

# ANESTHETIC DEATHS IN 54,128 CONSECUTIVE CASES

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IN AN ENDEAVOR to evaluate the safety of the various anesthetics in our hands we have analyzed all cases of sudden death occurring on the operating table at Duke Hospital during a 12.5-year period. The difficulty in assessing the part played by the anesthetic in the death of a patient during or following operation is well known and the difficulty increases in proportion to the time elapsing between the operation and the patient's demise. We have limited our study, therefore, to those cases in which death occurred during or shortly after operation.

From July 1, 1930, to January 1, 1943, a total of 54,128 anesthetics were administered for all types of operative procedures. During this period 38 patients died during operation or a few minutes thereafter (Table I). Twenty-seven deaths which are ascribed to the anesthesia (Table II) occurred during general or spinal anesthesia. Some of the patients undoubtedly would have succumbed sooner or later to the existing disease but the anesthesia could not be completely exonerated as the immediate cause of death.

TABLE I

Anesthetic	Total No. of Anesthetics	Total No. of Sudden Deaths	No. Per 1000 Anesthetics	Anesthetic Deaths	No. Per 1000 Anesthetics
Ether.....	14,724	6	.407	6	.407
Cyclopropane.....	5,744	7	1.21	4	.691
Cyclopropane with ether.....	393	0	0	0	0
Nitrous oxide.....	6,705	4	.590	2	.295
Nitrous oxide with ether.....	2,175	2	.919	2	.919
Ethylene.....	6	1		1	
Chloroform.....	9	0	0	0	0
Vinethene.....	266	0	0	0	0
Vinethene with ether.....	326	0	0	0	0
Avertin.....	261	1	3.83	1	3.83
Avertin with supplement.....	1,615	6	3.71	3	1.85
Sodium pentothal.....	1,006	1	.99	0	0
Sodium pentothal with nitrous oxide.....	226	0	0	0	0
Evipal.....	48	0	0	0	0
Spinal.....	5,436	6	1.10	6	1.10
Spinal with supplement.....	930	2	2.15	2	2.15
Caudal.....	1,106	0	0	0	0
Local.....	13,151	2	.150	0	0
Sodium amytal.....	4	0	0	0	0
Total.....	54,128	38	.702	27	.498

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TABLE II

CAUSE OF DEATH IN 38 CASES OF SUDDEN DEATH ON THE OPERATING TABLE

Shock.....	2	} Anesthetic deaths
Hemorrhage.....	2	
Infection.....	5	
Medullary compression.....	2	
Asphyxia due to aspiration of vomitus.....	1	
Unknown.....	26	
Total.....	38	

TABLE III

ANALYSIS OF ANESTHETIC DEATHS IN 39,880 CASES OF GENERAL AND SPINAL ANESTHESIA

	Case	Age	Sex		Race		Operative Risk		Autopsy
			Male	Female	White	Colored	Good	Poor	
Ether.....	1	50		+	+		+		0
Ether.....	2	2	+		+		+		0
Ether.....	3	8	+		+		+		0
Ether.....	4	7 wks.		+		+	+		0
Ether.....	5	21	+			+	+		0
Ether.....	6	30	+			+	+		+
Cyclopropane.....	7	11		+		+	+		+
Cyclopropane.....	8	17	+			+	+		0
Cyclopropane.....	9	17	+			+	+		+
Cyclopropane.....	10	26	+		+			+	0
Nitrous oxide.....	11	49	+			+		+	+
Nitrous oxide.....	12	55	+			+		+	+
Nitrous oxide-ether.....	13	36		+		+		+	+
Nitrous oxide-ether.....	14	29		+		+		+	0
Ethylene.....	15	28		+		+		+	+
Avertin.....	16	25	+			+		+	+
Avertin-ether.....	17	20		+		+	+		0
Avertin-ether.....	18	33	+			+	+		+
Avertin-ether.....	19	16	+			+	+		0
Spinal.....	20	37	+		+			+	0
Spinal.....	21	50		+		+		+	0
Spinal.....	22	31	+			+		+	+
Spinal.....	23	62	+		+			+	+
Spinal.....	24	39	+			+		+	0
Spinal.....	25	53		+	+			+	0
Spinal with supp.....	26	41		+	+			+	+
Spinal with supp.....	27	63	+		+			+	0
Total.....	27	—	17	10	9	18	12	15	12

Eighteen of the 27 deaths, or 66 per cent, were in Negroes (Table III). This is significant in view of the fact that less than 15 per cent of the total number of patients undergoing operation annually at this hospital are Negroes. The explanation for this high mortality rate probably lies in the difficulty of judging the degree of cyanosis in colored individuals and in the poorer general condition of the average Negro as contrasted to the average white patient in the Duke Hospital.

It is interesting to note that of the six patients (Cases 1-6) who died during ether anesthesia (Table III) four were receiving *ether* through oral catheters and three of the latter were undergoing operations upon the eye. The combination of draping necessary for eye operations and the administration of ether vapor through a catheter makes it difficult for the anesthetist to judge the depth of anesthesia and the degree of cyanosis. The deaths,

except for one due to aspiration of vomitus, probably were due to overdosage. In 2,200 cases of general anesthesia, excluding cyclopropane, Schmidt and Waters<sup>10</sup> report two anesthetic deaths, one of which occurred during an eye operation in which the patient was receiving ether through an endotracheal catheter.

