the sleep depth index value from the EEG data for a few seconds, it is ensured that data is effectively corrected to avoid unnecessary variations in bispectral standards. It also permits the purpose of a worth, even if the EEG indication is cut presently. Many bispectral systems are intended to permit the user to variation the flattening rate to suit the clinical situation. The bispectral worth is hypersensitive. However, it does not change with clinical changes. When sudden changes in the hypnotic state occur, for example, the BIS value during induction or rapid emergence may be delayed for about 5 to 10 seconds behind the observed clinical change.

However, many BIS systems show a graph showing ongoing calculations of the BIS Index throughout the operation. This trend uses a general anesthetic to provide values that can be obtained from the BIS monitoring during the three stages of the case.

The interaction of BIS monitoring with other standard monitoring methods has produced new results in terms of patient assessment and management. By using hypnotic and analgesic effects, conceptual management strategies based on the combination of clinical profile with BIS monitoring results in balanced anesthesia techniques are formed. The use of BIS with hemodynamic data and patient evaluation makes the choice of rational sedative, analgesic and autonomous blocker effective.

The BIS value target range should be adapted to the anesthetic technique, even though it is a typical target in the BIS value between 40 and 60 maintenance stages. For sample, throughout stable anesthesia including opioid management to deliver passable analgesia, a mark choice of 45 to 60 may be very suitable. Nevertheless, for anesthetic organization using or using very little opioid or analgesic supplementation, cumulative the amount of the hypnotic cause to confirm an suitable conquest of a hazardous inspiration reply will also outcome in lesser BIS values. This value is between 25 and 35.

There is no only anesthetic method proper for a piece patient. Ideal use of bispectral index monitoring to leader anesthesia action depends on the clinical aims of thedoktors. It is significant to tolerate in attention that there is no single bispectral index value or range that can be suggested for all patients, settings and anesthetic methods founded on this idea and agent-specific sleep reply replies.

2.2 EEG

2.2.1 Electroencephalograph

The human brain weighs about 3 lb. It has the most complex software in the world. It is so sophisticated that even the supercomputers remain like the abacus. The brain is the body's boss and contains of nearby usually most them cells are named neurons. Neurons transmit an electrical charge from the axon and transmit it to the next neuron through the synapse. Since Neurons are not physically dependent. Chemical messengers are called neurotransmitters. They must pass through the synaptic cavity to deliver the message to the next neuron. These neurotransmitters activate the corresponding receptors in the neuron and generate currents that pass to the next synapse and the like in figure 6. Message is consequently both chemical and electrical.

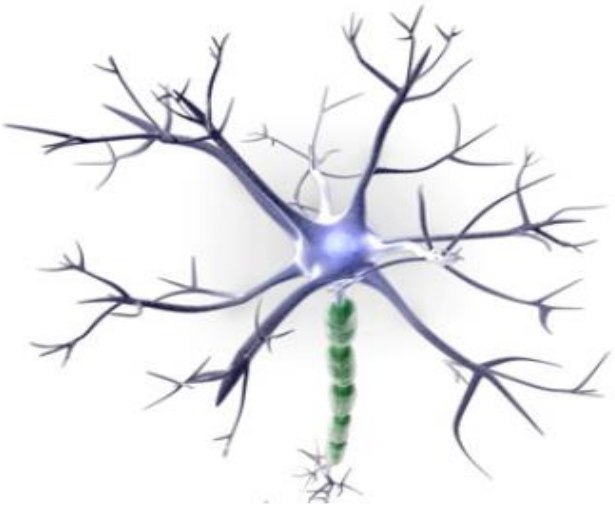


Figure 6: Artistic illustration of a single neuron and its synapses [38].

Doctors have learned how the brain works to measure this electrical activity. In addition, physicians learned that activity is a superposition of a range of potential of electric. This electric actually appear from numerous foundations [38]. Though, the abilities rising from independent neurons inside the brain have become the main concern for physicians and researchers to describe their brain activity and not to overlap.

As a result of direct calculations made from different centers in the brain, electrodes should be placed in the head region of the patient to be operated. This is not acceptable because it creates pain and risk for the subject [39]. A better solution can be placed the interest signals obtained in the scalp as shown in Figure 7.

These signals are summaries of the activity of neurons with signal-dependent weights from electrodes to the brain cell. The same potential can be recorded from multiple electrodes.

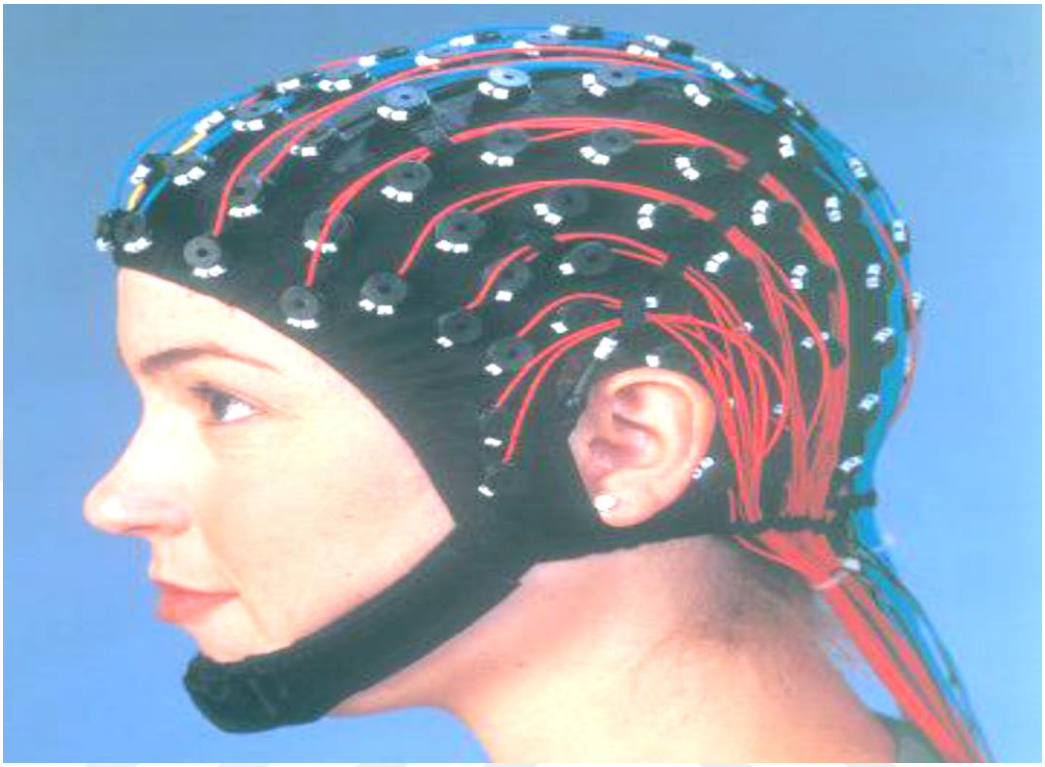


Figure 7: Location of EEG electrodes on a patient [39].

This assumes that the signals from the electrodes are probably related. Therefore, researchers place tens or hundreds of electrodes in different places on the surface of the head and collect records. These potentials are also tested through the channels of individuals. These records, determined from any channel, do not represent a total discharge from a single subdivision of the brain. However, each pair of electrodes represents the potential difference between the two areas below [40]. It is shown in figure 8. Electroencephalograph and electroencephalogram (EEG) signals are collected in the machine. From these records, an accurate assessment of separation from norms can be made.

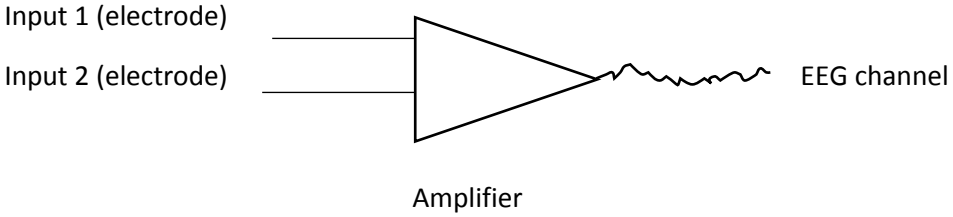


Figure 8: Amplifier which produces an indication EEG [40].

