Capital Punishment by Lethal Injection
We’ve come a long way, baby – or have we?

Capital punishment
The “Botched” Lethal Injection of Clayton Lockett

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“Old Sparky”
“The Electric Chair” at Sing Sing Prison

Which one of you wants to “pull the switch” on Dr. Benjamin?

Answer: There’s a group of people lined up to do it!

Where the “Deed” is Done!

The Texas execution chamber in Huntsville, TX. (Headline: Mark Berman, Photo: Pat Sullivan/AP, Washington Post, March 13, 2016)

Lethal Injection
- Lethal injection is the practice of injecting a person with a fatal dose of drugs (typically a barbiturate, paralytic (i.e., curare-like drug), and potassium solution) for the express purpose of causing immediate, painless (?), death. But
  - Often, it’s not lethal.
  - Often it’s not immediate
  - Often it’s not painless
  - Medical doctors often are not part of the team
History of Lethal Injection

On May 11, 1977, Oklahoma's state medical examiner, Jay Chapman, proposed a new, less painful method of execution, known as Chapman's Protocol:

"An intravenous saline drip shall be started in the prisoner's arm, into which shall be introduced a lethal injection consisting of an ultra-short-acting barbiturate in combination with a chemical paralytic."

After the procedure was approved by anesthesiologist Stanley Deutsch, formerly Head of the Department of Anesthesiology of the Oklahoma University Medical School, the Reverend Bill Wiseman introduced the method into the Oklahoma legislature, where it passed and was quickly adopted (Title 22, Section 1014(A)).

Since then, until 2004, 37 of the 38 states using capital punishment introduced lethal injection statutes.

On August 29, 1977, Texas adopted the new method of execution, switching to lethal injection from electrocution. On December 7, 1982, Texas became the first state to use lethal injection to carry out capital punishment, for the execution of Charles Brooks, Jr.

Convention lethal injection protocol

Typically, three drugs are used in lethal injection.
- Sodium thiopental is used to induce unconsciousness,
- pancuronium bromide (Pavulon) to cause muscle paralysis and respiratory arrest, and
- potassium chloride to stop the heart.

The Drugs

1. A rapidly-acting CNS depressant usually used to induce rapid loss of consciousness (i.e., an IV induction agent) e.g., Sodium pentothal to midazolam
2. A "curare-like" drug used to paralyze the respiratory muscles, muscles of the chest and rib cage, and diaphragm, (potency and onset of action) and
3. KCl (potassium chloride), a cardioplegic drug (a drug that is used to stop the heart during open heart surgery).

Sodium Pentothal

Pentothal (Thiopental Sodium for Injection, USP) is indicated:
• (1) as the sole anesthetic agent for brief (15 minute) procedures,
• (2) for induction of anesthesia prior to administration of other anesthetic agents,
• (3) to supplement regional anesthesia,
• (4) to provide hypnosis during balanced anesthesia with other agents for analgesia or muscle relaxation,
• (5) for the control of convulsive states during or following inhalation anesthesia, local anesthesia, or other causes,
• (6) in neurosurgical patients with increased intracranial pressure, if adequate ventilation is provided, and
• (7) for narcoanalysis and narcosynthesis in psychiatric disorders.
Diana Rigg saved him.

are well known in the medical community, where patients have been patients dying from hyperkalemia (usually secondary to renal failure) complex, and eventually fire by reducing the ability of the sodium atoms to re-enter the heart and "repolarize" the sodium-dependant channels leading to:

- peaked T-waves, PR interval prolongation, widening of the QRS complex, and eventually asystole (heart stops beating). Cases of patients dying from hyperkalemia (usually secondary to renal failure) are well known in the medical community, where patients have been known to die very rapidly, having previously seemed to be normal.
- George C. Scott tried to commit suicide with KCl in "Hospital" but Diana Rigg saved him.

George C. Scott tried to commit suicide with KCl in a hospital.

Oral ingestion is not toxic.

plant respiratory muscles will lead to death in a considerably shorter time. The binding of the neurotransmitter, acetylcholine, to receptors on the end-plate causes depolarization and contraction of the muscle fiber is blocked (where the nerves connect to the muscles). The typical dose for pancuronium bromide in capital punishment by lethal injection affects the electrical conduction of heart muscle. Elevated potassium can be given orally, which is the safest route; or it can be given intravenously, in which case there are strict rules and hospital protocols on the dose and rate at which it is given.

Pancuronium bromide

A non-depolarizing Neuromuscular blocking agent
- Lethal injection dosage: 100 mEq (milliequivalents) immersion and anaphylactoid reactions to Pentothal (thiopental anesthetic induction dose is 0.35 grams (350 mg). Loss of consciousness is induced within 30-45 seconds at the typical dose.
- A 5 gram dose for Lethal Injection (14 times the normal dose) is likely to induce unconsciousness in 10 seconds.
- Lethal injection dosage: 2.5 grams
- Sodium thiopental (US trade name: Sodium Pentothal) is an ultra-short acting barbiturate, often used for anesthesia induction and for medically induced coma.

