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## Determination of Cause and Mode of Death Before and After Medicolegal Autopsy: A Comparative Study

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**ABSTRACT:** Two hundred and twenty-eight consecutive medicolegal autopsies were studied as to the cause of death established by a physician, the mode of death as suggested in the police report, and findings of medical interest often discovered following autopsy. Corrections had to be made even in some cases which seemed to be obvious. With a decrease of the number of autopsies, the records of various registration bureaus would be affected. Autopsies are still necessary for control and correction of clinical causes of death.

**KEYWORDS:** pathology and biology, postmortem examinations, education, quality assurance, medicolegal autopsy

The necessity of performing autopsies in large numbers has been questioned with regard to the information they provide about the last illness or state of the deceased. Among both clinicians and pathologists, opinions diverge as to the value of the autopsy as the final medical audit. The clinician may be interested in how accurately he was able to diagnose the illness of his patient, whether some diagnosis was missed because the appropriate diagnostic test was not performed, if the patient had another illness which was not known due to lack of symptoms, how far a malignant disease had spread, how effective a treatment had been, and why a postoperative death occurred. In a medicolegal autopsy, the cause of death has to be determined in many cases without any knowledge of the state of health of the deceased. In the medicolegal cases, legal interests and questions of insurance are considered more important than in hospital autopsies.

According to Finnish law, the police shall investigate the cause of death whenever:

- (1) it is not known that death is caused by illness, or when the deceased has not, during his last illness, been attended by a physician;
- (2) death is caused by homicide, accident, suicide, poisoning, occupational disease, or malpractice, or whenever there is reason to suspect that death may have followed such a cause; and
- (3) death has occurred unexpectedly.

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The aid of a physician should be used whenever needed. If the cause of death is not determined after external examination by a physician, a medicolegal autopsy should be performed. The medicolegal autopsy is ordered by the head of the police district where the death occurred, or by an official who has been commissioned to do it, such as the county government, the criminal investigation department, or a court of justice. In Finland, a complete autopsy is performed in some 80 to 90% of medicolegal cases. (A complete autopsy is here defined as sectioning of the thoracic and abdominal organs, the brain, and the neck; sectioning of the extremities when required; and examination of histologic, toxicologic, bacteriologic, serologic, and other specimens when needed.)

The Finnish death certificate includes:

1. The cause of death consists of the immediate cause of death (Ia) which is caused by one or more intermediate states (Ib) caused by the principal cause of death (Ic). As an example, massive sudden hemoptysis may be the immediate cause of death in a case where pulmonary tuberculosis is the principal cause of death. Further, there may be one or several contributory causes of death (II).
2. The events obtained from the police report are to be mentioned in the death certificate. The information of the police report and the findings at the autopsy provide data on the basis of which the mode of death is determined.
3. The mode of death is to be ruled as natural death, accident (including malpractice), suicide, homicide, death associated with warfare, or undetermined.

### Materials and Methods

To obtain an answer of the questions "From what did the deceased die?," "How many persons would have been interred with the wrong cause and mode of death had an autopsy not been performed?," "In how many cases were the cause and the mode of death the ones they seemed to be before the autopsy was performed?," "In how many cases will the cause and the mode of death be clear only after additional investigation?," and "How many details of medical interest had been missed, had the autopsy not been performed?," the following points were studied in 228 consecutive medicolegal autopsies.

1. Was the diagnosis or the cause of death provided by a physician right, was it wrong, or was there no diagnosis?
2. What was the mode of death in cases that in the police report were marked "The death is not known to be caused by illness," "The deceased has not been seen by a physician during last illness," or "The death has occurred unexpectedly"? Does the police report's "homicide," "accident," "suicide," "poisoning," "occupational disease," or "malpractice" remain as the mode of death, or will it be changed?
3. Would external investigation of the body have been sufficient for establishing the cause of death?
4. Was the cause of death determined without additional tests?
5. Was the mode of death determined without additional tests?
6. Was the cause of death determined after additional tests?
7. Was the mode of death determined after additional tests?
8. Were there details that were interesting clinically or otherwise, apart from determining the cause and mode of death?
9. Was the intake of alcohol a contributory cause of death?

### Results

The results are listed in Tables 1 and 2, and are commented upon below. The numbers correspond to those of the questionnaire.

TABLE 1—*Summary of results.*

1. No diagnosis	100
Right diagnosis	102
Wrong diagnosis	19
Right 1c, wrong 1a	7
2. The cause of death was evident at external examination	
Yes	12
No	216
3. The cause of death was determined after inspection of internal organs	
Yes	179
No	49
4. The mode of death was determined after inspection of internal organs	
Yes	183
No	45
5. The cause of death was determined after additional investigations	
Yes	47
No	2
6. The mode of death was determined after additional investigations	
Yes	37
No	8
7. Malignant disease reported to Cancer Register	19
Material for teaching	17
Meetings on medical or surgical problem cases	2
Phlebography of esophageal varices	10
Contagious diseases	1
8. Intake of alcohol was a contributory cause of death	
No	193
Yes	35
of the latter, violent or poisonings	30
natural deaths	5