2.2.2 History

EEG studies began in the 1870s, but these studies were performed in animals. Five years later, the presence of electric current in a human brain was discovered by the British doctor Richard Caton. The results obtained were recorded by the doctor. But no more research was done. In 1924, Hans Berger, a German neurologist, took these documents and put them in a trial. He used ordinary radio equipment to increase the electrical activity of the brain. He transferred the results to the graph paper and examined the results. Thus, he found that these rhythmic changes were dependent on the individual's state of consciousness and called the recorded signals as Electroencephalogram [41]. The signals from this EEG were complex and random signals that could give information about neural activity.

2.2.3 Electroencephalograph Measuring System

There are different EEG types. This is a variety of electrodes placed in different ways and places. Among these, it is the most widely used method to locate the internationally established skin electrodes. It is based on the relationship between the location of an electrode and the area beneath the cerebral cortex. Usually it uses 21 electrodes. Positions are determined by dividing the skull by several reference points and by parameters. Each lobe in the brain has a number or another letter to identify a letter. The hemispherical shape is used to determine this. Double figures are right hemisphere; single figures belong to left hemisphere. "Z" means an electrode placed on the center line and the smaller the number, the closer the center line is. [42].

2.2.4 Wave Analysis of the EEG

The advanced the neurons that trip synchronously and the quicker the neurons, the more the potential of measured electrical oscillations in microvolts than the greater the frequency of measured oscillations in Hertz. These two parameters, amplitude and occurrence, are the simple features of brain waves. EEGs are copies of these minor electrical potentials or waves, typically less than 300 μV [43].

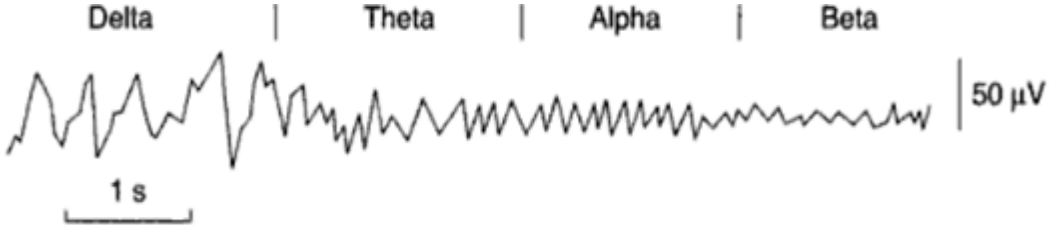


Figure 9: Some of Frequency Bands in EEG

The waves having variable small amplitude are among the specific values in an ordinary adult. These values are between 1 μV and 100 μV. These values can be measured with an average of 10 mV and 20 mV when the measurements are made with the so-called needle electrodes on the brain surface. There is a frequency-based EEG recording where a record can offer six classic categories for EEG waves. There are six different frequencies recorded for these EEG waves. This diversity is a great challenge for researchers who are trying to read a large amount of information. These waves are delta, theta, alpha, beta, mu and gamma waves. Figure 10 shows the frequency band of some waves.

2.2.4.1 Alpha (α) waves

These frequencies are like in Figure 11. These were exposed by Hans Berger in 1908. These waves are mainly caused by the occipital lobe in case of wakefulness with closed eyes in the frequency range of 30-50μV amplitude 8-12Hz.

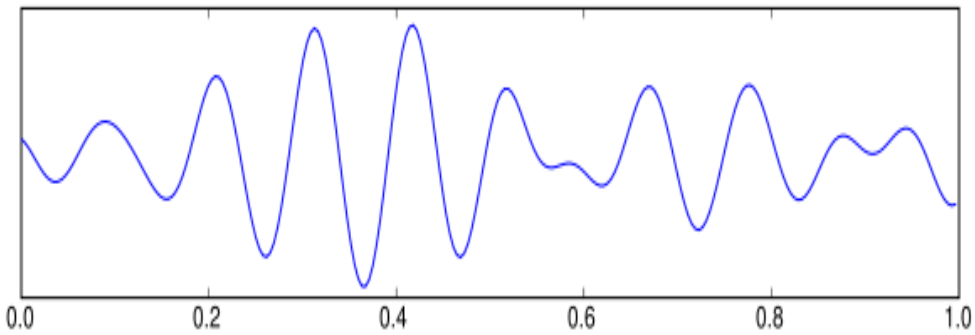


Figure 10: One second Recording of EEG Alpha Waves

Alpha waves aren't a quantity of peace and tranquility. It is not an indication of a changed state of consciousness. Fewer graphic dispensation and extra focused alpha waves are generally stronger. If we are not in deep thought, if we do not concentrate on live images and close our eyes, the alpha waves will be quite strong. The waves, known as the alpha wave, are also referred to as the occipital alpha wave. These waves are the most powerful EEG brain signals that are usually detectable. These are usually seen in all ages. But it is the most common waves in adult people. This activity is lost in situations such as stress and eye opening.

2.2.4.2 Mu (μ) waves

The mu waves are as in Figure 12. It produces oscillations in the motor and sensorimotor cortex at 8-13 Hz. It partially coincides with other incidences and reproduces the synchronous gunfire of motor neurons at break. When the object

moves and consequently the width changes are also known as the orsensorimotor rhythm.

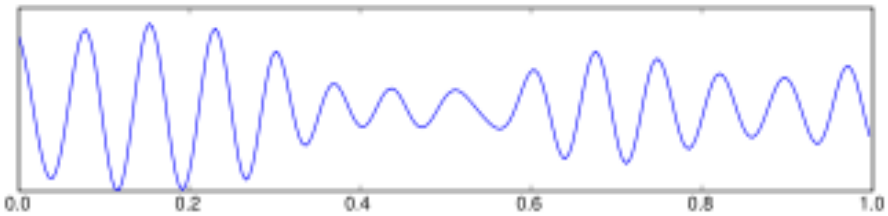


Figure 11: Mu Wave

2.2.4.3 Beta (β) waves

Beta waves are as in Figure 13. Beta waves are the frequency of human brain activity. Beta waves are low voltage. It is usually divided into three parts. The first one is high Beta Waves. The frequency value is less than 19Hz. The latter are medium Beta Waves. The frequency is 15Hz-18Hz. The last one is low Beta Waves. The frequency value is less than 15 Hz and more than 12 Hz. These waves are observed at any age and as a rhythm of active thinking, focusing on the external world of the brain and normal awakening. It is usually produced by the left hemisphere of the brain and solves concrete problems.

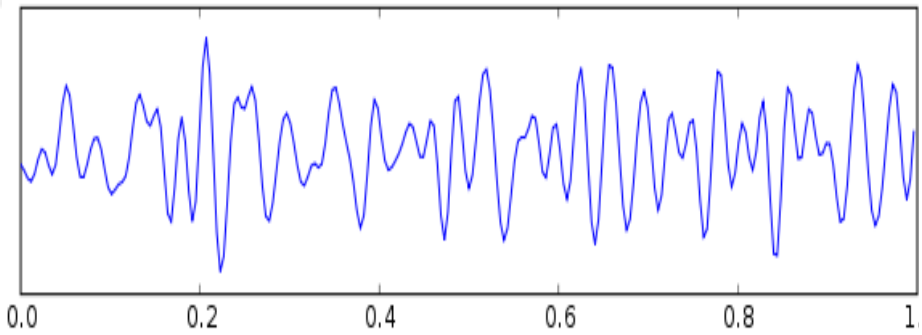


Figure 12: One second Recording of EEG Beta Wave

2.2.4.4 Theta (θ) waves

Theta waves independent of its sources. Theta waves are the slowest second frequency of brain waves. Theta waves frequency in the variety of 4-7 Hz. It is shown in figure 14. They are related with early periods of sleep, day dream, sleepy, improved creativity situations, super learning, deep reduction or consideration and dream action. These waves have high amplitude and occur in cases of arousal and strong emotion fluctuations. In an awake adult, these waves are abnormal in extreme waves.

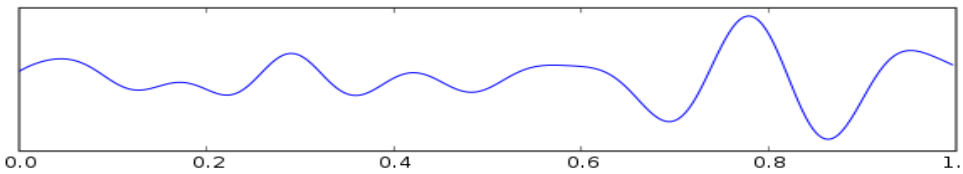


Figure 13: One second Recording of EEG Theta Wave

2.2.4.5 Delta (δ) waves

A high amplitude wave in brain in humans is Delta waves. It is associated with a 1-4Hz frequency and deep sleep for all ages, which is usually slow wave sleep is delta wave figure 15. Delta waves are abnormal in awake adults because they are completely unconscious. These waves are estimated to be caused by thalamus in relation to the reticular formation. Delta waves are responsible for the slowest mental processing. Theta and delta waves are both known as slow waves.