Pancuronium bromide is a derivative of the alkaloid, curare, from the plant Malouetia bequaertiana. Curare is used in blow guns to hunt food.

Other drugs in use are succinylcholine chloride and tubocurarine chloride, like pancuronium, is a non-depolarizing Neuromuscular blocking agent (a muscle relaxant agent) that blocks the action of acetylcholine at the motor end-plate of the neuromuscular junction (where the nerves connect to the muscles). The typical dose for pancuronium bromide in capital punishment by lethal injection is 0.2 mg/kg to 1.0 mg/kg, depending on the weight of the patient. Curare is used in blow guns to hunt food. Oral ingestion is not toxic.

Pancuronium bromide is a derivative of the alkaloid malouetine from the plant Malouetia bequaertiana. Curare is used in blow guns to hunt food.

Adverse reactions include respiratory depression, myocardial (heart) depression, cardiac arrhythmias, prolonged somnolence and recovery, sneezing, coughing, bronchospasm, laryngospasm and shivering. Anaphylactic and anaphylactoid reactions to Pentothal (thiopental sodium) have been reported. Symptoms, e.g., urticaria, (blisters all over your body), bronchospasm, vasodilation and edema should be managed by conventional means.

Rarely, immune hemolytic anemia with renal failure and radial nerve palsy have been reported.

Seizures also are possible due to paradoxical excitation.

Potassium chloride (KCl)

Lethal injection dosage: 100 mEq (milliequivalents) Potassium is an electrolyte, 98% of which is intracellular. The 2% remaining outside the cell has great implications for cells that generate action potentials. Doctors prescribe potassium for patients when there is insufficient potassium, called hypokalemia, in the blood. The potassium can be given orally, which is the safest route; or it can be given intravenously, in which case there are strict rules and hospital protocols on the dose and rate at which it is given.

The usual intravenous dose is 10-20 mEq per hour and it is given slowly since it takes time for the electrolyte to equilibrate into the cells. When used in state-sanctioned lethal injection, bolus potassium injection affects the electrical conduction of heart muscle. Elevated potassium, or hyperkalemia, causes the heart to stop beating, and this effect is used in open-heart surgery where the effect is known as a "cardioplegic effect."

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New lethal injection protocols

The Ohio protocol, developed after the incomplete execution of Romell Broom, ensures the rapid and painless onset of anesthesia by only using sodium thiopental and eliminating the use of curare and potassium as the second and third drugs, respectively. It also provides for a secondary fail-safe measure using intramuscular injection of midazolam (a water-soluble diazepam) and hydromorphone (an opioid 7-8 times as potent as morphine) in the event intravenous administration of the sodium thiopental proves problematic.

The first state to switch to midazolam as the first drug in a new three-drug protocol was Florida on October 15, 2013. Then on November 14, 2013, Ohio made the same move.
Manufacturers in US stopped manufacturing Sodium Pentothal

- After sodium thiopental began being used in executions, Hospira, the only American company that made the drug, stopped manufacturing it due to its use in executions.
- The subsequent nationwide shortage of sodium thiopental led states to seek other drugs. Pentobarbital, a drug often used for animal euthanasia, and was used as part of a three drug cocktail for the first time on December 16, 2010, when John David Duty was executed in Oklahoma.
- It was then used as the drug in a single drug execution for the first time on March 10, 2011, when Johnnie Baston was executed in Ohio.

Pfizer tightens restrictions to keep drugs from being used in executions

- Pfizer tightens restrictions to keep drugs from being used in executions

Friday, May 13, 2016

The pharmaceutical giant Pfizer announced that it has imposed sweeping controls on the distribution of its products to ensure that none are used in lethal injections, a step that closes off the last remaining open-market source of drugs used in executions.

More than 20 American and European drug companies have already adopted such restrictions, citing either moral or business reasons. Nonetheless, the decision from one of the world’s leading pharmaceutical manufacturers is seen as a milestone.

Problems with “Lethal Injection”

- Physicians don’t want to do it, requiring less well-trained technicians to perform the procedure.
- The American Medical Association believes that a physician’s opinion on capital punishment is a personal decision. Since the AMA is founded on preserving life, they argue that a doctor “should not be a participant” in executions in any professional capacity with the exception of “certifying death, provided that the condemned has been declared dead by another person” and “relieving the acute suffering of a condemned person while awaiting execution”.

Problems with “Lethal Injection”

- Some states specifically detail that participation in a lethal injection is not to be considered practicing medicine. For example, Delaware law reads “the administration of the required lethal substance or substances required by this section shall not be construed to be the practice of medicine…”
- Drug doses have not been well chosen.