TABLE 2—*Reasons for autopsy and mode of death findings based on autopsy.*

Reason Why Medicolegal Autopsy Ordered	No.	Mode of Death Based on Medicolegal Autopsy Findings and Police Report	No.
Death not known to be caused by illness, not seen by doctor during last illness, death occurred unexpectedly	94	Natural death caused by disease	83
		Accident	6
		Undetermined	5
Suicide	20	Suicide	19
		Undetermined	1
Poisoning	21	Accident	7
		Natural death	10
		Undetermined	4
Occupational disease	2	Occupational disease	2
Accident	46	Accident	31
		Natural death	12
		Undetermined	3
Malpractice	36	Natural death	35
		Malpractice	1
Homicide	9	Homicide	7
		Accident	2

One hundred persons were admitted for autopsy without diagnosis. They were persons who were found dead and were either taken directly to the morgue or to a physician who confirmed that death had occurred without attempting to determine the cause of death. The other 128 persons had been seen by a doctor who had given a diagnosis which usually was the same as the supposed cause of death. Of these, 102 persons had the right diagnosis, whereas 19 had a wrong diagnosis. The wrong clinical diagnoses (causes of death) and the causes of death obtained at autopsy are shown in Table 3. The 7 cases with both right and wrong diagnoses were cases where the principal cause of death (Ic) was right, with either an immediate cause of death (Ia) where there should be none, a wrong immediate cause of death, or a missing immediate cause of death where there should be one.

Of the 94 cases which in the police reports were marked "Death not known to be caused by illness" or "The deceased has not during the last illness been seen by a physician" or "Death has occurred unexpectedly," 83 turned out to be natural deaths which was to be expected because the information in the police reports suggested a disease. In the 6 cases that turned out to be accidental deaths, civil litigation interests in terms of compensation or responsibility may have been stimulated after the autopsy.

Of the twenty-one cases marked as poisonings in the police reports, most were suspected alcohol intoxications, usually because empty bottles were found at the scene. Seven cases were at autopsy ruled as accidental poisoning with alcohol, alcohol and drugs, or drugs alone. Most drugs were tranquilizers, sleeping pills, or remedies for cardiac disorders. None of the cases in this group was a "hard narcotic" overdosage. Ten cases of alleged poisoning were ruled as natural death with signs of disease and with alcohol or drugs either lacking or present in quantities insufficient to cause poisoning. Of the four cases of alleged poisoning ruled as undetermined mode of death, three were either suicidal or accidental poisonings, and one case remained undetermined as to the cause and mode of death. There were no homicidal poisonings in this group.

TABLE 3—*Alleged and actual causes of death.*

No.	Wrong Clinical Diagnoses (Alleged Causes of Death)	Causes of Death Obtained at Autopsy
3	Intracranial or cerebral hemorrhage	Coronary heart disease with or without cardiac infarct
2	Cerebral hemorrhage	Subdural hemorrhage with cerebral contusion
1	Cerebral hemorrhage	Pulmonary embolia
1	Cerebral hemorrhage	Rupture of aneurysm of abdominal aorta
1	Cardiac infarct	Hemorrhage of cerebral pons
1	Peptic ulcer and bronchial asthma	Ischemic heart disease
2	Ventricular fibrillation and cardiac asystole	Intoxication with alcohol (1 case) and with alcohol and melperone (1 case)
1	Dementia senilis. melena	Foreign body stuck in larynx
1	Epilepsia	Drowning
1	Fractured skull	Stenosis of carotid artery with cerebral infarct
1	Stenosis of femoral artery caused by diabetes	Ischemic heart disease
1	Gastrointestinal bleeding	Alcoholic cardiac fibrosis
1	Multiple injuries of which fracture of cervical vertebra was lethal	Multiple injuries of which rupture of ascending aorta was lethal
1	Pulmonary emphysema	Ischemic heart disease
1	Bleeding after vascular operation	Thrombosis in operated vessel with gangrene and septicemia

The two cases ruled as occupational disease had the diagnosis of pulmonary asbestosis. Both had developed pulmonary carcinoma. In both cases the victims were entitled to workman's compensation.

The twelve persons who died natural deaths, in the police reports suspected to be accidents, were persons who had a recent history of accident but who died of natural causes. The three undetermined cases marked as accidents in the police reports were drowning and falls from balconies. These may have been suicides or homicides as well.

Of the 36 cases of suspected malpractice, 35 were ruled as natural deaths after the autopsy. The patients in these cases were severely ill persons who were not strong enough to stand the stress of operations or other treatment properly performed. Malpractice is ruled when, for instance, the medical personnel had made a mistake or the apparatus used in the treatment has a fault with fatal result for the patient. One case was an accidental overdosage of morphine administered by a nurse on a hospital ward.

The cause of death was evident at external inspection in twelve cases, all of which were violent deaths with severe injury of the head and brain, or suicides by hanging. In some of these cases, intake of alcohol was a contributory cause of death, a fact which had not been evident had a complete autopsy with toxicologic study not been performed in these cases. A death certificate based on the external inspection is rarely issued in medicolegal cases in Finland. The results obtained in this study indicate that several cases would have gotten a wrong cause and mode of death if a complete autopsy had not been performed. The same conclusion is obtained in other studies [1].