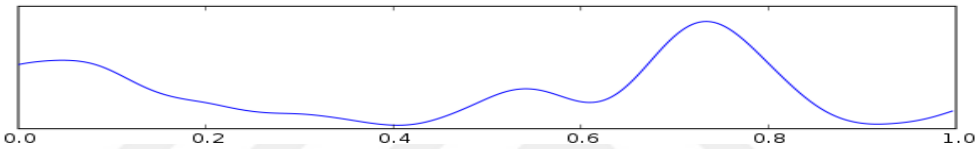


Figure 14: One second Recording of EEG Delta Wave

2.2.4.6 Gamma (γ) waves

Gamma waves are as in Figure 16. It has regularity among 25 and 100 Hz. However, 40 Hz is classical. Since analogue electroencephalography is usually limited to recording this is measuring less than 25Hz rhythms. Gamma waves were ignored in advance. However, digital electroencephalography was later taken seriously. Gamma waves are thought to characterize the required of dissimilar neuronal units to a network to perform specific cognitive or motor functions. In addition, it has long been thought to be a wave of brain knowledge and sensory binding. Gamma waves are generally associated with perception, consciousness, advanced mental and mental advancement activities, advanced intelligence, pity, self-confidence and feelings of happiness. It is also linked to a great memory and a growing sense of reality.

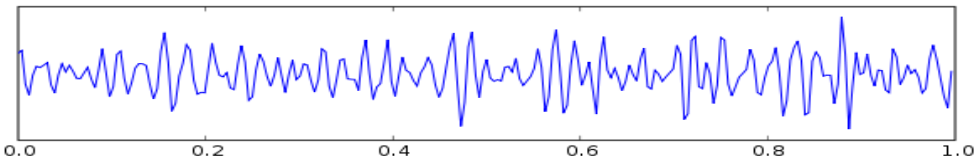


Figure 15: One second Recording of EEG Gamma Wave

2.2.5 Flow of EEG Waves

The determined EEG signals are linked to the level of consciousness of people. As the level of awareness increases, the EEG moves to a higher and more dominant frequency. It also moves to low amplitude. When the alpha waves begin to dominate the EEG, it is the time when the eyes are closed. When a person falls asleep, the effective EEG frequency decreases. Thus, theta waves begin to form. In a particular sleep phase, the so-called quick eye movement sleep system becomes active. The person thus imagines and accommodates the active movement of the eyes, which can be seen as a characteristic EEG signal. In deep sleep, delta waves start to be superior in EEG signals. These waves have big and slow deviations. Brain activity cannot be detected in a patient with complete brain death. Examples of said waveforms are shown in Figure 16.

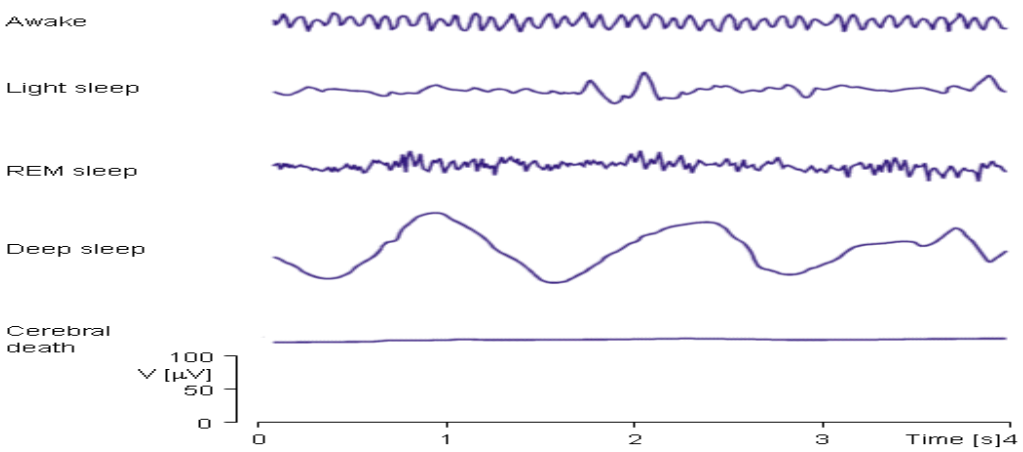


Figure 16: EEG activity is reliant on the equal of notice

2.2.6 Uses of EEG

Understanding the brain is one of the major goals of neuroscience. The development of EEG also leads to such a goal and sheds light on. The analysis of EEG waves is involved in many studies. In neurology, EEG is used to:

- Help a person know if they have a physical or cerebral fitness difficult.
- View for non-convulsive seizures.
- To classify illnesses such as Alzheimer's and Schizophrenia.
- Help a person find a chance to recover after a variation in awareness.
- Approving and identifying epilepsy.
- To distinguish therapeutic seizures and to characterize them.
- Identify fainting, migraine and cortical movement deviations.

- To localize the brain region for possible seizure surgery.
- Controlling unconsciousness problems.
- Identifying brain death.
- To investigate sleep disorders.

Previously, EEG was used as a priority method for the diagnosis of tumors, stroke and other brain diseases. However, due to the presence and development of Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) imaging techniques, the use of EEG has dropped to the background. EEG is used in neuroscience to investigate the neural correlates of mental activities from low-level processes to high-level cognition, such as attention, memory, and reading. It is also used in psychology to better understand how the brain thinks, feels and how it behaves and how it affects it.

CHAPTER III
THE RAMSAY SCORE IN ICU

3.1 Overview

Greatest of the patients in the ICU are treated with sedation. Absolute control of the depth of sedation should be done well. Human in the hospitals may experience morbidity and mortality as a consequence of this control overlook. A study was initiated 25 years ago to bring the sedation level to the same serious controlling of fluid and electrolyte equilibriums, oxygen and metabolic limitations control [44]. It took a long time for this method to be used in intensive care units and reached critical care. Though, there have been reasons that led to a critical reassessment of sedation techniques. These are economic issues and developments in pharmacology. Thus, it resulted in shorter time of mechanical respiratory support and low residence time in the intensive care unit [45].

3.2 Sedation Goals

The main purpose of sedation treatment is pain, anxiety and effective management of sleep. Intensive care is often a non-fine experience for patients who are here. Those who live here are exposed to a large number of bad and exhausting practices that take a significant part in their care period. Sedation treatment is carried out to make this place more treatable and more humane. Careful and precise control of the treatment of sedation provides better control of the patient requiring mechanical ventilation support. It may also reduce the use of neuromuscular arrest agents [46].

The wanted and expected result of a sedation application is to allow the patient to minimize the need for but distracting practices and treatments in the physical environment and ICU. In this way, we facilitate the nursing care and management. In this way, we reduce both anxiety and stress. Thus, posttraumatic stress disorder does not occur after discharge from the intensive care unit. The most important thing in intensive care is patient safety. The patient should be prevented from multiply the self extubation tube. In the addition, it is important to prevent the removal of the catheters and other vital equipment connected to the patient uncossciosusly by the

patient. Amneia is another important goal of sedation application. Therefore, the patient should not remember disturbing events or the environment. However, it has been suggested that patients recovering from intensive care treatment should recall the severity of their illness, suggesting that they may have an unrealistic idea of their recovery [47]. Low oxygen consumption and ventilator compatibility are other important goals of sedation therapy. The continuation of a normal sleep pattern can eliminate the loss of exhaustion and increase the desire for survival [48]. Agitation in the patient in the intensive care unit is another common problem. Hypoxia, which means low oxygen, ie low, can cause metabolic deterioration under ventilation. This is an important situation that should be considered first. Since this is correctable. Sedation is required for interaction and control [49].

3.3 Pain Management

Effective pain management is essential for proper management of sedation. This leads to a faster recovery with increased patient satisfaction and reduced complications. It should be prioritized when evaluating the sedation requirements of a patient. Adequate sedation can decrease the essential for extra sedative actions. Nearly totally people in the intensive care unit suffer from the procedures applied to them, as a result of the illness procedure, tubes or located tubes, or since they are powerless and cannot change locations. If the people in the intensive care unit lose his / her sensation, he / she will have lost his / her ability to communicate to the upkeep crew. Plain unprocessed discomfort can source psychosomatic things with negative hemodynamic changes.

