EVIDENCE WORKSHEET

Guideline 9.2.4 First Aid Management of a Seizure

ARC Subcommittee: BLS	**Guideline author: Julie Considine**

Clinical (PICO) question:

P: in adults and children having a seizure
I: does giving oxygen
C: compared with not giving oxygen
O: improve outcome (reduced mortality, shorter seizure duration, decreased incidence of post-seizure hypoxaemia)

Search Strategies:

PubMed: (Search Completed: September 8, 2014): 195 results

Search: Search (((((((((convulsion[MeSH Terms]) OR epileptic seizure[MeSH Terms]) OR epileptic seizures[MeSH Terms]) OR seizure*[Title]) OR fit*[Title]) OR epilep*[Title]) OR convulsion[Title]) AND humans[Filter])) AND ((*oxygen*[Title]) AND humans[Filter])

Inclusion / exclusion criteria:

Inclusion criteria: Studies specifically looking at oxygen administration during or after seizure activity

Exclusion criteria: Animal studies

Search results:

The combined searches outlined above yielded 195 studies:

- 190 were deemed not relevant to the PICO question: of these, 35 papers focused on hyperbaric oxygen use and 14 were related to oxygen toxicity
- 2 were review papers and not scientific studies

Number of studies meeting inclusion / exclusion criteria for worksheet inclusion: 2

Two LOE IV studies have provided evidence for this guideline.

Methodological quality, levels of evidence & outcomes of studies examining pre-hospital oxygen use

Good	**Fair**	**Poor**
The methodological quality of the study is high with the likelihood of any significant bias being minimal	The methodological quality of the study is reasonable with the potential for significant bias being likely.	The methodological quality of the study is weak possessing considerable and significant biases

1. Studies *supportive* of oxygen administration during seizures:

Good							
Fair							
Poor						**Rasanen 1989 (B)**	
	I	**II**	**III-1**	**III-2**	**III-3**	**IV**	**Extrapolated evidence**
	NH&MRC levels of evidence						

2. Studies *neutral for* oxygen administration during seizures:

Good							
Fair							
Poor						**Bergsholm 1984 (A)**	
	I	**II**	**III-1**	**III-2**	**III-3**	**IV**	**Extrapolated evidence**
	NH&MRC levels of evidence						

3. Studies *opposing* oxygen administration during seizures:

Good							
Fair						**Dami et al. 2012 (C)**	
Poor							
	I	**II**	**III-1**	**III-2**	**III-3**	**IV**	**Extrapolated evidence**
	NH&MRC levels of evidence						

Endpoints:
A = Seizure duration
B = Hypoxaemia during seizure

Treatment recommendation: N/A

Class: N/A

Summary of science

There are no published high level studies that test the effect of oxygen administration during or after seizure activity. Two LOE IV studies were identified: both were small studies of oxygen use during seizure activity in patients undergoing electroconvulsive therapy. One study (Bergsholm) had a primary outcome of seizure duration and was neutral for oxygen administration. The other study (Rasanen) showed no significant difference in rates of hypoxaemia (Sa02 less than 90%) in patients receiving 100% oxygen when compared to 30% oxygen. There were no studies related to oxygen use immediately after seizure activity identified.

Reviewer's final comments:

There are no published high level studies that test the effect of oxygen administration during or after seizure activity and the two studies identified were related to oxygen use during seizures included by electroconvulsive therapy.

Evidence gaps and research priorities:

The effect of oxygen administration during and after seizure activity warrants further investigation.

Citation List:

Bergsholm P, Gran L, Bleie H. Seizure duration in unilateral electroconvulsive therapy. The effect of hypocapnia induced by hyperventilation and the effect of ventilation with oxygen. *Acta psychiatrica Scandinavica* 1984; 69: 121-8

Seizure duration in unilateral electroconvulsive therapy (ECT) was recorded by means of EEG in an intra-individual comparison under different alveolar O2- and CO2-concentrations. Hypocapnia induced by hyperventilation to an alveolar CO2-concentration of 2% (2 kPa) resulted in a highly significant increase in seizure duration compared to a normal CO2 of 5%, when the alveolar O2-concentration was constant at 92%. Oxygen ventilation to an alveolar O2-concentration of 92% gave no significant increase in seizure duration compared to 15%, obtained by ventilation with air, when the CO2-concentration was kept constant at 5%. Seizure duration seems to augment progressively with decreasing alveolar CO2-concentration.