New lethal injection protocols

- Primary: Sodium thiopental, 5 grams, intravenous
- Secondary: Midazolam, 10 mg, intramuscular, and hydromorphone, 40 mg, intramuscular
- Typical IV doses of midazolam are a few mg, and typical IV doses of hydromorphone are 2-4 mg. Sometimes even 1 mg is adequate for pain control.
Opposition to “Lethal Injection”

- Opponents of lethal injection believe that it is not actually painless as practiced in the United States. Opponents argue that the thiopental may wear off (anesthesia awareness) and lead to consciousness and an uncomfortable death wherein the inmate is unable to express their discomfort because they have been rendered paralyzed by the paralytic agent.
- Following the administration of thiopental, pancuronium bromide is given. Opponents argue that pancuronium bromide not only dilutes the thiopental, but (since the inmate is paralyzed) also prevents the inmate from expressing pain.
- Additional concerns have been raised over whether inmates are administered an appropriate dose of thiopental owing to the rapid redistribution of the drug out of the brain to other parts of the body.
- Probably need a reinforcing dose if 2nd and 3rd drugs aren’t administered within 777 mins
- Additionally, opponents argue that the method of administration is flawed. They state that since the personnel administering the lethal injection lack expertise in anesthesia, the risk of failing to induce unconsciousness is greatly increased.

Research

- In 2005, University of Miami researchers, in cooperation with an attorney representing death row inmates, published a research letter in the medical journal, *The Lancet*. The article presented protocol information from Texas and Virginia which showed that:
  - executioners had no anesthesia training,
  - drugs were administered remotely with no monitoring for anesthesia,
  - data were not recorded and no peer review was done.

According to Jay Chapman, M.D., the forensic pathologist who developed the method in 1977, "It never occurred to me when we set this up that we'd have complete idiots administering the drugs."

Research

- An analysis of toxicology reports from AZ, GA, NC, and SC showed:
  - That in 43 of 49 executed inmates (88%), post-mortem blood concentrations of thiopental were lower than that required for surgery and that
  - Blood concentrations of thiopental were consistent with awareness.
- The authors concluded that some inmates were aware and probably suffered extreme pain and distress during execution.
- The authors attributed the risk of consciousness among inmates to the lack of training and monitoring in the process, but carefully made no recommendations on how to alter the protocol or how to improve the process.
- The authors concluded, “Because participation of doctors in protocol design or execution is ethically prohibited, adequate anesthesia cannot be certain. Therefore, to prevent unnecessary cruelty and suffering, cessation and public review of lethal injections is warranted.”

Postmortem Redistribution

- The phenomenon of changing concentrations of drugs and their metabolites in postmortem fluids and tissues postmortem.
- Net change is a function of multiple factors:
  - Pharmacokinetic properties of the drug
  - Orientation of the body
  - Putrefaction
  - Drug dosage
  - Interval between drug administration and death
Postmortem Redistribution

- Practical Considerations
  - PM Interpretation is a complex process
  - Value in measuring multiple sites
  - Heart blood is not a meaningful sample on its own
  - Collect femoral or iliac blood
  - Published data are of limited reliability

Clayton Lockett

Clayton Lockett, died of a heart attack during a failed execution attempt on April 29, 2014 at Oklahoma State Penitentiary in McAlester, Oklahoma. Lockett was administered an untested mixture of drugs that had not previously been used for executions in the U.S., and survived for 43 minutes before being pronounced dead. Lockett convulsed and spoke during the process, and attempted to rise from the execution table 14 minutes into the procedure, despite having been declared unconscious. Technicians could not locate a good venous access due to his prior days of dehydration and technical inadequacies of the staff trying to find a

Cruel and unusual Punishment?
Yes or No

- On occasion, there have also been difficulties inserting the intravenous needles, sometimes taking over half an hour to find a suitable vein. Typically, the difficulty is found in convicts with a history of intravenous drug use. Opponents argue that the insertion of intravenous lines that take excessive amounts of time are tantamount to being cruel and unusual punishment. In addition, opponents point to instances where the intravenous line has failed, or where there have been adverse reactions to drugs, or unnecessary delays during the process of execution.

"the conventional view of lethal injection leading to an invariably peaceful and painless death is questionable"

- A study published in 2007 in the peer-reviewed journal PLoS Medicine suggested that “the conventional view of lethal injection leading to an invariably peaceful and painless death is questionable.”
- The execution of Romell Broom was abandoned in Ohio on September 15, 2009, after prison officials failed to find a vein after 2 hours of trying on his arms, legs, hands and ankle. This has stirred up intense debate in the United States about lethal injection.
Don’t Take Pharmacology from Strangers