Sudden Unexpected Death in Epilepsy: Pathogenesis, Risk Factors, and Prevention

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Abstract

Sudden unexpected death in epilepsy (SUDEP) is a tragic and unexpected cause of death in patients with a known diagnosis of epilepsy. It occurs in up to 6.3 to 9.3/1,000 patients with drug-resistant epilepsy. The main three risk factors associated with SUDEP are the presence of generalized tonic–clonic seizures, the presence of a seizure in the past year, and an intellectual disability. There are several mechanisms that can result in SUDEP. The most likely sequence of events appears to be a convulsive seizure, overactivation of the autonomic nervous system, cardiorespiratory dysfunction, and death. While the risk of SUDEP is relatively high in patients with drug-resistant epilepsy, studies indicate that more than 50% of patients and caregivers are unaware of the diagnosis. Counseling about the diagnosis and preventative measures at the time of diagnosis is important. There are numerous interventions that may reduce the risk of SUDEP, including conservative measures such as nocturnal surveillance with a bed partner (where applicable) and automated devices. Optimizing seizure control with antiseizure medications and surgical interventions can result in a reduced risk of SUDEP.

Keywords
- sudden unexpected death in epilepsy
- refractory epilepsy
- drug-resistant epilepsy

Sudden unexpected death in epilepsy (SUDEP) is a tragic and unexpected cause of death in patients with a known diagnosis of epilepsy. It occurs in approximately 1.2 per 1,000 adults and 0.2 per 1,000 children with epilepsy each year.[1] However, these numbers can increase up to 6.3 to 9.3 per 1,000 in patients with drug-resistant epilepsy (DRE).[2] Compared with the general population, patients with epilepsy have been found to have a 24 times higher risk of sudden death.[3] Those with DRE, nocturnal seizures, and generalized tonic–clonic seizures (GTCS) have a higher risk of SUDEP. In this article, we discuss the risk factors and pathogenesis underlying SUDEP, and highlight potential preventative strategies.

Definition and Classification of SUDEP

The definition of SUDEP has varied across providers. Nashef et al has defined SUDEP as sudden, unexpected, witnessed or unwitnessed, nontraumatic, and nondrowning death in patients with epilepsy, with or without evidence for a seizure and excluding documented status epilepticus, in which postmortem examination does not reveal a toxicologic or anatomic cause for death.[4]

The Annegers criteria classifies the certainty of the diagnosis to divide SUDEP into three categories: (1) definite SUDEP—in which clinical criteria are met and autopsy reveals no alternative cause of death, (2) probable SUDEP—in which clinical criteria are met but an autopsy is not performed, and (3) possible SUDEP—in which SUDEP cannot be ruled out. However, there is insufficient evidence with respect to the circumstances of death and postmortem evaluation is unavailable.[5] This criteria was further modified by Nashef et al to include modifications to categories 1 and 2, as well as the addition of a fourth category called near SUDEP/near SUDEP plus, as detailed in ►**Table 1**.[4]

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Table 1 Classification of SUDEP[4]

1	Definite SUDEP	Sudden, unexpected, (un)witnessed, nontraumatic, nondrowning death, occurring in benign circumstances in a patient with epilepsy with or without evidence for a seizure and excluding documented status epilepticus, in whom postmortem examination does not reveal a cause of death
1a	Definite SUDEP plus[a]	Satisfying the definition of definite SUDEP, if a concomitant condition other than epilepsy is identified before or after death, if the death may have been due to the combined effect of both conditions, and if autopsy or direct observations/recording of the terminal event did not prove the concomitant condition to be the cause of death
2	Probable SUDEP/Probable SUDEP plus[a]	Satisfying the definition of definite SUDEP but without autopsy. The victim should have died unexpectedly while in a reasonable state of health, during normal activities, and in benign circumstances, without a known structural cause of death
3	Possible SUDEP	A competing cause of death is present
4	Near SUDEP/Near SUDEP plus[a]	A patient with epilepsy survives resuscitation for more than 1 h after a cardiopulmonary arrest that has no structural cause identified after investigation
5	Not SUDEP	A clear cause of death is known
6	Unclassified	Incompletion information is available; not possible to classify

Abbreviation: SUDEP, sudden unexpected death in epilepsy.
[a]"Plus" is indicated in these categories when there is evidence of a preexisting condition other than epilepsy that may also have contributed to death.