Tachycardia and hypertension, as well as increased systemic vascular resistance, lead to increased myocardial oxygen consumption and increased demand for myocardial ischemia [50]. Furthermore, the patient may have a detrimental effect on the immune system. Good and effective pain control can reduce the need for deep sedation. It also reduces the need for muscle relaxants. Morphine or fentanyl is two of the most commonly used narcotics in the intensive care unit. These are known as effective painkillers. However, they may have significant side effects that may have a detrimental effect on the patient [51].

These opposing properties are breathing despair, deep sedation, nausea, vomiting and low communication ability. Almost all narcotics have long-term effects when administered continuously to patients with multiple organ system insufficiency. This is the common profile for inpatients. A relatively new type of

drugs that are rapidly metabolised to metabolites with very poor narcotic activity by nonspecific esterases can play a upcoming part in the nearby controller of hurt in the ICU patient [52].

3.4 Over Sedation

Excessive sedation may cause different results in mechanically ventilated patients. These are increased ventilation time, increased time to stay in intensive care unit and increased maintenance cost. This may facilitate the ventilator synchronization, but will extend the time of the ventilator removal. The patient, who is removed from the extra-oxygen ventilator, may not have a sensitive respiratory depression monitor. Under these conditions, the parameters associated with respiratory distress are the parameters of respiration and the level of consciousness. Breathing degree and end-tidal carbon dioxide values measured by catheter insertion are not reliable monitors for depressing breathing [53]. The pulse oximeter is a late breathing despair sensor when there is an improved total of oxygen [54].

3.5 Sedation in Under

Amplified creation of endogenous catecholamines which cause increased blood pressure and heart rate is one of the undesirable effects of sedation. Patients in intensive care units might be at risk of damage by themselves or by staff due to inadvertent removal of the endotracheal tube or other significant tubes. The cerebral properties subsequent from existence wakeful while sore and the patient discharged after the procedure on the patient may develop posttraumatic stress disorder that may require long-term treatment [55].

Patients who do not respond since of the management of neuromuscular spoiling pills are at the maximum danger [56]. Snooze removal is much shared and may lead to the advance of characteristic intensive care psychology [57].In order to prevent the negative effects of bad sedation, sedation therapy should be applied carefully and precisely. If the patient is sedated at high depth, they ought to be carried to a near where neurological duty can be completed each a day, unless clinically contraindicated [58].

To meet this endpoint, by identifying the level of sedation and carefully controlling sedation, the dangers below or below sedation are minimized. To achieve this goal, sedation scales should be routinely used. The chosen scoring system should be easily understood. It should be used routinely. They should be part of the regular evaluation of their patients.

3.6 The Ramsay Sedation Scale

Between 1996 and 1999, 25 sedation assessment tools were published, in which the validity and reliability of adults were rigorously tested: MAAS this means that “the motor action assessment scales”, the Ramsay sedation scale and the sedation agitation scale (SAS). Since 1999, other scales, including ATICE this means that “the adaption to the intensive care environment scale” and the Richmond agitation scale (RAS) have been validated and are used in some critical care areas. Research shows that the SAS has been consistently rated as reliable, possibly because it comprises only one item, with a response option ranging from one to seven (Riker et al 1994). The MAAS, which also receives consistent ratings for reliability, is anadaptation of the SAS and also comprises only one item. De Jonghe et al (2000) systematically reviewed 25 studies involving 900 patients to measure the effectiveness of the MAAS, Ramsay and SAS scales in evaluating consciousness level, sedation level and the side effects of sedation, but not the ability to detect change in responsiveness over time.

The reviewers also noted that the scales could be used to evaluate agitation, pain and anxiety, as well as reactions to endotracheal aspiration, although this can be inappropriate in the care of sedated patients. Their study can be criticised, however, because, of the three scales under review, only the Ramsay scale had been validated adequately for use in the critical care environment.When deciding on the most appropriate sedation assessment tool for use in EDs, practitioners should bear in mind that reliability studies, like those mentioned above, are largely generalized to critical care, where patients have different requirements from those cared for in EDs. The introduction of a simple tool, therefore, can ensure such assessments are reliable as long as the difference between assessments of sedation and consciousness is clear.

When performing a sedation scoring system, it should not be separated from another sedation protocol and should be considered together. The four most commonly used scoring applications are the following. The first one is called the "Ramsay Sedation Scale". The second is the "Sedation Shaker Scale" known as SAC. The third is the MASS (Motor Activity Assessment Scale). The latter is the "Comfort Scale" for pediatric patients [59]. Ramsay Sedation Scale (RSS) is the most commonly used scale. RSS is designed as the first scale and reusability test. RSS scores six levels of sedation depending on the patient's condition. It is an intuitive open scale. For this reason, it can also be used in services where sedatives or narcotic

drugs are given besides the ICU. Pain can be added to the score. The sixth can be considered a vital sign.

Table 1: Ramsay Sedation Scale

Response	Score
Anxious or restless or both	1
Cooperative, orientated and tranquil	2
Responding to commands	3
Brisk response to stimulus	4
Sluggish response to stimulus	5
No response to stimulus	6

The RSS defines as like that. Level 1: In this level the patient is restless or anxious, and this scale can be changed through to the sedation level 6. In grade 6 the sufferer t has no answer. So, if an assessment is to be made, the primary result is to note whether the patient is awake. In RSS 1 state, the patient is awake. If the patiens are they co-operative and communicative, they are in state 2. If the sufferer is asleep, a reusability exam is required. In RSS 3, the patient responds the voice and command if the reactions start to decrease gradually; it means that it is passed tograde four. If the patient does not respond, a stronger stimulation response is made. This is a higher auditory alert. This makes the patient respond to RSS 4 if the patient responds quickly to the reusability test. If the patient's answers and reactions are slow, the patient is sent to grade 5 in RSS.

The re-usable stimulation was exactly tapped as a tender test to avoid confounding the patient. The aim here is to try to bring a sleeper patient to a completely awakened state. Thus, it is thought that the sleep design is not troubled. A difficulty of RSS is that the patient can respond. Consequently, if the patient is taking blocking drugs, it is not appropriate to evaluate this way.

Furthermore, there is no other meaning of the mark of agitation of the 1st grade result. However, there is a situation in which recording can be important. The Sedation-Agitation Scale takes this into account [60]. In the depth of the scale, there may be no other data about whether this is an RSS 6. The patient may be under general anesthesia or in a deep coma. Bispectral index results interrelated well with each other.

CHAPTER IV
COMPUTED TOMOGRAPHY

4.1. Introductıon

Diagnosis of many diseases became easier with the invention of Computed Tomography in the early 1970s. In other words, a new era has started in disease diagnosis. The main advantage of CT compared to conventional radiography is that anatomy is illustrated without superimposition as multiplanar CT can provide sectional anatomic images in axial, sagittal and coronal planes .

During a CT scan, the x ray tube rotates in a circular orbit around the patient as an X ray fan shaped beam penetrates the patient. nA number of detectors calculate the attenuation value of the beam which corresponds to the linear attenuation coefficient (μ). The linear attenuation coefficient, through complex algorithms is converted into the CT or Hounsfield Units which are being used for display purposes. These numbers can be found only in CT imaging and each one defines the relative density of a substance in the tissue (Table 2) which represents a specific shade of gray.

Table 2: Tissue types and CT Numbers (2010)

Tissue type	**CT Numbers**	**Appearance**
Cortical Bone	+1000	White
Muscle	+50	Gray
White Matter	+45	Light Gray
Gray Matter	+40	Gray
Blood	+20	Gray
CSF	+15	Gray
Water	0 (baseline)	
Fat	-100	Dark gray to black
Lung	-200	Dark gray to black
Air	-1000	black

A CT image is constructed by a square array of pixels which are the basic two dimensional element of the digital image. Each one of these pixels represents a CT number (specific value of linear attenuation coefficient) which means a specific shade of gray, thus a CT image is actually constructed by a variety between shades of gray which can be seen on the screen. Each pixel corresponds to a voxel which has three dimensions, the pixel which has the basic two dimensions and the slice thickness which represents the third dimension of the CT image. In the late 1990's with the invention of Slip Ring technology the x-ray tube rotates around the patient and the patient moves towards the z-axis so that the x-ray tube obtains continuous images along the patient's path. can be described as helical or spiral. Examination protocols with spiral scanners can be done in much less time because there are no pauses between the slices (data acquisition cycle is 100%) and this provides many advantages comparing to conventional-nonspiral scanners (Baert, et al., 2009; Thorsten, 2008). A larger volume of the patient can be covered in shorter time without demanding breath holds and furthermore, angiography is available especially in multiphase abdominal imaging and 3D imaging can be reconstructed. Helical scanning can be used in both single slice and MSCT, where multiple slices can be acquired during a single tube rotation. Nowadays, MSCT scanners can obtain a total number of 256 slices within one rotation and of course this is an advantage which brings down even more scanning time and improves spatial resolution and image quality as slices of submillimiter can be acquired. Nowadays, a CT stroke protocol includes a Non Contrast Computed Tomography (NCCT) which it is used mainly to detect a hemorrhage due to its high sensitivity. If an intracranial hemorrhage is not detected, then Computed Tomography Angiography (CTA) is performed to identify an occluded vessel which may confirm an ischemic stroke and then Perfusion imaging to evaluate the ischemic penumbra).