NHMRC:IV Case series study of 17 patients receiving ECT.
QUALITY: Poor
OUTCOME: Group A: seizure duration in 10 patients was compared when the patients were normocapnic and hypocapnic. There was an increase in seizure duration from 73 seconds to 123 seconds ($p<0.001$) when alveolar CO_2 was reduced from 5% to 2% by hyperventilation – hypocapnia increased seizure duration. Group B: effect of ventilation with oxygen on seizure duration was studied in seven patients with constant $ETCO_2$. Patients were ventilated alternatively with air and "pure oxygen" Mean seizure duration was 72 seconds in the oxygen group and 63 seconds in the air group but difference was not statistically significant ($p>0.3$).
INTERVENTION: air vs ? 100% oxygen

Rasanen J, Martin DJ, Downs JB, Hodges MR. Oxygen supplementation during electroconvulsive therapy. *British journal of anaesthesia* 1988; 61: 593-7.

The effects of ventilation with 30% and 100% oxygen were investigated on the circulatory and electrocardiographic response to electroconvulsive therapy (ECT) in 12 patients during 40 treatments. Administration of 30% oxygen resulted in a 25% decrease in seizure duration compared with 100% oxygen ($P < 0.0125$). Hypoxaemia, defined as Sa02 less than 90%, occurred during five of 20 treatments with 30% oxygen and during two of 20 treatments with 100% oxygen (ns), and was associated invariably with loss of airway control. Heart rate, arterial pressure, and the incidence of cardiac arrhythmias were not affected significantly by oxygen supplementation. Inspired oxygen concentration has a significant effect on seizure activity and should be of a consistent value if a reproducible seizure is to be produced during ECT. Breathing 100% oxygen does not appear to affect adversely the cardiovascular response to ECT. However, arterial hypoxaemia may develop rapidly during or after the seizure, regardless of oxygen supplementation, if adequate control of airway and ventilation is not maintained.

NHMRC:IV Case series study of SpO_2 levels in 12 patients during 40 ECT treatments.
QUALITY: Poor
OUTCOME: Administration of 30% oxygen resulted in a 25% decrease in seizure duration compared with 100% oxygen ($P < 0.0125$): actual seizure durations not reported. Hypoxaemia, defined as $Sa0_2 < 90\%$, occurred during five of 20 treatments with 30% oxygen and during 2 of 20 treatments with 100% oxygen (ns) and due to apnoea secondary to loss of airway control. There were no significant differences in heart rate, arterial blood pressure, and cardiac arrhythmias between the two groups. Hypoxaemia may develop during or after the seizure, regardless of oxygen supplementation, if adequate control of airway and ventilation is not maintained. There were no adverse cardiovascular effects of 100% oxygen breathing identified in this study. The authors conclude that the current practice of using 100% oxygen appears to be safe.
INTERVENTION: 30% vs 100% oxygen

NOT INCLUDED IN REVIEW AS OXYGEN WAS NOT USED BUT MAY BE OF INTEREST
Blum AS, Ives JR, Goldberger AL, Al-Aweel IC, Krishnamurthy KB, Drislane FW, Schomer DL. Oxygen desaturations triggered by partial seizures: implications for cardiopulmonary instability in epilepsy. *Epilepsia* 2000; 41: 536-41.
Summary: Purpose: The occurrence of hypoxemia in adults with partial seizures has not been systematically explored. Our aim was to study in detail the temporal dynamics of this specific type of ictal-associated hypoxemia. Methods: During long-term video/EEG monitoring (LTM), patients underwent monitoring of oxygen saturation using a digital SpO_2 (pulse oximeter) transducer. Six patients (nine seizures) were identified with oxygen desaturations after the onset of partial seizure activity. Results: Complex partial seizures originated from both left and right temporal lobes. Mean seizure duration (+SD) was 73 rt 18 s. Mean SpO_2 desaturation duration was 76 k 19 s. The onset of oxygen desaturation followed seizure onset with a mean delay of 43 k 16 s. Mean (LSD) Spo, nadir was 83 * 5% (range, 77-91%), occurring an average of 35 k 12 s after the onset of the desaturation. One seizure was associated with prolonged and recurrent SpO_2, desaturations. Conclusions: Partial seizures may be associated with prominent oxygen desaturations. The comparable duration of each seizure and its subsequent desaturation suggests a close mechanistic (possibly causal) relation. SpO_2 monitoring provides an added means for seizure detection that may increase LTM yield. These observations also raise the possibility that ictal ventilatory dysfunction could play a role in certain cases of sudden unexpected death in epilepsy in adults with partial seizures.

NHMRC:III-3. Study of SpO_2 levels during 49 seizures in 17 patients.
QUALITY: Poor
OUTCOME: Of the 49 seizures, 29 were generalized seizures; three (10%) of the generalized seizures from six patients had accompanying oxygen desaturations. Twenty of the 49 seizures were characterized as partial seizures. Twelve (60%) of these 20 partial seizures demonstrated SpO_2 desaturations. Detailed analysis of the six patients having generalised seizures involving oxygen desaturation showed that mean seizure duration was 73±18 seconds and mean SpO_2 desaturation was 76±19 seconds. Oxygen desaturation paralleled seizure duration but was delayed from seizure onset. Average desaturation was 83±5%.
INTERVENTION: N/A