Deaths that occur in water constitute a gray area. These deaths are classified as "not SUDEP" if there is autopsy evidence of drowning or circumstantial evidence. If death occurs in water without evidence of submersion, Nashef et al suggested that the death be classified as possible SUDEP.[4]

Epidemiology

The incidence of SUDEP is felt to be under-represented due to varying factors such as inconsistent definitions and an overall under-recognition by medical providers and coroners. Studies have indicated that relying on death certificates to diagnose SUDEP can result in an underestimation of its incidence.[6] The risk of SUDEP per 1,000 patients with epilepsy per year ranges from 6.3 to 9.3 in patients who are candidates for epilepsy surgery or those who have undergone epilepsy surgery.[7] Meanwhile the risk of SUDEP in prospective community-based studies of newly diagnosed patients is 0.09 per 1,000 person-years.[2,7]

Risk Factors for SUDEP

A meta-analysis by Degiorgio et al identified 10 risk factors associated with SUDEP. They are listed in ►**Table 2**, sorted by the descending weighted odds ratio (OR) estimate and described further below.[8]

Age and Its Relationship with SUDEP

Historically the risk of SUDEP was considered to be lower in young children, with an increase in adolescence and young adulthood, followed by reduced risk at older ages. The perceived lower risk of SUDEP in young children could be due to misdiagnosing SUDEP as sudden infant death syndrome (SIDS).[2] In older adults, SUDEP may be missed due to attribution of the cause of death to an alternative etiology such as underlying cardiac factors without a complete evaluation.[9] Recent data have demonstrated a comparable incidence of SUDEP in children and adults alike, with an incidence rate of 1.11, 1.13, and 1.29 in persons younger than 16 years, aged 16 to 50 years, and older than 50 years, respectively.[6,10]

Studies have also indicated that the cumulative risk of SUDEP varies with age of onset of epilepsy. Epilepsy onset at the age of 1 and 15 years yields a corresponding risk of 8 and 7.2%, respectively, by the age of 70 years. However, epilepsy onset at or above 30 years of age yielded a lower risk of 4.6% of

Table 2 Risk factors associated with SUDEP

Three or more GTCS/year (vs. 0)
Seizure frequency $\geq$13 in the prior year (vs. 0–2)
No antiseizure medications (vs. 1–2)
$\geq$3 antiseizure medications (vs. 1)
$\geq$3 GTCS in the previous year (vs. 0)
11–20 GTCS in last 3 mo (vs. 0–5)
Age at onset 0–15 y (vs. 45 y)
IQ $<$ 70
3–5 antiseizure medication changes/year
$\geq$3 antiseizure medications at the last visit (vs. 0–2)

Abbreviations: GTCS, generalized tonic–clonic seizures; SUDEP, sudden unexpected death in epilepsy.
Note: Overall, the most important risk factors that clinicians need to consider when assessing SUDEP risk is the presence of GTCS and frequency of seizures.

SUDEP.[9] Epilepsy-related deaths are rare in patients with childhood onset epilepsy with well-controlled seizures.[11]

Case–control studies have found a significantly lower age at onset of epilepsy in patients with SUDEP, with a mean age of 7.7 years compared with 20 years in controls.[12] A meta-analysis of pediatric patients with epilepsy found that the age of onset of epilepsy was on average 3.1 years in patients with SUDEP.[13] In a group of 57 patients, there was a nearly eightfold increase in the relative risk of SUDEP associated with onset of epilepsy in childhood or early adolescence compared with onset after the age of 45 years. Risk factors such as age at onset of epilepsy and seizure frequency had weaker associations with SUDEP in females. In contrast, frequent change of antiseizure medications and the use of antipsychotic medications had a stronger association with SUDEP in females.[14] These findings suggest that gender might influence SUDEP risk and is an area for continued investigation. In a group of 37 patients with SUDEP, the average duration of epilepsy was 21 years.[15]

In a retrospective study of 245 patients with childhood onset epilepsy, 60 died during the follow-up period of 40 years. Eighteen of the 60 had SUDEP. Epilepsy-related deaths were solely seen in patients who had not been seizure free for a period of 5 years.[11] These data appear to be consistent with the known association of frequent seizures and SUDEP.