4.2. Some common uses, Benefits and risks of the CT

- CT is classically used to detect head
- Hemorrhage in patients with head impact
- In a patient with sudden and severe headache due to tearing or leakage of an aneurysmStroke condition detection.
- It's a brain tumor.

- In the detection of brain damage and skull fractures.
- Detection of enlarged brain spaces.
- Detection of skull diseases.
- A blood clot or depletion in the brain, which is one of the situations in which the patient may show signs of paralysis in a short period of time.

CT is also accomplished to:

- Measure the grade of bone and soft tissue injury and schedule surgical reconstruction. especially in patients with facial trauma
- Identify bone illnesses in the skull because these can cause hearing problems.
- Determine if there are any inflammations.
- Organization radioactivity rehabilitation for cancer of skins.
- Evaluate the malformations of aneurysms by a technique called CT angiography

Benefits

- CT scan is not painful.
- CT scan is invasive and accurate.
- It can display tissue which is not hard and blood vessels meanwhile.
- CT scan provides many detailed images of lungs, bones and blood vessels as well as many tissue types.
- CT examinations are quick and simple.
- It can cause internal injuries and bleeding very quickly in case of emergency.
- It is suitable for the resolution of a wide variety of clinical problems of CT.
- Cost-effective display tool.
- Less sensitive than CT, MRI in moving patients
- Computed tomography can be performed even if you have an implanted medical device placed on your body.

Risks

- When radiation is exposed, there is always a small risk of developing cancer.
- Although there is a risk of cancer, this risk falls to the lowest level, considering the benefit of a correct diagnosis.

- The effective radiation dose can vary for each procedure.
- Women who are likely to become pregnant should always inform their physician or IT technician.
- A CT for pregnant women is generally not suggested if the CT scan for babies is medically required due to a very high risk. Though, this danger is the lowest in the head scans.

Children compared to radiation CT should not be performed unless they are more sensitive because they are more sensitive, but if there is no other remedy to make a diagnosis, a CT examination should be performed. Also, duplication should be avoided unless a CT scan is absolutely necessary. The lowest dose should be used when performing CT scans in children.

4.3. CT dose and effects

The atom, the building block of matter, consists of a nucleus of protons and neutrons and electrons rotating around the nucleus. If the number of neutrons in the atomic nucleus of any substance is greater than the number of protons, indecisiveness occurs in the nucleus. Excess neutrons are disintegrated to stabilize. The energy emitted to the environment during this fragmentation is called radiation Bu. X-rays used in medical imaging are high-frequency, high-energy rays from the ionizing radiation group.

The effects of radiation on tissues can be divided into two main classes as somatic and genetic effects [61, 62]. The somatic effects are also separated as predictable effects. Detectable effects occur by exposure to high-dose radiation of large body regions. A radiation dose above a certain threshold value is required and the effect increases in direct proportion to the dose. Burns, skin lesions, sheet loss, cataracts and prenatal effects are included in this group. The estimated effects are due to prolonged exposure to radiation at low doses. There is no specific threshold dose. The risk increases with the dose but the intensity of the effect is independent of the dose. Usually a long waiting period is required for the effect to occur. Radiation-related cancer is in this group. The risk is cumulative and the degree of impact is closely related to age, type of tissue, and the type of radiation. Genetic effects are in the reproductive cells and occur in later generations, not in the person exposed to radiation. In order for the genetic effect to occur, the exposed cell must be fertilized.

Although different parameters are recommended to measure the radiation dose to which the patient is exposed, the most commonly used parameter for this purpose

in daily practice is the effective dose of the unit miliievert (mSv), since it allows comparison of the radiation dose used in different methods [63, 64]. The effective dose is defined as the amount of total body radiation that will cause the same damage as localized radiation in a given organ. This is calculated based on data from long-term follow-up of survivors of atomic bomb explosions. It should be noted, however, that this parameter does not have a physical standard in which it is a relative value calculated by a number of formulas based on assumptions. It is also an important limitation that the partial radiation-induced damage to medical procedures is estimated by the results of high-dose radiation exposure [64]. In addition, ED has been developed to show the risk in the general population rather than showing the absolute patient-specific risk [63]. Dose-length product (DLP) shows the amount of radiation the patient is facing during a single CT scan and is given in mGy x cm on CT devices [63].

The most important parameters are radiation units at the beginning of these doses and calculations. Because we have heard that radiation values are mentioned in different names. It is necessary to know the amount of radiation in order to achieve results and to determine the harmful biological effects in studies with ionizing radiation. For the measurement methods to be developed for this purpose, it is mandatory to first define the units used in the measurement of the amount of radiation. The International Committee on Radiation Units (ICRU) defined specific units for the activity, irradiation dose, absorption dose and dose equivalent, which are the concepts used in radiation studies.

These are respectively, Curie (Ci), X-ray (R), rad and rem. These special units have been abandoned since 1986 and replaced by the International Units System (SI) in order to have the same units used all over the world. SI units for the same concepts were chosen as Becquerel (Bq), Coulomb / kg, Gray (Gy), and Sievert (Sv) respectively.

Units of Radiation Used in Medicine:

Curie: $3.7x10^{10}$ per second is the activity of the substance showing degradation or degradation.

X-Ray: x and gamma ray amount which creates positive and negative ions at the electric load of $2.58x10^{-4}$ C in 1 kg of air under normal weather conditions.

Rad: It is the amount of radiation that gives 10^{-2} joule energy to 1 kg of irradiated material. The absorbed energy may be particle or photon.

Rem (rontgren equivalent man): 1 X-ray is the amount of radiation that generates the same biological effect as the X or G ray.

Rem = (rad) x (W_R)

The WR is called the ü Radiation weight factor W. It is a factor used to take into account the differences in biological effects of different radiations and also to simplify radiation protection calculations.

International system of units

Bequerel: It is the activity of the nucleus which makes 1 fragmentation per second.

Coulomb / kilogram (C / kg): is the amount of X or (radiation that forms the (+) and (-) ions in the electric charge of 1 Coulomb at 1 kg of air in normal weather conditions.

Gray: The amount of radiation that gives 1joule of energy to 1 kg of irradiated material.

Sievert: 1 Gray is the amount of radiation that produces the same biological effect as gray and x ray.

In Table 4, the relationship between specific units used in radiation terms and dose calculations and SI units is given.

Table 3: Dose calculation between specific units and SI units and radiation term

TERM	**UNIT**		**CONVERSION**
	SPECIAL UNIT	**SI**	
Activity	Curie (Ci)	Becquerel (Bq)	1Ci=3.7x10^{10} Bq 1 Ci=37GBq
Irradiation Dose	Röntgen (R)	Coulomb / kilogram (C/kg);	1C/kg=3876 R1R=2.58x10^{-4}C/kg
Adsorbed Dose	Radiation doz (rad)	Gray (Gy.	1Gy=100rad 1rad=0.01 Gy
Dose Eqivalent	Rontgen equivalent man (Rem)	Sievert (Sv)	1Sv=100 rem 1rem=0.01Sv

We all live under the irradiation of natural background radiation from cosmic radiation from space, from earth crust, from certain foods and beverages, even from natural radiation sources in our bodies and from radon gas. This radiation is

expressed as low intensity radiation. The radiation exposure to patients undergoing ionizing radiation and those who have undergone diagnostic investigations (e.g., computed tomography) is also considered to be a low-intensity radiation. The intensity of this radiation is estimated between 100 mSv and the natural background. What everyone is curious about is the effect of this low radiation on the health. It has been accepted that low-dose radiation can also have a very low cancer risk due to high-dose cancer. This led to the emergence of a radiation phobia in societies. The most important reason for this is that most people do not think that the concept of risk is a possibility and that it is a risk that is definitely a result. However, the risk is the probability of occurrence of an event, no certainty. For example, the risk of a person dying in an airplane crash is 1 in 11 million. This value was determined by taking into account the numbers of people who died in the past flights and accidents.

