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Medical Aspects of Capital Punishment Executions*

ABSTRACT: Between 1976 and the middle of 2001, approximately 718 human executions occurred in the U.S. (a small segment of worldwide executions). Data regarding the medical aspects of these executions are not readily available. We searched all public domain data in the U.S. to obtain specific data for all persons executed in the U.S. since 1976. Of the five methods of execution used (lethal injection, lethal gas, electrocution, hanging, and firing squad), significant differences emerged as measured by rate of complications, duration of time spent by the condemned in the "death chamber," as well as duration of time from the onset of execution procedures to pronouncement of death. These data suggest that human executions are difficult to carry out. Human executions are associated with significant physical complications. These data may help inform future discussions on human executions.

KEYWORDS: forensic science, capital punishment, death penalty, executions, lethal gas, firing squad, hanging, electrocution

Human execution to mete out public justice has a long tradition in all cultures. Methods of execution have changed from forced drinking of hemlock (Socrates), to beheadings (Charles I of England), to multiple methods in recent decades. These include hanging, electrocution, lethal gas, firing squad, and lethal injections.

Among most western nations, physicians have abstained from direct participation in human executions. Such a position was articulated early by Hippocrates (1) and currently supported by most western medical organizations (for example, American Medical Association [AMA]) (2). However, like most other medical organizations, AMA supports a position of providing humane treatment and succor to those to be executed.

Based on these factors, many legal scholars have come to assume that modern day executions are simple and straightforward proceedings (3). However, such an assumption is not based on data. This assumption exists in part due to a lack of information about human executions. For example, Bedau (3), in a 468-page book titled *The Death Penalty in America*, does not describe any procedures and protocols involved with executions. (It appears that legal scholars are unable to fully assess medical aspects of human executions without input from physicians.) Understandably, physician interest has been low, in keeping with Hippocratic tradition. As an illustration, none of the textbooks of forensic medicine describe contemporary practices and procedures involved in human executions. Paradoxically, most of our information on executions is based on mass media coverage.

Because of these factors, we decided to gather all available public domain data so that we can assess medical aspects of executions in the U.S. Specifically, we evaluated methods of execution since

1976 (based on the amendment to *Furman vs. Georgia*, 408 U.S. 238 in 1972). These included details of contemporary methods of execution. In addition, we assessed duration of time spent in the "death chamber," duration of time from the onset of execution procedures to pronouncement of death, and frequency of complications ("botched executions") during executions. It is our aim to inform discussions on public justice deliberations in the U.S. and elsewhere. This report is not a commentary about the contemporary modes of public justice administration.

Methods

In order to obtain all available data, we first reviewed data from the federal government and later state governments. We reviewed data for all those executed in the United States in the last 25 years, 1976 to the present (6/18/01). Initially, we utilized the U.S. Department of Justice website (www.usdoj.gov) to assess the federal death penalty system, using "The Federal Death Penalty System: A Statistical Survey" www.usdoj.gov/dag/pubdoc/dpsurvey.html). This survey presents considerable data on legal factors as well as group data, but no case-specific data. This is in part due to absence of executions by the Federal Government until June 2001.

Thus, we assessed the death penalty procedures/data by individual states, where we could obtain more detailed case-specific data. Utilizing the Death Penalty Information Center (DPIC) website (<http://www.deathpenaltyinfo.org/index.html>) and Death Penalty News and Updates website (<http://www.smu.edu/~deathpen/>), we were able to obtain all names of those executed as well as the state and method used.

To assess medical aspects of these executions, we first reviewed data relating to methods of execution among the states. Next, we reviewed data about the duration of time spent in death chamber, including any data regarding use of medications (pain killers, sedatives, anxiolytics, etc.). Following this evaluation, we assessed the duration of time from the onset of execution procedures to the pronouncement of death. Lastly, we assessed the frequency of complications, including failed attempts, physical injuries, need to repeat

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execution procedures, and similar factors among each of the execution methods, commonly referred to as “botched executions.”

In order to obtain these data, we wrote a general letter by email describing our research to the governors (4), attorney generals (5) and departments of corrections (6), separately, for each state with the death penalty. There were several states that either did not have an e-mail address to any one of these three previous references, or we received a mailer daemon message stating that our letter did not get through to a correct address (thus, not included in our reference list). To further enrich our database, we used Google as a search engine to locate information on execution procedures and found <http://www.agitator.com/dp/states/index.html>, which contains useful information regarding case-specific data for time spent in the chamber for several cases.