Seizure Semiology and Seizure Localization at Its Relationship with SUDEP

Patients who experience GTCS are at a significant risk of dying from SUDEP. A nationwide population-based case–control study found that 251 of 255 (98.4%) cases had a history of GTCS; experiencing GTCS within the preceding year was associated with a 27-fold increased risk (OR: 28.81, 95% confidence interval [CI]: 14.86–48.38), whereas no excess risk was seen in those without GTCS (OR: 1.15, 95% CI: 0.54–48.38).[16] Similar findings were also seen in children.[13] While the precise mechanism of GTCS resulting in SUDEP has yet to be elucidated, GTCS are associated with electroencephalogram (EEG) finding of postictal generalized electroencephalographic suppression (PGES), which may be a biomarker of severe breathing dysfunction.[16,17] Seizures that start or involve the limbic and paralimbic structures may be critical for inducing severe apnea; the MORTEMUS trial on SUDEP patients found an epileptic focus in the temporal lobe in 64%, insula in 8%, and bilateral or generalized epileptic foci in 20% of patients.[18]

Frequency of GTCS and Its Relationship with SUDEP

Seizure frequency is a well-established SUDEP risk factor, and the risk of SUDEP correlates with increased seizure frequency or shorter seizure-free interval. A patient who experiences a single GTCS within the preceding year has a 27-fold higher risk of dying from SUDEP compared with a patient who did.[16] Patients who experience one to three GTCS per year have a 22-fold increased risk of SUDEP, compared with patients who do not experience any GTCS. This risk is increased to 32-fold in patients with 4 to 10 GTCS per year.[16] A history of nocturnal GTCS was associated with a nine times higher risk of SUDEP. Patients who do not experience GTCS are not generally thought to be at a significantly increased risk of SUDEP, but the literature has been quite sparse on this topic.[16]

Role of Autonomic Dysfunction

Autonomic dysfunction affecting the cardiorespiratory system has been proposed to be a major contributor in the pathogenesis for SUDEP.[19] Autonomic dysfunction is defined as an imbalance of sympathetic and parasympathetic activity, and can be measured by testing including deep breathing, Valsalva maneuver, isometric exercise, tilt-table, and heart rate variability (HRV).[20] HRV is thought to reflect the integrity of vagus nerve-mediated autonomic control and is measured by root-mean square differences of successive R-R intervals (RMSSD). One study of 31 patients with DRE, when compared with patients whose seizures were well-controlled on seizure medications, exhibited a higher degree of dysautonomia.[20] Specifically, patients with DRE had higher vasomotor tone, higher sympathetic tone, lower parasympathetic tone, and lower parasympathetic reactivity compared with drug-responsive patients.[20] Similar findings were reported in another study in which patients with DRE had reduced levels of HRV (RMSSD), reflecting loss of integrity of vagus nerve-mediated autonomic control of the heart.[19] Patients with frontal lobe epilepsy may also have reduced levels of HRV, which may be more pronounced at night, therefore making them more susceptible to SUDEP.[20,21]

Autonomic dysfunction can result in pulmonary edema secondary to increased sympathetic activity which causes pulmonary vasoconstriction and increased left atrial pressure from systemic hypertension.[19] Depression of motor function and respiratory function in a patient with a partially obstructed airway following a seizure can have fatal consequences. Typically, a stimulus of hypoxia will trigger brainstem autonomic reflexes to initiate movement that clears the airway and stimulates respiratory centers. However, in a postictal state, these reflexes are depressed, further worsening hypoxia and respiratory drive.[19]

Antiseizure Medications

Polytherapy is a possible indicator of drug resistance and has been associated with increased SUDEP risk (►**Table 2**). A case–control study demonstrated that 12 of 57 patients (21.1%) who died from SUDEP were on at least three antiseizure medications, as compared with 7 of 171 controls (4.1%). This association between polytherapy and higher SUDEP rate was not seen when the rates were adjusted for the presence and frequency of GTCS in a follow-up study.[21] In fact, a larger nationwide case–control study in Sweden revealed that polytherapy with three or more antiseizure medications was associated with a significantly *reduced* risk of SUDEP.[22] This suggests that the use of antiseizure medications is not associated with increased SUDEP risk, either as monotherapy or polytherapy, when seizures are controlled.