X-rays are used in various devices in medical imaging. Computed Tomography (CT) is the most comprehensive use in today's clinical practice. Since the introduction of CT in the 1970s, its use has increased rapidly. The most important factor in this shot is the rapid technical developments in CT and the widespread use in clinical applications. The increase in CT use was especially in pediatric patients. Multislice CT technology reduced the duration of shooting and facilitated the use of CT in children. Thus, the use of CT examinations increased rapidly without the need for anesthesia. The largest increase in CT use is in adult patients. Adults are usually screened in the lung, cardiac and whole body.

In computed tomography, more radiation doses are taken when compared to conventional x-ray examinations. For example, in a lung x-ray, the organ dose is approximately 0.01-0.15 mGy, while the thorax CT is 10-20 mGy. Even in 64 cross-sectional CT this dose is approximately 80 mGy [65]. The amount of organ taken in CT depends on many factors. The most important ones are patient size, section thickness, section number, pitch value, tube voltage and current value. Most of these shooting parameters can be changed by radiologists or technicians during the examination [66]. Ideally, a separate shooting protocol is planned for each individual and for each examination. However, this practice is not possible in the intensive workflow [67]. The number of examinations is also an important factor affecting the amount of dose taken. What Mettler and his friend’s do. In the study, 30% of the cases had three examinations on the same day, 7% had five examinations and 4% had more than nine examinations [68].

Studies carried out after the gold standard atom bomb explosions are considered in quantitative evaluation of the cancers caused by radiation at low doses [69]. In these studies, the population is over 100.000 and includes all ages and both sexes. It is known that approximately 30.000 of the inhabitants are exposed to low dose radiation. The accepted low-dose radiation is between 5-200 mSV and is equivalent to the dose that can be taken during one or more CT examinations. In these studies, two main results have been obtained. First, there was an increased relationship with radiation dose at the risk of all solid cancer. Secondly, and perhaps most importantly, children are much more affected than adults [70].

So are we aware of the risk? Answer is no. Because, in a study conducted between radiologists and emergency physicians in the US, the radiation dose consisting of CT was found to be ignored by 75% in both groups. 53% of radiologists and 91% of emergency physicians do not believe that the risk of cancer has increased in CT examination [71]. This for the purpose of physicians' awareness raising in the United States by the National Cancer Institute and the Society for Pediatric Radiology distribution [72]. Another question that should be asked is whether CT use or organ dose can be reduced? Yes, it can be reduced and there are several different ways [73]. First of all, the need for CT with a good clinical approach can be limited. Blunt abdominal trauma, epilepsy, chronic headache, and even acute appendicitis may reduce CT use.

Other imaging methods use can be provided. For example, use of ultrasonography (US) or abdominal radiography in nephrolithiasis; Magnetic resonance imaging instead of CT examinations MRG or appendicitis instead of CT can be used as alternative imaging method. In spite of all this, the CT scan should of course be used as a medical requirement. To obtain sufficient information, the minimum dose should be taken. By making changes to the CT shooting parameters, the optimum configuration should be ensured. Nowadays, most of the big companies that produce IT have started to produce automatic dosing control devices.

In 2006, a committee of scientists and educators gathered by the National Research Council and edited by the National Academy of Sciences published a report on Health Risks without Ionizing Radiation to Low Levels of Ionizing Radiation. BEIR VII Phase 2 Reports [74]. The table estimates the number of additional cancer cases attributable to a single 0.1Gy (100 mSv) dose for different age groups. The data are based on the prevalence of all types of cancer.

Table 4: Lifetime Attributable Risk of cancer from exposure to radiation. Number of cases per 100.000 persons exposed to a single dose of 0.1 Gr

Age at Exposure	Male	Percent	Female	Percent
0	2563	2,56 %	4777	4,78 %
5	1816	1,82 %	3377	3,38 %
10	1445	1,45 %	2611	2,61 %
15	1182	1,18 %	2064	2,06 %
20	977	0,98 %	1646	1,65 %
30	686	0,69 %	1065	1,07 %
40	648	0,65 %	886	0,89 %
50	591	0,59 %	740	0,74 %
60	489	0,49 %	586	0,59 %
70	343	0,34 %	409	0,41 %
80	174	0,17 %	214	0,21 %

In addition, after exposure to the cancer-triggering event, this disease takes decades to emerge. Therefore, it is not possible to distinguish additional cases of radiation-induced cancer from the cancer cases caused by natural causes. In order to understand the effect of low-intensity radiation, there must be a large number of people irradiated and irradiated. Moreover, in order to take into account the possibility of other causes of cancer, the lives, ages, habits of millions of people in these two groups should not be very different from their health status. Such a study cannot be practiced in practice radiation formed by medical imaging techniques. It is stated in the United States that it is responsible for half of the radiation exposed to the public. In the report reported from the UK in 2005, it is reported that approximately 6 out of 1 annual radiation effects are caused by radiological imaging. When we look at the source of the radiation exposed to the public in 2006 in the United States;

- 50%: Natural (radon gas, cosmic rays, etc.) radiation
- 2%: Professional impact
- 24%: Effect due to computed tomography applications
- 12%: Applications of Nuclear Medicine
- 7%: Interventional radiology applications
- 5%: Conventional radiological examinations (radiographs)

Different models have been developed to estimate the dose-cancer risk relationship. The most accepted of these models is linear no-threshold? (LNT). In this model, radiation exposure is considered to be at risk of developing cancer no

matter how low. The LNT model was formed from the long-term follow-up information of the surviving population after the Hiroshima atom bomb. The data on this population is used to calculate the risk of future cancer for those exposed to low-dose radiation. The effect of radiation on the tissues is expressed as the biological biological effect. The effective dose definition is used to calculate the cancer risk due to radiation effect and the unit is inverted (Sv). The calculation of the exposed radiation from the sievert form allows us to make comparisons between different imaging techniques. The effective dose that we are exposed to from the natural environment (due to radon gas and cosmic rays) is around 3 mSv (spindle sievert) per year. The effective doses given in most of the most commonly used imaging tests in the following table are calculated for an average adult, and this dose may vary up to 10 times depending on the individual (due to factors such as age, weight, gender of the patient). The following table shows the average dose amount of computed tomography.

Table 5: The amounts of the dose affected the human body from BT.

Technics	**Mean effective dose (mSv)**
Whole Body CT	12
Anterior and posterior chest X-ray	0,02
Anterior, posterior and lateral ches+6t X-ray	0,1
Lung CT	8
Pelvis BT	6
Abdomen BT	8
Abdomen CT (Dedicated Liver)	15
BrainBT	2
Neck BT	6
Thoracic Spine CT	10
Lumbar Spine CT	5,6
Chest CT	15
Cardiac CT (Coronary CT)	16
Virtual Colonoscopy CT	10
Anterior and posterior chest X-ray	12

The American Society of Radiologic Technologist has an online radiation risk calculation system (www.xrayrisk.com/calculator/calculator.php). Although the need for education in this area is clearly evident, there is no common source of information for both patients and health care providers to increase the risk of cancer in medical imaging. X-RayRisk.com is a training website that focuses on predicting this risk. One of the key features of the site is a web-based calculator that allows

users to track frequently viewed questions, track their viewing history, and estimate their personal risks. For this reason, every examination should have a basis in diagnosis and follow-up, and should be followed as often as necessary in follow-up. Calculations from this site are shown in table 6 and table 7.

Table 6: The risk of developing cancer in women and men between the ages of 20 and 50's years.BT is implemented once a year.