Section A: Summary of Methods of Execution

In the past 25 years, five methods of executions have been used: lethal gas, electrocution, lethal injection, hanging, and firing squad. In the following sections are abbreviated composite summaries of procedures in place among various states. These are designed to provide the reader with an appreciation for the psychological aspects of human executions as they relate to two groups: those executed and those performing execution procedures. All of these data, including additional information, can be found at <http://www.fcc.state.fl.us/fcc/reports/monitor/methmon.html>.

Lethal gas involves cyanide poisoning, with the cyanide pellets placed in a metal container beneath the execution seat. There is a metal canister on the floor with sulfuric acid solution under this cyanide container. There are three keys in the control room, with three executioners, and each executioner turns each one of the keys as part of sequential procedures. When the keys are turned, an electric switch causes the bottom of the cyanide container to open allowing the cyanide to fall into the sulfuric acid solution, producing a lethal gas. The warden pronounces death by reading a heart monitor in the control room. Post execution, ammonia is pumped into the execution chamber to neutralize the gas. Exhaust fans then remove the inert fumes from the chamber into two scrubbers that contain water and serve as a neutralizing agent. The neutralizing process takes approximately 30 min from the time the condemned's death is determined. Litmus paper is used to test the level of lethal gas emissions remaining in the chamber. When gas is neutralized and the chamber is cleared, staff members wearing disposable protective clothing enter the chamber and remove the condemned's body for release to the county medical examiner.

Electrocution occurs in the execution chamber with an oak chair set on rubber matting and bolted to a concrete floor, with electricity passing between electrodes, one on the scalp and one on the right calf. Staff ensures that a wet sponge covers all areas of the electrodes to prevent any direct contact of the electrode with the skin to avoid burns. Further, staff ensures that the sponge is sufficiently wet (slightly dripping). Excess saline solution from the sponge is dried with a clean towel. Staff ensures that a salt-free hypoallergenic, electrically conductive gel is applied in a total of approximately 4 oz to the shaven head and calf of the condemned. The executioner is signaled to engage the execution switch and the electrocution cycle begins. When the cycle is complete, the electrician indicates that the current is off. All of the equipment is disconnected. The manual circuit behind the chair is disengaged. The time in which the execution switch is disengaged is recorded. If death does not occur, the entire electrocution cycle is repeated.

Lethal injection induces cardiac arrest by intravenous (IV) potassium and takes place in an execution chamber. A gurney with leather straps located at wrists, biceps, chest, stomach, and legs are used to hold the condemned person. Two IV administration sets are used, one for each arm. The line for the right arm is held in reserve as a backup contingency line in case of a malfunction or blockage in the first line. Head movement is allowed so that the condemned may turn to face witnesses when making a final statement. A flow of normal saline is begun. Following any last statement, the execution procedure is initiated. First, a potentially lethal dose of sodium thiopental is administered to achieve unconsciousness as well as death. After a saline flush, pancuronium bromide is administered as a muscle relaxant. After a second saline flush, potassium chloride is administered. Several minutes after the last signs of life are evident, the warden asks a physician to be brought in to pronounce death.

Hanging involves death by severe spinal injury or by asphyxiation and occurs in the gallows area. Release mechanisms for the trap door are inspected for proper operation. A determination as to the proper amount of the drop of the condemned through a trap door is calculated using a military execution chart for hanging. The rope is a manila hemp at least three-quarters of an inch and not more than one-and-one-quarter inch in diameter and approximately 30 ft in length. The rope is soaked and then stretched while drying to eliminate any spring, stiffness, or tendency to coil to ensure that the rope slides smoothly through the knot. The end of the rope, which does not contain the noose, is tied to a grommet in the ceiling and is tied off to a metal T-shaped bracket, which takes the force delivered by the condemned's drop. The condemned's file is reviewed to determine if there are any unusual characteristics that warrant deviation from field instructions on hanging. The condemned is placed standing over a hinged trap door from which the condemned will be dropped. Following the condemned's last statement, a hood is placed over the condemned's head. Restraints are also applied. If the condemned refuses to stand, or cannot stand, he is placed on a collapse board. The noose is placed snugly around the condemned's neck in such a manner that the knot is directly behind the condemned's left ear. Upon direction from the superintendent, a member of the execution team pushes a button that mechanically releases the trap door. The condemned drops through the trap door. Escorts move to the lower floor location to assist the removal of the condemned's body.