Genetic Associations with SUDEP

Multiple genetic abnormalities have been found in cases of SUDEP; however, these changes do not necessarily confer an increased risk of SUDEP in and of themselves. Genetic variants found in SUDEP cases include Unverricht-Lundborg syndrome, Dup15q syndrome, 5q14.3 deletion, SCN1A, SCN2A, and SCN8A mutations.[2] In a group of 61 patients, 46% were found to have an underlying genetic abnormality.[23] Seven percent had mutations in genes that commonly result in cardiac arrhythmias such as long QT syndrome.[23]

SUDEP-related deaths in Dravet syndrome represent 53 to 61% of reported deaths, compared with 14.5% in patients with new-onset epilepsy.[24] While there is an association between Dravet syndrome and SUDEP, these patients are also at a high risk for several risk factors known to be associated with SUDEP, such as frequent GTCS (often nocturnal) and recurrent episodes of status epilepticus.[24] Hence, it is unclear if this is a causal relationship; however, it would be prudent to bear this risk in mind when educating patients and caregivers.

Comparing the Adult and Pediatric Population

When compared with children, adolescents and young adults have a higher rate of SUDEP. One of the reasons contributing to this phenomenon may be that GTCS are rarely, if ever, seen in infants younger than 2 years. A retrospective review of clinical manifestations and electrographic features of 109 distinct seizures in 77 infants (1 month to 2 years) found that there were no GTCS at onset.[25] The infrequent nature of GTCS in the very young is thought to be secondary to lack of organization, immature myelination, incomplete interhemispheric connections, and variable neuronal excitability.[26] In addition, children are more likely to have a caregiver who may implement some preventive strategies for SUDEP. These include nocturnal supervision and medication adherence. Improved medication adherence can result in improved seizure control and thus a reduced risk of SUDEP.

Pathogenesis

While the precise mechanism of SUDEP is unknown, the MORTEMUS study shed light on the underlying terminal cardiorespiratory dysfunction. In this international multicenter retrospective study of patients in the epilepsy monitoring unit (EMU), there were 29 cardiorespiratory arrests, of which 16 had SUDEP, 9 had near SUDEP, and 4 deaths from other causes.[18] Six patients had a history of postictal apnea, postictal cardiorespiratory arrest, or ictal asystole prior to their EMU admission.[18] Data collection in 11 patients permitted an assessment of the timeline of events that led to SUDEP. These data revealed that there was an initial period of rapid breathing followed by postictal generalized EEG suppression wherein the EEG voltage reduced to below 10 µV within 30 seconds of a seizure.[17] This was then followed by early cardiorespiratory dysfunction characterized by bradycardia ending in asystole in 9 of the 11 patients. Lastly, this study also revealed that terminal apnea always preceded terminal asystole.[18]

Though SUDEP typically follows a GTCS, there have been case reports of SUDEP in the EMU that occur in the absence of a sentinel GTCS, thus raising the possibility that a seizure may not be necessary in all cases of SUDEP.[27] In a case series of three patients, where two had definite and one probable SUDEP, all three deaths occurred in Caucasian patients with a history of long-standing epilepsy. These patients were awake and were not in the prone position at the time of their death.[27] They did not have evidence of arrhythmias; however, they had abnormal breathing patterns and EEG suppression.[24]

Obstructive Apnea and Its Role in SUDEP

Rodent models have demonstrated that autonomic changes result in obstructive apnea that can spearhead a flurry of events that result in SUDEP. The inciting trigger of a GTCS can result in spread to brainstem laryngomotor neurons, resulting in laryngospasm and consequent obstructive apnea.[25] This obstructive apnea can result in further activation of the autonomic nervous system compounding hypoxemia and resultant cardiorespiratory compromise.[25] Peri-ictal laryngospasm has been noted in several case reports wherein patients were found to have persistent inspiratory stridor and cyanosis following a GTCS, with the emergency code team finding laryngospasm upon attempting intubation.[28,29] Rodent models have demonstrated that complete glottic closure has been associated with increases in recurrent laryngeal nerve activity with subsequent ST elevation, bradycardia, and death ensuing seconds later.[30]

Central Apnea and Its Role in SUDEP

Though central apnea is more prevalent in rodent models, it is obstructive apnea that causes more significant damage.[30] Attempts to breathe against a closed glottis can cause a significant degree of stimulation of the autonomic nervous system which can result in cardiorespiratory dysfunction and death. This degree of activation of the autonomic nervous system is not seen in association with central apnea.[30]

Cardiovascular Abnormalities and Its Role in SUDEP

Centers have reported instances of near-lethal arrhythmias in patients admitted to the EMU.[31,32] Ictal arrhythmias such as ictal asystole, bradycardia, and atrioventricular block have been identified in patients admitted to the EMU.[33] These patterns were not associated with deaths and were self-limiting.[33] In comparison, postictal arrhythmias including postictal asystole atrioventricular block, atrial fibrillation, and ventricular fibrillation were associated with near SUDEP.[33]