Study	**Gender**	**Age**	**# of exams**	**Dose (mSv)**	**Additional Cancer Risk (%)**
Brain CT (Standard)(yearly)	Male	20-50	31	62	0.488059%
Brain CT (Standard)(yearly)	Female	20-50	31	62	0.730604%
Brain and Neck CTA/CTP(yearly)	Male	20-50	31	508.4	4.002080%
Brain and Neck CTA/CTP(yearly)	Female	20-50	31	508.4	5.990950%
Neck CT(yearly)	Male	20-50	31	186	1.464176%
Neck CT(yearly)	Female	20-50	31	186	2.191811%
Thoracic Spine CT(yearly)	Male	20-50	31	310	2.440293%
Thoracic Spine CT(yearly)	Female	20-50	31	310	3.653019%
Lumbar Spine CT(yearly)	Male	20-50	31	173.6	1.366564%
Lumbar Spine CT(yearly)	Female	20-50	31	173.6	2.045690%
Chest CT (Low Dose Screening)(yearly)	Male	20-50	31	62	0.488059%
Chest CT (Low Dose Screening)(yearly)	Female	20-50	31	62	0.730604%
Chest CT (Standard)(yearly)	Male	20-50	31	217	1.708205%
Chest CT (Standard)(yearly)	Female	20-50	31	217	2.557113%
Cardiac CT (Coronary CT)(yearly)	Male	20-50	31	496	3.904468%
Cardiac CT (Coronary CT)(yearly)	Female	20-50	31	496	5.844830%
Cardiac CT (Calcium Scoring)(yearly)	Male	20-50	31	93	0.732088%
Cardiac CT (Calcium Scoring)(yearly)	Female	20-50	31	93	1.095906%
Abdomen CT(yearly)	Male	20-50	31	248	1.952234%
Abdomen CT(yearly)	Female	20-50	31	248	2.922415%
Abdomen CT (Dedicated Liver)(yearly)	Male	20-50	31	465	3.660439%
Chest, Abdomen and Pelvis CT(yearly)	Male	20-50	31	651	5.124615%
Chest, Abdomen and Pelvis CT(yearly)	Female	20-50	31	651	7.671339%
Pelvis CT(yearly)	Male	20-50	31	186	1.464176%
Pelvis CT(yearly)	Female	20-50	31	186	2.191811%
Sinus CT(yearly)	Male	20-50	31	21.7	0.170820%
Sinus CT(yearly)	Female	20-50	31	21,7	0.255711%
Virtual Colonoscopy CT(yearly)	Male	20-50	31	310	2.440293%
Virtual Colonoscopy CT(yearly)	Female	20-50	31	310	3.653019%
	Totals:		**992**	**8847.4**	**8.6951555 %**

Table 7: The risk report of a 30-year-old man and woman shot once a year on CT.

Study	**Gender**	**Age**	**# of exams**	**Dose (mSv)**	**Additional Cancer Risk(%)**
Brain CT (Standard)	Male	30	1	2	0.017529 %
Brain CT (Standard)	Female	30	1	2	0.026684 %
Brain and Neck CTA/CTP	Male	30	1	16,4	0.143741 %
Brain and Neck CTA/CTP	Female	30	1	16,4	0.218809 %
Neck CT	Male	30	1	6	0.052588 %
Neck CT	Female	30	1	6	0.080052 %
Thoracic Spine CT	Male	30	1	10	0.087647 %
Thoracic Spine CT	Female	30	1	10	0.133420 %
Lumbar Spine CT	Male	30	1	5,6	0.049082 %
Lumbar Spine CT	Female	30	1	5,6	0.074715 %
Chest CT (Low Dose Screening)	Male	30	1	2	0.017529 %
Chest CT (Low Dose Screening)	Female	30	1	2	0.026684 %
Chest CT (Standard)	Male	30	1	7	0.061353 %
Chest CT (Standard)	Female	30	1	7	0.093394 %
Cardiac CT (Coronary CT)	Male	30	1	16	0.140235 %
Cardiac CT (Coronary CT)	Female	30	1	16	0.213472 %
Cardiac CT (Calcium Scoring)	Male	30	1	3	0.026294 %
Cardiac CT (Calcium Scoring)	Female	30	1	3	0.040026 %
Abdomen CT	Male	30	1	8	0.070118 %
Abdomen CT	Female	30	1	8	0.106736 %
Abdomen CT (Dedicated Liver)	Male	30	1	15	0.131470 %
Abdomen CT (Dedicated Liver)	Female	30	1	15	0.200130 %
Abdomen and Pelvis CT	Male	30	1	14	0.122706 %
Abdomen and Pelvis CT	Female	30	1	14	0.186788 %
Chest, Abdomen and Pelvis CT	Male	30	1	21	0.184059 %
Abdomen and Pelvis CT	Female	30	1	14	0.186788 %
Chest, Abdomen and Pelvis CT	Male	30	1	21	0.184059 %
Chest, Abdomen and Pelvis CT	Female	30	1	21	0.280182 %
Pelvis CT	Male	30	1	6	0.052588 %
Pelvis CT	Female	30	1	6	0.080052 %
Sinus CT	Male	30	1	0.7	0.006135 %
Sinus CT	Female	30	1	0.7	0.009339 %

On the other hand, in some CT techniques, PET / CT, CT fluoroscopy and high patient doses may occur in CT for cardiac purposes. The risk of cancer in women aged 40 years who undergo brain examination is 1: 8100, but this rate can be as high as 1: 270 in CT coronary angiography. Once again, I have to underline that the risks of radiation doses from CT examinations are extremely small compared to other risks of daily life, especially cigarettes. It should not be forgotten that CT is an indispensable technique in the diagnosis of many diseases. There is no doubt that the prevention of disease diagnosis will result in much more grave problems due to the fact that radiation is not used as a result of fear of radiation.

In conclusion, although CT has important medical benefits in terms of diagnosis, there is a great risk of radiation-associated cancer. This situation can be a big problem of the future in the social sense. The profit loss rate should be considered well before deciding on the use of IT. Good clinical approach and other imaging methods should be used before the indication is made. If the CT scan is absolutely necessary, automatic dose control methods or appropriate shooting parameters should be selected. Children and women are at greater risk; high dose of radiation in screening programs should be known and the necessity should be questioned. Research and publication institutions for radiation risks should be more active and the community and physicians should raise awareness on this issue.

CHAPTER V

SEDATION CHANGE MEASUREMENT OF METHOD

The study was conducted with 20 people between the ages of 18-60. 10 of these will be computerized tomography. These people were called Group B. The other 10 persons were identified as the control group. These were called Group K. Computer tomography will not be done at this group K. Inclusion criteria for the study were the patient's desire, pregnancy, propofol allergy, infection at the site to be injected, hypovolemia, soy allergy

In the volunteers who are taken to work; Group B: Propofol (0.5 mg/kg) and alfentanil (25 ug/kg) sedation were initiated and alfentanil infusion of 0.25 μg/kg/hr /IV was administered before taking it to the imaging room. When the patients had a Ramsay sedation score of 3, the medication was taken to the CT room without added doses

Group K: Sedation of propofol (0, 5 mg/kg) and alfentanil (25 ug/kg) started to volunteers. 0.25 μg/kg/hr/IV alfentanil infusion was administered. The drug dose was not added when the volunteers had a sedation scale of 3. All the volunteers were monitored for oxygen saturation, heart rate and blood compressions. The duration of the Ramsey sedation scale score of 9 of both group volunteers was recorded.

SPSS 11.0 program was used for statistical analysis. ANOVA variance analysis for repeated measures POST HOC (Tukey) for $p < 0.05$ difference between two variables. Student's t test for analysis of intergroup variables, Mann Whitney-U test if needed as a nonparametric alternative test.

CHAPTER VI

FINDINGS THE DATA

Demographic characteristics such as body mass index, duration of operation, age, ASA (American Society of Anesthesiologists**)** classification, gender, age of both groups are shown in Table 8. When these data were analyzed there was no important change among the sets.

