Electroconvulsive therapy - a shocking topic

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The effects of electroconvulsive therapy on the nervous system

Electroconvulsive therapy, or ECT, is still used in the United States and throughout the world.
Outline

1. Electroconvulsive (Shock) Therapy - A History
2. The Neuron
3. The Synapse
4. Neurotransmitters
5. The Mechanism of Electroconvulsive Therapy
I. Electroconvulsive Therapy - A History

Convulsions and electricity have been known to reduce symptoms in people with neurological disorders for many years.

- Hippocrates saw that insane patients showed reduced symptoms after suffering from convulsions brought on by malaria.

- There is an account in AD 47, of a physician using an electric eel to cure headaches of the Roman emperor Claudius.

- In the 1500s
  * A Jesuit missionary wrote of Ethiopians using electricity to “expel devils.”
  * Paracelsus, a Swiss physician, used camphor to produce seizures to cure insanity.
I. Electroconvulsive Therapy - A History

- In the 1700s
  - Individuals treated with hellebore went into convulsions and coma and were cured of “mania” and “raving madness.”
  - In 1792 John Birch used electric shocks to the head to cure patients.

- In the 1800s there were reports of insanity being cured with electric shock.

- In 1927 insulin coma therapy was invented by Manfred Sakel. It involved giving insulin in order to lower levels of glucose, producing coma and convulsions. Mathematician John Nash (A Beautiful Mind) was given this treatment in the 1960s.

- In 1932 Ladislaus von Meduna used camphor to treat schizophrenia. He later used metrazol since it was faster.
1. Electroconvulsive Therapy - A History

- In 1937 two neurologists studying epilepsy, Ugo Cerletti and Lucio Bini, decided to use electric shock to induce seizure without the side effects of metrazol.
  - The idea to apply shock therapy to humans came to Cerletti when he saw pigs being shocked into a coma before being slaughtered.

- In 1938 the first electroconvulsive therapy treatment was tested on a schizophrenic in Rome. He had a full recovery.

- In 1940 the first electroconvulsive therapy treatment was given in the United States.

Find out about what type of patient gets ECT today and answer question 1

en.wikipedia.org/wiki/ECT#91E41
The mechanism of ECT is not fully understood, but in order to understand some of the explanations it is important to know something about neurons and how they work.

As you move through the presentation, follow the links to answer questions on your study guide.
II. The Neuron

- Consists Of:
  - cell body
  - dendrites
  - axon
  - axon terminal
  - myelin
More neurons

These neurons are from mice and contain a gene, isolated from jellyfish, that makes them fluoresce in uv light. These pictures are from studies done by Dr. Joshua R. Sanes of the department of molecular and cellular biology at Harvard University.

A section of the brain - the dendrites are at the top of the image

A closer look at the cell bodies and their extensions
More neurons

A closer look at the boxed section from the image on the left - there is a synapse at every place where yellow overlaps red.

The axon terminals - yellow is the pre-synaptic neuron and red is the post-synaptic organ (striated muscle).
Questions About the Neuron

• Use the links below to find out more about the parts of a neuron


http://faculty.washington.edu/chudler/chnt1.html

http://faculty.washington.edu/chudler/cells.html

• Answer Questions 2-7 on your study guide
Action Potential

• Neurons are normally at rest. They do not fire unless they have a proper stimulus.

• Once stimulated, the neuron will send an impulse. This is called an all or nothing response.

Check out this website to see how an impulse is generated and answer questions 8-13 on your study guide.

www.tvdsb.on.ca/2.webloc
III. The Synapse

- **Neurons are capable of sending a message to another neuron or another organ (muscle, gland)**

- **Neurons do not actually touch - There is a space between them called the synaptic cleft**

http://www.mtsu.edu/~studskl/synapse2.GIF
An actual synapse
from a presentation by Dr. Venkatesh N. Murthy
iii. The Synapse

The action potential cannot cross the synaptic cleft, so.....

How does the message get from one neuron to another?

Check out this website to find out and answer questions 14-18 on your study guide.

www.tvdsb.on.ca/webloc
IV. NEUROTRANSMITTERS

There are several types of neurotransmitters and not all of them are the same. Some of them excite the next cell, depolarizing it, while some inhibit a cell and prevent depolarization.

Check out another animation of how the synapse works and answer question 19 on your study guide.

www.wisc-online.com/webloc
# Some neurotransmitters

This is a very short list of the many neurotransmitters. These are some of the most well known.