Postictal Generalized Electroencephalographic Suppression and Its Role in SUDEP

PGES[16] is commonly seen in patients who experience GTCS. Several studies have demonstrated that there may be an association between the duration of PGES and increased SUDEP risk, and that PGES may be an indicator of depressed respiratory drive. In a study comparing 10 adults with 30 documented epileptic seizures during video EEG recording

and who later died of SUDEP, a strong association was noted between PGES and SUDEP.[17] There was a significantly increased odds of SUDEP with PGES duration lasting longer than 50 seconds. PGES lasting longer than 80 seconds was associated with a quadrupled odds of SUDEP. This group also reported that for each 1 second increase in duration of PGES, the odds of SUDEP increased by 1.7%.[17] Studies in the pediatric population have also yielded similar results, with 32.4% of patients with epilepsy with PGES.[30,34] PGES has been associated with a lower oxygen desaturation nadir and a longer duration of desaturation compared with GTCS without PGES. The pathophysiology of respiratory changes in the setting of PGES has been debated.[35] There has been evidence that this could stem from an inhibition of respiratory centers or be due to seizure-related intrinsic pulmonary dysfunction.[17,35]

Preventive Strategies

The goal of understanding the pathogenesis and risk factors is to help establish potential preventive strategies. Although several preventive strategies have been proposed, there has yet to be an evidence-based intervention for preventing SUDEP.

Patient and Caregiver Counseling

The emotional burden and anxiety that a discussion of SUDEP can trigger in a patient, caregiver, and clinician can often make it a difficult topic of discussion.[36] Despite physicians' reluctance, the majority of patients prefer that physicians discuss the possibility of SUDEP and prefer that the discussion takes place as early as at the time of the initial diagnosis of epilepsy. In a study of 23 adult patients with epilepsy, 57% had not heard of the diagnosis of SUDEP prior to being enrolled in the study.[37] This study also went on to show that all 23 patients wanted to be informed about SUDEP.[37] Twenty of 23 patients preferred that their neurologist discuss the risk of SUDEP at the time of diagnosis of epilepsy.[37] In the pediatric population, all 42 parents preferred to discuss SUDEP.[38] Nearly 50% of the mothers and most fathers wanted to hear about SUDEP at the time of diagnosis.[38] During this crucial step of counseling, the importance of adequate seizure control and medication compliance should be highlighted. The following SUDEP risk assessment tools may be useful in determining high-risk patients to streamline discussion.

SUDEP Risk Assessment Tools

These risk assessment tools utilize key points in a patient's history to identify those who are at a high risk of SUDEP; hence, they can be easily administered at the bedside and included in a clinic visit. Core risk factors associated with SUDEP were assembled and compared with RMSSD to form the SUDEP-7 risk inventory (►**Table 3**).[39,40] Lower RMSSD has been associated with a higher score on the SUDEP-7 inventory.

While the SUDEP-7 inventory looks at numerous data points in a patient's history, studies have indicated that patients with PGES have been found to have a significantly higher SUDEP-7 score than those without PGES.[34] Recent data have suggested that though all seven factors listed in the SUDEP-7 inventory involve an increased risk of SUDEP, there are three components that are most important: frequency of GTCS, having had any seizures in the past year, and the presence of an intellectual disability.[41] These factors have been coined the "SUDEP-3 risk inventory" and are scored as detailed in ►**Table 4**.

Prone Positioning

A meta-analysis of 253 patients with SUDEP revealed that 73.3% died in the prone position.[42] The MORTEMUS trial noted that 11 of 11 patients with SUDEP were in the prone position, with 3 of 11 turning to a prone position with versive seizures.[18] Though the reason is unclear, the prone position was significantly more common in patients younger than 40 years. Nearly 86% of patients in a cohort of 88 patients with SUDEP had adopted a prone position, in comparison to 60% in patients older than 40 years.[42] While their efficacy in reducing SUDEP is unclear at this time, several providers support the use of lattice pillows which have large air channels that allow air

Table 3 SUDEP-7 risk factor inventory[39,40]

SUDEP risk factor	Points assigned (if positive)
More than 3 BTCS in last year	2
One or more BTCS in last year	1
One or more seizures of any type over the last year	1
More than 50 seizures of any type per month over the last year	2
Duration of epilepsy $\geq$30 y	3
Current use of 3 or more antiseizure medications	1
Intellectual disability, developmental delay, IQ $<$ 70, or too impaired to test	2
Total weighted score (0–12)	

Abbreviations: BTCS, bilateral tonic–clonic seizure; SUDEP, sudden unexpected death in epilepsy.