Table 8: Demographic information

	Grup B	**Grup K**	**p**
Age	28,2 ± 6,23	30 ± 6,5	0,53*
Body Mass Index (BMI)	31 ± 1,8	32 ± 2,2	0,42*
ASA(grup1/grup2)	4/6	5/5	
Gender (Woman/Man)	5/5	5/5	

*P > 0.005

There was no statistically important change among sets in hemodynamic parameters, heart rate and mean arterial pressure. (p > 0, 05). Figure 17

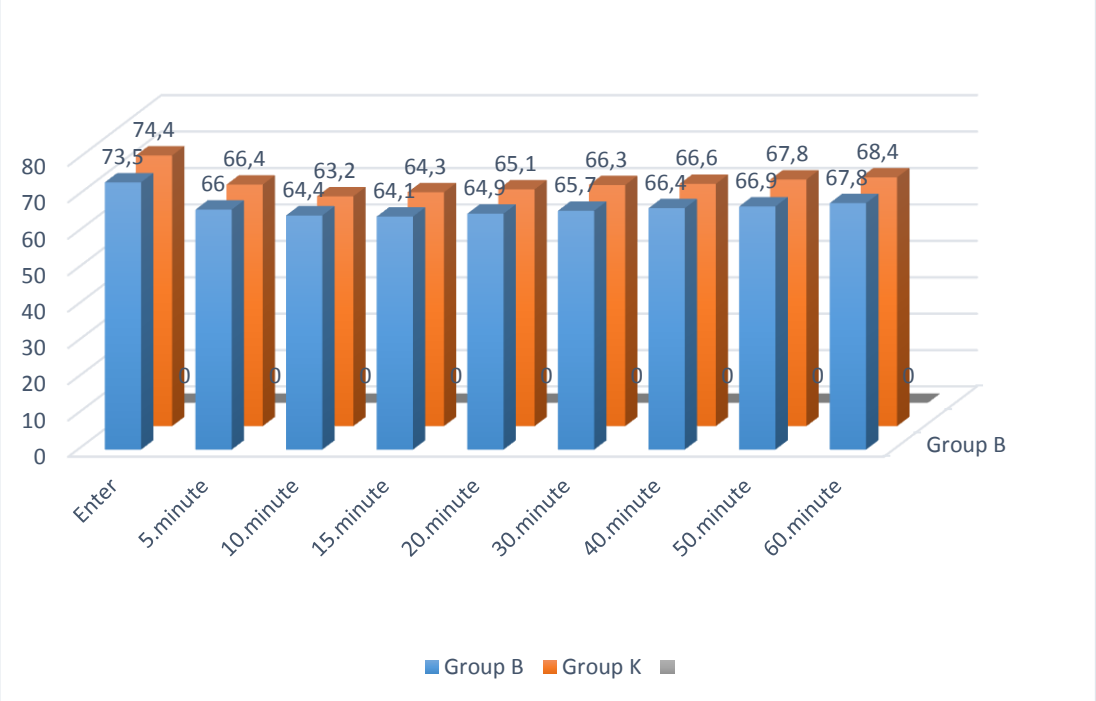


Figure 17: Hearth Rate

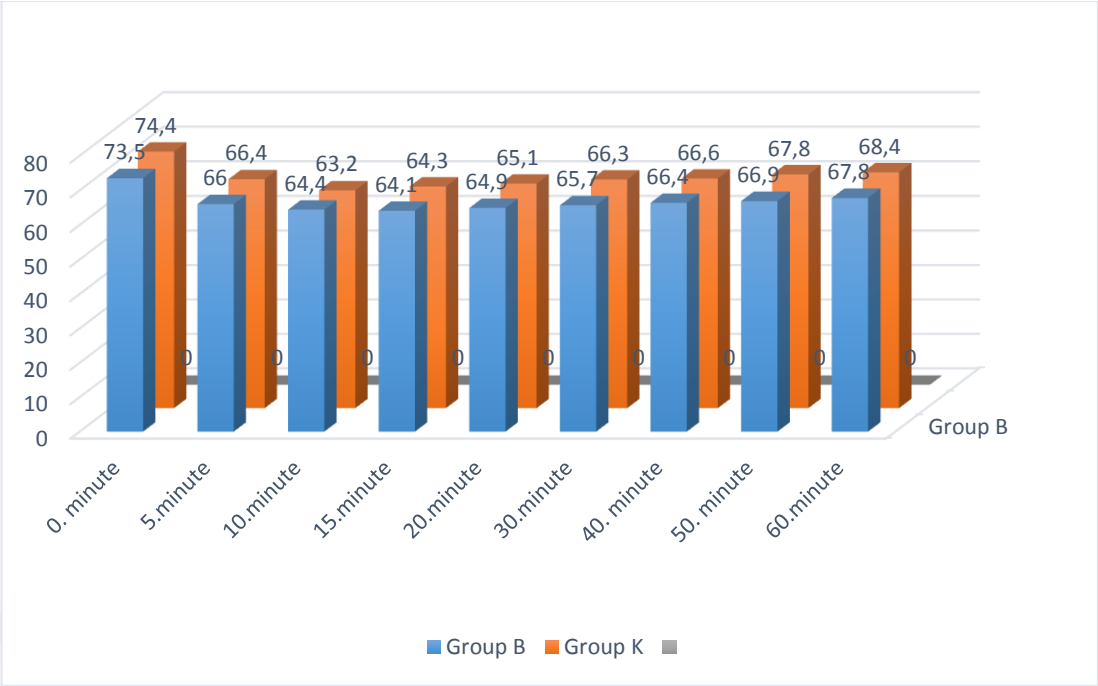


Figure 18: Mean Arterial Pressure

The inter-group allegorical score 3 was measured after sedation. 15,5 ± 0,84 in group B and 15,6 ± 0,96 in group K were observed. (p: 0, 62) It is not statistically significant. Since the introduction of sedation, the overall score of 9 has been 30, 3±1, 3; 31, 9±1, 1 (p: 0, 3) in table 4.

TAble 9: Comparison of group alleys score

	Grup B	**Grup K**	**P**
Aldrete 3 (minute)	15,5 ± 0,84	15,6 ± 0,96	0,62*
Aldrete 9 (minute)	30,3 ± 1,3	31,9 ± 1,1	0,3*

*P>0.005

Statistical studies were accomplished expending the SPSS 13.0 database. The data were related using the unpaired student's t-test, and recurrent events were compared using the variance analysis test. A p grade of ≤0.05 was known as statistically important.

CHAPTER VII

DISCUSSION AND CONCLUSIONS

It is very important to relieve anxiety of patients in CT. Propofol in anxiety management is a routine drug [75]. In order to reduce the amount of propofol use to reduce anxiety; additional drug use to propofol is frequently used to increase patient safety. Alfentanil is a drug that is frequently used for this purpose [76]. Sultan and his colleagues have successfully used the combination of propofol and alfentanil in colonoscopy cases and observed a rapid and reliable recovery in day anesthesia [77].

BT shooting is a daily process. Fast and safe compilation of patients undergoing sedation is important. In our study, we used propofol and alfentanil combination to provide fast and safe recovery. Our study showed a successful and safe recovery in combination with propofol and alfentanil as indicated in the literature.

The use of BIS has been to measure the state of consciousness during anesthesia in adults. Characteristically, BIS is practical, precise, and non-invasive and can be used at bedside. BIS standards return the reduced metabolic degree of the brain caused by several hypnotic drugs. In one study, PET (positron emission tomography) shown a important connection among BIS importance and reduced cerebral metabolic action [78].

Aneja and his colleagues in a 1-16 age group in patients who did not apply neuromuscular blockade, BIS and RSS has been compared [79]. For comfort sedation between RRS 6 and excessive sedation, RSS 2-5, BIS value was found to be 42. BIS value is expressed as 76 in low sedation in RSS 1.

G. Consales and his colleagues [80] compared the Ramsey sedation scale (RSS) and BIS in fourty (40) patients who were asleep by propofol and midazolam after main stomach and vascular operation. In this study, the unanswered patient with an RSS score of 6, which can be easily and similarly evaluated by everyone, was chosen as the desired level of sedation. The BIS index corresponding to this value was found to be 32-68. For patients under deep sedation, BIS is said to be an appropriate form of monitoring and emphasized that extreme sedation and difficulties related to this sedation can be prevented with BIS. RSS is not able to show deep sedation and may

cause excessive sedation. According to this study, the appropriate BIS level for adherence to mechanical ventilation is shown as 40-60 for intensive care. When BIS index is <40, excessive sedation is called. Optimum sedation cause titration can be attained with BIS.

In our study, there was a connection among MAS and BIS and assessed the sedation grade of patients closely. Erden and his friends for the invasive radiological applications in the sedation period of 12-14 minutes as they have determined and in this minute, they observed the modified aldrate score was 10. In this study, we followed the patients with routine monitoring in the recovery room after 5 minutes. [81]. In these patients, MAS was at the 10th level in both groups at the end of the 10th minute.

In conclusion, there was no statistically important change in demographic information among collections in our study. The goal of our study is obserevation of the effect of radiation on patient who are under sedation while imaging of CT. We observed that there ise no significant correlation effect of radiation on patient who is under sedation while imaging of CT. But this study has got some limitation like as the number of patiens and we used propofol and alfentanil. New sedation agents should use for this correlation.

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