<table>
<thead>
<tr>
<th>Neurotransmitter</th>
<th>Basic Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetylcholine</td>
<td>Mostly <strong>Excitatory</strong></td>
</tr>
<tr>
<td>Dopamine</td>
<td>Generally <strong>Excitatory</strong></td>
</tr>
<tr>
<td>Epinephrine</td>
<td><strong>Excitatory</strong></td>
</tr>
<tr>
<td>Norepinephrine</td>
<td><strong>Excitatory</strong> or <strong>Inhibitory</strong></td>
</tr>
<tr>
<td>GABA</td>
<td><strong>Inhibitory</strong></td>
</tr>
<tr>
<td>Serotonin</td>
<td>Generally <strong>Inhibitory</strong></td>
</tr>
<tr>
<td>Glutamate</td>
<td><strong>Excitatory</strong></td>
</tr>
</tbody>
</table>

Check out this site to answer question 20 and see some cool images. You have to click on the images to get information about the neurotransmitters.

[Micro.magnet.fsu.edu/webloc](http://micro.magnet.fsu.edu/webloc)
Some neurotransmitters

You may have noticed that some of the neurotransmitters, like norepinephrine can be both excitatory or inhibitory. This depends on:

- The type of receptors on the post synaptic cell
- How the receptors actually work

- Some receptors directly open an ion channel (like Acetylcholine exciting skeletal muscle cells), but some lead to further activity in the cell which may cause a different response (like Acetylcholine inhibiting cardiac muscle cells).
What do neurons and neurotransmitters have to do with electroconvulsive therapy?
The mechanism of ECT

There are several possible explanations as to how ECT works, and there is evidence for all of them. The one that seems to be most accepted however is the neurotransmitter theory.
Neurotransmitter Theory

- This explanation is based on evidence that the electricity sensitizes serotonin receptors.
- Supporters also state that ECT desensitizes receptors that help reabsorb dopamine and norepinephrine, causing them to stay in the synapse.

People with depression seem to have fewer serotonin receptors or do not make enough of the neurotransmitter.

Why might ECT help patients who are depressed?
Use the knowledge you have gained in this presentation to answer this question in space 21 of your study guide.
Other Theories

- Anticonvulsant - the brain learns to resist seizures, slowing abnormally overactive brain circuits
- Neuroendocrine - causes hypothalamus to release chemicals that change the chemistry of the entire body
- Brain damage - memory loss and disorientation lead to the illusion of problems being gone
Extension activity

The bioethics of ECT - is this a safe, effective procedure or should it be banned?
“The Shock Shop, Mr. McMurphy might be said to do the work of the sleeping pill, the electric chair and the torture rack. It’s a clever little procedure, simple, quick, nearly painless it happens so fast, but no one ever wants another one. Ever.”

- Ken Kesey (excerpt from One Flew Over the Cuckoo’s Nest)

Many people have read or seen One Flew Over the Cuckoo’s Nest and have a negative view of shock therapy, believing that it creates zombie-like patients. In addition, Ernest Hemingway’s suicide has been attributed to his ECT treatment.

“What is the sense of ruining my head and erasing my memory...and putting me out of business? It was a brilliant cure...but we lost the patient.”

- Ernest Hemingway
"ECT has a higher success rate for severe depression than any other form of treatment.”
-Dr. Dimitris Popolos

Since the 1960s, the methods of ECT have changed somewhat and it seems to be safer. It is known to produce some memory loss, but seems to be the most effective treatment for people with severe depression.

It is estimated that in the United States, 100,000 people per year undergo ECT treatments and that there are about 1,300 treatments per week.
So, should this treatment be banned? You decide.

Research the effects of ECT and write a persuasive essay to express your opinion. Here are some websites to get you started. Make sure you cite all resources used and be sure they are good sources.

- [www.healthyplace.com/](http://www.healthyplace.com/)
- [www.medhelp.org/lib/ect.h#790F4](http://www.medhelp.org/lib/ect.h#790F4)
- [www.nmha.org/infoctr/fact#791C0](http://www.nmha.org/infoctr/fact#791C0)
- [en.wikipedia.org/wiki/Ele#791C4](http://en.wikipedia.org/wiki/Ele#791C4)
- [serendip.brynmawr.edu/](http://serendip.brynmawr.edu/)
- [serendip.brynmawr.edu/1.webloc](http://serendip.brynmawr.edu/1.webloc)
- [www.ect.org/index.shtml.webloc](http://www.ect.org/index.shtml.webloc)