Table 4 SUDEP-3 risk inventory[41]

SUDEP risk factors	Points assigned (if positive)	Odds risk (95% CI)
>3 GTCS in last year	1	2.7 (0.9–7.7)
Seizure of any type in last year	2	8.4 (1.0–71.1)
Intellectual disability	1	3.1 (0.7–13.4)

Abbreviations: GTCS, generalized tonic–clonic seizures; SUDEP, sudden unexpected death in epilepsy.

passage.[43,44] Nocturnal supervision with an adult bed partner would be ideal in appropriate situations. Unfortunately, this may not be the best option for teenagers and/or single individuals. Where nocturnal supervision is not possible, the use of automated devices can be advantageous.

Bed sensors can be placed under the patient to detect bed vacancy. In a group of 64 patients using the Medpage MP5 device, five of eight tonic–clonic seizures were detected.[45] However, in subsequent studies, only 1 of 9 GTCS and 1 of 10 focal unaware seizures were accurately detected.[46] Meanwhile, none of the eight partial seizures with secondary generalization were detected.[46] In addition, as these sensors are primed to detect tonic–clonic seizures, hypomotor and subtle seizures may be missed.

Automated Accelerometer Devices

Due to the higher risk of morbidity and mortality resulting from GTCS, current efforts are being directed toward generating automated devices to recognize the same.[47] Several types of sensors are used including accelerometer, video, and surface electromyography. The mostly stereotyped movements of a GTCS make it possible to develop programming algorithms for automated devices.[47] A wrist-held accelerometer device was able to correctly identify 20 of 22 motor seizures within an average time of 17 seconds from onset of ictal motor activity.[48] The study also found that false-positive alarms arose typically during the daytime during actions such as brushing teeth.[48] Some devices have been able to successfully modify the algorithm to permit patient-initiated cancellations of false alarms, resulting in optimization of patient satisfaction.[47] Limitations of this aid at present include inability to accurately distinguish psychogenic nonepileptic events and hypomotor seizures.

Role of Epilepsy Surgery

Thirty-six percent of patients who have failed two antiseizure medications will not achieve remission solely with medications.[49] Patients with focal epilepsy who have failed an adequate trial of two appropriately chosen and trialed medications should be referred to a surgical center for further evaluation. The risk of SUDEP reduces from 6.3 to 9.3/1,000 patient-years to 2.4 to 4/1,000 patient-years following epilepsy surgery.[50,51]

In situations where resective surgery is felt to be unsafe and/or unhelpful, devices such as a vagal nerve stimulator (VNS), brain-responsive neurostimulation (RNS), or deep brain stimulation can be considered. With VNS, the risk of SUDEP is reduced from 5.5 to 1.7 per 1,000 patients after 2 years of implantation.[52] In a study of 707 patients with an RNS for an average of approximately 3 years, the SUDEP rate was 2.0 per 1,000 patient-years.[53] These findings were replicated with a longer period of follow-up as well. During the span of a 9-year prospective study, 9 of 256 patients treated with brain-RNS were diagnosed with SUDEP.[54] Two of the nine patients were not being treated with RNS at their time of death.[54] The rate of probable or definite SUDEP was 2.8 per 1,000 patient-stimulation years and 3.2 per 1,000 patient-implantation years.[54]

Conclusion

Patients with epilepsy are at a high risk of dying prematurely from SUDEP. This SUDEP risk increases with the presence of GTCS, increased seizure frequency, and intractability to antiseizure medications. Although the precise mechanism of SUDEP is not yet fully understood, there seems to be a strong respiratory component that may facilitate the cascade of events that ultimately result in death. There are several clinical tools to measure SUDEP risk, including the SUDEP-7 and SUDEP-3 risk factor inventories. Patient education with early discussion and disclosure of SUDEP risk is encouraged in most circumstances. There are many emerging technologies such as wearable accelerators and bed alarms that may be useful when the provider is present to assist the patient during their postictal recovery. However, there has yet to be a rigorous prospective clinical trial proving their efficacy in reducing SUDEP risk. Compliance with antiseizure medications, sleeping in the supine position, and appropriate surgical management in patients with DRE may be practical, effective strategies in reducing SUDEP risk.

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