The cause of death was determined after the inspection of the internal organs in 179 cases. In 49 cases, toxicologic, histologic, radiologic, bacteriologic, or diatomic investigations were needed.

In 183 cases, the mode of death was determined after inspection of the internal organs. In 45 cases, additional investigation had to be done. The cases where the mode but not the cause of death was determined after inspection of the viscera were suicides with unspecified drugs, in which the victim had left a letter of farewell.

After additional investigation, 47 of the 49 cases of obscure cause of death were determined. Cases in which the cause of death remains undetermined even after additional investigation are possible but rather rare. In this material, there were 2 cases that had to be ruled as "sudden nonviolent death of unknown reason."

Additional investigation made the mode of death clear in 37 of the 45 cases that needed further tests. In 8 cases, the mode of death remained undetermined. Of these, 6 were intoxications with no indication as to whether they were suicidal or accidental. The other 2 were the cases of undetermined cause of death in which the mode of death also remained obscure.

Of special interest other than determining the cause and mode of death were 19 cases in which malignant disease was discovered. In none of those persons was the malignant disease diagnosed before autopsy, and thus, none of them had been previously reported to the Cancer Register. The cases were 6 hypernephromas with or without renal adenomas, two lymphatic leukemias, one of which had an additional epidermoid cell carcinoma of the lung, one linitis plastica of the stomach, one adenocarcinoma of the prostate gland, one adenocarcinoma of the breast, one cholangiocarcinoma, one meningioma with a potentially fatal pattern of growth, one mucinocellular carcinoma of the rectum, one borderline serous papillary cystadenoma of both ovaries, one transitional cell carcinoma of the urinary bladder, one thyroid carcinoma with Hürthle cells, and two primary carcinomas of the liver.<sup>2</sup>

Rare histologic findings, unusual presentations of disease, and odd anatomic variations were found in seventeen cases. Two cases were analyzed at the clinicians' problem case meetings. In ten cases the esophageal veins were demonstrated with a new phlebographic method [2]. One case of untreated contagious disease (pulmonary tuberculosis) was revealed and

<sup>2</sup>M. Segerberg-Konttinen, manuscript in progress.

reported to the health authorities. No case of acquired immunodeficiency syndrome (AIDS) was discovered in this study. Tragically, one victim of suicide had suspected that he suffered from AIDS but the blood sample obtained at the autopsy showed a negative antibody test.

Intake of alcohol as a contributory cause of death was noted in 35 cases. Of these, 30 were violent deaths or accidental or suicidal poisoning. Five were contributory to natural death. These were: (1) a case of acute myocardial infarction where a blood alcohol level of 0.321 g/100 L was supposed to have benumbed the pain and the ability of purposeful action of the victim, (2) a case of hemorrhagic pancreatitis, (3) a case of neglected unstable diabetes which after intake of alcohol proceeded to coma, and (4 and 5) 2 cases of massive sudden bleeding from ruptured esophageal varices in persons with alcoholic cirrhosis of the liver.

### Discussion

The cause of death was erroneously defined in approximately 15% of the cases of this study in which diagnosis was made before autopsy was performed. In 5.5% of the cases the cause of death was partly erroneous before autopsy. In this material cerebral hemorrhage was clearly overestimated clinically as the cause of death.

Malignant disease was discovered in 8.3% of the cases in this study. This exceeds the percentage of malignant disease discovered in other studies [3,4]. At least four persons had a malignant disease that had developed far enough to be detectable at clinical investigation. The patients should have presented with clinical symptoms of illness. For some reason, they failed to go for a medical checkup.

Of the cases of this study 0.88% remained undetermined after autopsy. This is by and large in accordance with the large-system studies by Gantner [5] during which 1 to 2% of the cases remain undetermined.

The purposes for an autopsy are to instruct, to correct, to discover and investigate, to store knowledge, and to serve as a handmaiden of the law [6]. Autopsies provide a good picture of what diseases people suffer from and why they die. In cases of medicolegal investigation, the next of kin or the clinician who treated the patient usually cannot decide whether an autopsy should be performed or not, but the police decide on this in accordance with the law. Of special interest is whether there has been foul play, and also for instance whether the death is due to an accident which has been caused by another person, an accident where nobody is to blame, or an occupational disease where preventive measures and questions of insurance and compensation are important.

Of paramount medical interest in this study are the 19 cases where the clinical diagnosis was wrong, the 35 cases where the patient died during treatment or shortly after an operation, and the 49 cases mentioned in Part 7 of Table 1.

### Conclusion

Dorsey was absolutely correct when stating that progress in medical science depends not only on the autopsy but on the person who is examining the material and his ability to profitably utilize the data of autopsies, and persons who have imagination, originality, perspective, mental acuity, sound education, and the indispensable prepared mind [7]. It is useless to decide whether an autopsy is of value before it has been performed. This study shows that many autopsies offered important and intriguing knowledge. The conclusion is that autopsies are still essential for control and correction of causes of death.

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