TABLE IV  
COMPARATIVE STUDY OF ANESTHETIC DEATHS

		From the Literature*		Total No. of Cases	Anesthetic Deaths	No. Per 1,000
Anesthesia						
General and spinal	{ Schmidt & Waters <sup>10</sup> .....		4,400	3	.681	
	{ Dealy <sup>4</sup> .....		19,529	18	.921	
	{ Duke Hospital.....		29,880	27	.677	
Cyclopropane	{ Schmidt & Waters <sup>10</sup> .....		2,200	1	.454	
	{ Sahler, <i>et al.</i> <sup>9</sup> .....		7,120	0	0	
	{ Taylor <sup>11</sup> .....		39,284	10	.254	
	{ Duke Hospital.....		5,744	4	.691	
Avertin with supplement	{ Beecher <sup>1</sup> .....		3,934	7	1.78	
	{ Mueller <sup>8</sup> .....		5,000	0	0	
	{ Duke Hospital.....		1,615	3	1.85	
Spinal	{ Dealy <sup>4</sup> .....		3,193	7	2.19	
	{ Veal & Van Werden <sup>13</sup> .....		33,811	30	.887	
	{ Duke Hospital.....		6,366	8	1.25	

\* No really accurate comparison of statistics is possible since there are such wide variations in nutritional states, conditions requiring operation, color (the "anesthetic" death rate is over ten times greater in the colored than in the white patients in the Duke Hospital), distances traveled, *etc.*

Autopsy performed upon the patient who died during herniorrhaphy (Case 6) revealed a partial occlusion of the right coronary artery by a sclerotic plaque. Follis<sup>5</sup> reports three consecutive cases of sudden death during nitrous oxide-oxygen-ether anesthesia in which a similar condition was found.

Two deaths in our *cyclopropane* series (Cases 7 and 9) appear to have been due to overdosage and in another (Case 8) overdosage could have been responsible for death. At autopsy, one patient (Case 7) was found to have a "granulomatous myocarditis," the significance of which is unknown. In retrospect, the choice of anesthesia for the patient with thyrotoxicosis (Case 10) was poor in view of the likelihood of the occurrence of ventricular fibrillation in this condition following the administration of cyclopropane.<sup>2</sup>

Both patients who died while receiving *nitrous oxide* were classified as poor operative risks. Perhaps an anesthetic permitting the use of a higher percentage of oxygen would have been a better choice for the individual with pulmonary tuberculosis (Case 11). There is still some disagreement over the choice of anesthesia in Ludwig's angina (Case 12). Trout<sup>12</sup> favors pentothal or ethylene, but adds that the surgeon should be ready to perform an emergency tracheotomy before the anesthesia is started and should stand by during the induction of the anesthesia. Bennett<sup>3</sup> recommends intratracheal intubation before operation. If this can be done any anesthetic agent is satisfactory.

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The patients who expired while receiving a mixture of nitrous oxide-oxygen-ether (Cases 13 and 14) were poor operative risks, and it is difficult to say whether another type of anesthesia would have been a better choice.

Our experience with *ethylene* has been too limited to warrant comment. The one death (Case 15) is included in this study although shock appears to have been the more likely cause of death.

It is doubtful whether the patient who died under *avertin* anesthesia (Case 16) could have withstood the operation under any other type of anesthesia.

*Avertin supplemented with ether* has proved to be the most dangerous of all anesthetics in our hands. Three deaths have occurred in young adults considered good operative risks (Cases 17-19). The dangers of *avertin* used alone or as a basal anesthetic are generally recognized,<sup>1</sup> and in our experience its disadvantages appear to outweigh its advantages; its use, therefore, at the Duke Hospital has been discontinued except for an occasional case.

All deaths which occurred during spinal anesthesia at this hospital were in patients judged poor operative risks who were undergoing emergency abdominal operations (Cases 20-27). Perhaps the high mortality rate could be bettered by the judicious administration of fluids and careful continuous observation of blood pressure. At the present time special care is taken to insure constant blood pressure observation, and it is routine for intravenous fluids to be administered during all operative procedures of any length requiring a general or spinal anesthesia. Despite the high immediate mortality experienced when employing spinal anesthesia in emergency abdominal surgery, there are certain conditions which some feel demand this type of anesthesia. Graham and Brown<sup>7</sup> feel strongly that if adequate facilities are available spinal anesthesia should be used for all operations for acute intestinal obstruction. Foss and Bush<sup>6</sup> believe the risk of spinal anesthesia in cases where there is likelihood of extensive trauma to the viscera under general anesthesia is more than offset by the decreased risk resulting from the lessened visceral trauma made possible by the more complete relaxation. These views are opposed by Wangenstein,<sup>14</sup> however, who feels that in spite of certain advantages afforded by spinal anesthesia inhalation anesthesia offers the greatest safety to the patient suffering from intestinal obstruction.

### SUMMARY

1. During 54,128 anesthetics of all types there have been 38 sudden deaths, or 0.702 per 1,000.
2. Twenty-seven so-called "anesthetic" deaths have occurred during 39,880 general and spinal anesthetics, or 0.677 per 1,000.
3. Two-thirds of the "anesthetic" deaths occurred in Negroes although

less than 15 per cent of the total number of patients undergoing operation annually at the Duke Hospital are Negroes.

4. If the ages and preoperative conditions of the patients who died are taken into consideration in evaluating the results, the most dangerous agents in our hands have been avertin-ether, with a death rate of 1.85 per 1,000, and cyclopropane, with a rate of 0.691 per 1,000.

5. The administration of ether through an oral or tracheal catheter to patients whose faces are obscured by heavy drapes is a dangerous practice.

6. Spinal anesthesia in debilitated, acutely ill patients with low blood pressure may hasten the end, but offers certain advantages not found in other types of anesthesia.

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