Firing squad takes place in a well-lit execution area, with lighting directed toward the condemned. A specially designed chair has a pan beneath to catch and conceal blood and other fluids. The condemned is dressed in a dark blue outfit with a white cloth circle attached by Velcro to the area over the heart. Restraints are applied to arms, legs, chest, and head. A head restraint is placed loosely around the neck to hold the head and neck in an upright position. A hood is placed over the condemned's head. Behind the condemned are sandbags to absorb the volley and prevent ricochets. Dark sheets are draped over sandbags. The firing squad members each stand at a firing port at a wall 20 ft from the condemned. The weapons used are 30-30 caliber rifles, with standard ammunition. Each squad member can sight and fire out of the firing port. There is a platform rest attached to the wall and below the firing ports on which each weapon rests. With their rifle barrels in the firing ports, the squad members sight through open sights on the white circle on the condemned's chest. On the command fire, the squad fires simultaneously. (One squad member has a blank charge in his weapon but none of the members know who has this blank charge.) Shortly after the shots are fired, death is determined.

TABLE 1—Executions in the United States by region and method between 1976 and 2001.*

Region†	Lethal Injection	Electrocution	Gas Chamber	Hanging	Firing Squad	Total
Northeast‡	3	0	0	0	0	3
Midwest§	69	6	0	0	0	75
South	436	141	6	1	0	584
West¶	47	0	5	2	2	56
Total	555	147	11	3	2	718

* Twelve states without the death penalty: Alaska, Maine, Minnesota, Vermont, Hawaii, Massachusetts, North Dakota, West Virginia, Iowa, Michigan, Rhode Island, Wisconsin, and additionally District of Columbia.

† Jurisdictions with the death penalty with no executions since 1976: Connecticut, Kansas, New Hampshire, New Jersey, New Mexico, New York, South Dakota, and additionally the military.

‡ Pennsylvania.

§ Illinois, Indiana, Missouri, Nebraska, Ohio.

|| Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia.

¶ Arizona, California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming.

Section B: Data Compilation and Analysis

Table 1 describes the number of executions in the United States between 1976 and 2001 by method and categorized by region. Only 31 out of the 38 states that subscribe to the death penalty have actively used their death sentence. Further, we reviewed patterns of executions among the 31 states by five-year intervals. In the Northeast region, there were 3 executions, 2 between 1991–1995, and 1 between 1996–2001. In the Midwest region, there were 75 executions, 2 between 1981–1985, 6 between 1986–1990, 20 between 1991–1995, and 47 between 1996–2001. In the Southern region there were 584 executions, one between 1977–1980, 44 between 1981–1985, 82 between 1986–1990, 136 between 1991–1995, and 321 between 1996–2001. In the Western region there were 56 executions, two between 1977–1980, 1 between 1981–1985, five between 1986–1990, 12 between 1991–1995, and 36 between 1996–2001.

Following this characterization, we evaluated study variables among all of these executions based on data obtained. We used appropriate statistical methods of analysis to detect any significant differences. Independent t-test or ANOVA were used when appropriate and Chi Square test when appropriate.

Results

Table 2 shows the duration of time condemned spent in the death chamber divided into two sections. Section A describes the duration of the execution procedures prior to the onset of execution (i.e., adjusting tubes, straps, etc.) to pronouncement of death. We obtained quantifiable data for three of the five methods of execution: lethal injection, electrocution, and lethal gas. As shown in Table 2, we obtained data for only a small sub-sample of those executed. Due to uneven distribution frequency, we did not conduct any statistical analysis. However, it should be noted that lethal injection method consisted of the longest duration of time in the “death chamber.”

It is important to note that we did not include data from four additional lethal injection executions in Table 2, as specific time interval was not available, although these exceeded half an hour. Also, we did not include data from one person undergoing electrocution (longer than 10 min). Of the six executed by hanging or firing squad, we obtained data for only one execution when a firing squad was used. In this instance, the reported duration of time in the “death chamber” was 16 min.

TABLE 2—Average time in minutes for the execution methods.

Section A		
Average duration of time spent in “death chamber” including procedures prior to onset of execution.		
Electrocution Chamber	Gas Chamber	Lethal Injection Chamber
(n = 2) 16.5 ± 3.54*	(n = 2) 19.0 ± 1.41	(n = 24) 29.0 ± 16.4†
Section B		
Average duration of time from onset of execution to declared time of death.		
Electrocution Chamber	Gas Chamber	Lethal Injection Chamber
(n = 3) 8.3 ± 7.77‡	(n = 2) 14.3 ± 5.3§	(n = 45) 8.4 ± 4.7

* Duration of time (>10 min) for one of the executions not included in this mean due to an inexactness of reported time interval.

† Duration of time (>50, >33, >45, >22 min) for four executions not included in this mean due to inexactness of reported time interval.

‡ Duration of time (>8, >14 min) for two executions are not included in this mean due to inexactness of reported time interval.

§ Duration of time (>8 min) for one execution is not included in this mean due to inexactness of time interval.

Section B describes duration of time between onset of execution (i.e., from start of chemical flow, flick of switch, etc.) to the pronouncement of death. Lethal injection and electrocution were of similar (8.4 ± 4.7, 8.3 ± 7.8, respectively) duration, whereas lethal gas took an average of 6 min or more (14.3 ± 5.3) to complete the execution. Further, we did not include data from two undergoing electrocution and one undergoing lethal gas execution, as specific time intervals were not available (see Table 2). Due to uneven distribution frequency, we did not conduct any statistical analysis.

Figure 1 describes the frequency of “botched executions” by method. There were 32 botched executions since 1976. Two of these were with the gas chamber, 18.2% (2/11) of all executions using the gas chamber. Ten botched executions were with electrocution, which is 6.8% (10/147) of all electrocutions, and 20 were with lethal injection, 3.6% (20/555) of all lethal injections. Chi square analysis suggested a statistically significantly higher frequency of

Frequency of "Botched Executions"

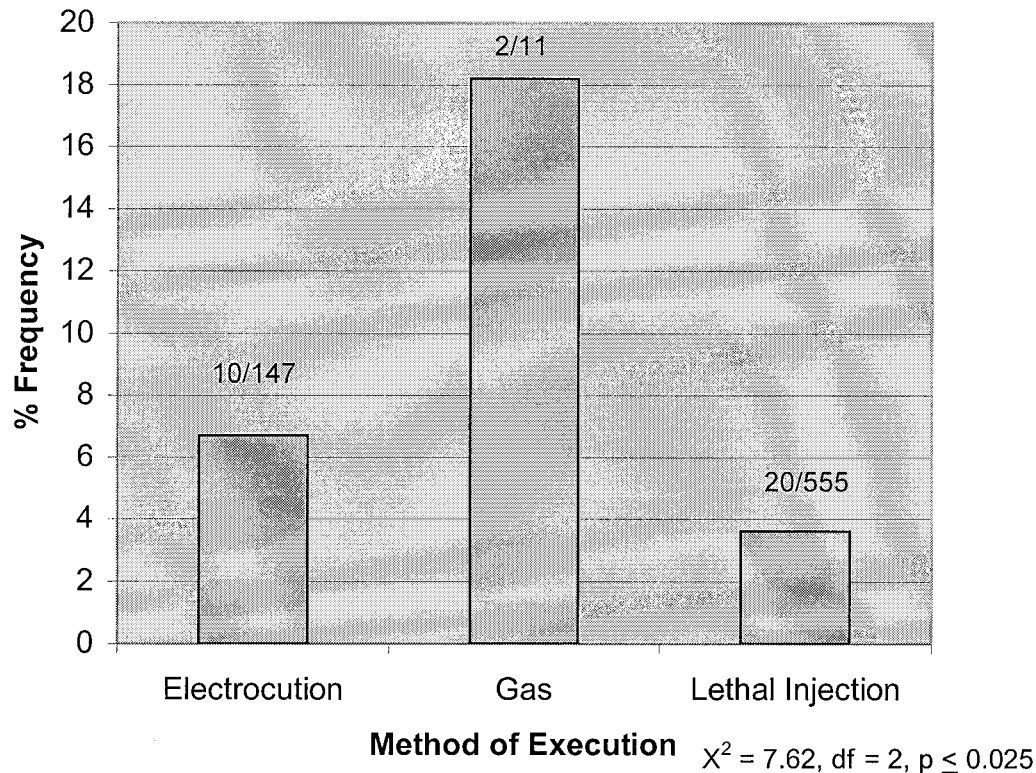


FIG. 1—Frequency of "botched executions."

botched executions with lethal gas administration ($\chi^2 = 7.62, df = 2, p < 0.025$).

Discussion

The aim of this study is to provide data about medical aspects of human execution. Our results suggest that executions are difficult to carry out (see Methods, Section A) and that there are significant differences among contemporary methods of execution. The duration of time for execution is relatively long, physical complications are relatively common, and rate of failure at first attempt is relatively high. However, we note that our data are only from a subsample of those executed in the U.S. Thus, caution is warranted in their interpretation. Further, these data form only a small sample of those executed worldwide.

Many of the other aspects of execution, such as medical and psychiatric histories of the executed individuals or details of events (from hours to days) preceding executions or use of secular succor such as psychological support and counseling or medication use, is unavailable. Also, any pre-medication immediately prior to execution, although available, appears rare when reviewing the few incidents where such data were to be found.

We are not legal scholars to interpret the significance of these findings in relation to U.S. constitutional law. However, these data may help legal scholars in their deliberations. This report and its findings are not meant to indict or support capital punishment in the U.S. or elsewhere.

In conclusion, we note that contemporary methods of human execution appear to be difficult to carry out. These findings may help inform future deliberations on human executions.

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