Correctly Identifying Deaths Due to Drug Toxicity Without a Forensic Autopsy

Daniel W. Dye, MD, Gerald McGwin, MS, PhD,† Daniel S. Atherton, MD,* Brandi McCleskey, MD,* and Gregory G. Davis, MD**

Abstract: In 2005, the National Association of Medical Examiners approved the Forensic Autopsy Performance Standards. Standard B3.7 indicates that a forensic pathologist shall perform a forensic autopsy when the death is by apparent intoxication by alcohol, drugs, or poison.

The Jefferson County Coroner/Medical Examiner Office has observed an increase in our caseload by 10% per year since 2012. We designed a study to determine if a pathologist could correctly classify the cause of death (COD) and manner of death (MOD) of suspected drug-related deaths without information from the internal examination. The determination of the COD and MOD was then compared with the case file, which includes information from the internal examination and microscopy, to determine agreement between the case file and the reclassification. The percent correct for COD and MOD was calculated, and kappa values were calculated for MOD.

The pathologists were able to correctly classify the COD in 73% of cases. For MOD, 2 pathologists achieved substantial agreement between the test cases and the actual case file. The third pathologist had moderate agreement. These findings indicate that a full postmortem examination is necessary to correctly classify the COD/MOD in cases of suspected drug toxicity. Our null hypothesis is that a full autopsy is not necessary to correctly classify the COD and MOD in cases of drug toxicity.

Key Words: autopsy, performance standards, limited autopsy, overdose

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The Forensic Autopsy Performance Standards were approved by the National Association of Medical Examiners (NAME) in 2005 and published in 2006.[1] Before 2005, standards of practice of forensic pathology did not exist in any accepted format or publication endorsed by the NAME membership.[2] The document was the culmination of the work of the NAME Standards Committee and used survey results from NAME members to develop the final document that was approved by the NAME.[1,2] The document is publically available on the NAME webpage, and revisions to the Forensic Autopsy Performance Standards can be made.[3] A revision must first be submitted to the NAME Standards Committee and be approved by that committee before the NAME membership votes on the proposed revision at the annual business meeting.[3]

The Forensic Autopsy Performance Standards provide a constructive framework that allows professional forensic pathologists to easily define which cases require a forensic autopsy.[1,4] Standard B3.7 indicates that a forensic pathologist shall perform a forensic autopsy when the death is by apparent intoxication by alcohol, drugs, or poison.[1] This standard was later amended to read, "a forensic pathologist shall perform a forensic autopsy when the death is by apparent intoxication by alcohol, drugs, or poison, unless a significant interval has passed, and the medical findings and absence of trauma are well documented."[1,4,5] However, in many cases of deaths due to drug/alcohol toxicity, the autopsy examination may not reveal a gross or microscopic cause of death (COD). Nonspecific findings such as pulmonary edema, bladder distention with urine, cerebral edema, aspiration, or steatohepatitis may be observed in some cases of deaths due to drug toxicity.[6,7] Despite nonspecific findings, some forensic pathologists refer to a postmortem examination with no significant gross or microscopic findings to explain death as a "negative autopsy."[8]

The current opioid epidemic has increased the number of deaths due to opioid-involved intoxication in the United States.[5,9,10] Recent data indicate that the number of deaths due to opioids has quadrupled, with more than 33,000 deaths in 2015, a number that is expected to increase.[9,10] The Jefferson County Coroner/Medical Examiner Office (JCCMEO) has observed an increase in their caseload by approximately 10% per year since 2012. The increase is largely due to an increase in deaths of suspected drug-related deaths. Per NAME standards, cases of suspected intoxication receive a full autopsy at the JCCMEO.[4,5] At autopsy, some nonspecific signs of a death due to drug toxicity are sometimes observed. In some cases, other important evidence of disease, which may explain death when the investigative information and results of toxicological testing are reviewed, is identified at autopsy. However, in many cases of deaths due to drug toxicity, it is our experience that the autopsy does not offer information that will override the (1) investigative information, (2) information from the external examination, and (3) information from toxicological testing. This observation brought into question the value of an internal examination in classifying a death due to drug toxicity. To assess the necessity of an autopsy, the current study sought to test the NAME standard that a full autopsy, specifically an internal examination, is necessary to correctly classify the COD and manner of death (MOD) in cases of suspected drug toxicity. Our null hypothesis is that a full autopsy is not necessary to correctly classify the COD and MOD in deaths due to drug toxicity.

MATERIALS AND METHODS

The JCCMEO Case Management Database was used to select the 629 cases from 1 year (2017) where a full autopsy (external and internal examination with microscopic examination) was performed. All of the cases with a MOD of homicide, suicide, and undetermined were excluded, in addition to accidental deaths due to motor vehicle–related fatalities; asphyxial deaths; deaths due to falls, fires, firearms; and 1 death due to an envenomation, leaving 386 cases. To avoid the pathologists recognizing information from a notable scene, memorable tattoo, or particularly impressive toxicology report in one of their assigned cases, 277 cases were excluded and only cases from 1 pathologist (D.W.D.) were used. Notably, pathologists at the

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From the *Department of Pathology, and †Department of Epidemiology, University of Alabama at Birmingham, Birmingham, AL.
The authors report no conflict of interest.
Reprints: Daniel W. Dye, MD, Department of Pathology, University of Alabama at Birmingham, 1515 6th Avenue S, Birmingham, AL 35233.
E-mail: dwdye@uab.edu.

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JCCMEO do not cosign one another's autopsy reports. In addition, cases with "contributing factors" were excluded from the test cases. Of the remaining 109 cases, 60 cases were selected, including accidental deaths due to drug toxicity (38 cases) and natural deaths (22 cases). The age of the decedents ranged from 21 to 77 years (mean, 44 years). The cases were composed of 44 males and 16 females.

One pathologist (D.W.D.) designed a series of questions for the other 3 pathologists at the JCCMEO. The 3 reviewing pathologists are all board certified in anatomic, clinical, and forensic pathology by the American Board of Pathology. One reviewer (G.G.D.) has been a practicing forensic pathologist for 25 years, 1 reviewer (D.S.A.) for 4 years, and the third reviewer (B.C.M.) for 2 years. For each case, each pathologist was given information including a history/scene investigation, the narrative account from the external examination, and information from the toxicology report on each case. The information was in the form of a narrative, and no information from the internal examination or microscopic examination was provided to the reviewing pathologist. Essentially, the pathologist was "blinded" to the internal examination and microscopic findings in every question, thus mimicking an external examination. The pathologists conducted their reviews separately and were instructed not to discuss the questions with each other. After reviewing the narrative account of the history/scene, external examination, and toxicology report, the pathologist was asked to classify the COD and MOD for each case.

The agreement between the COD and MOD from the original case was compared with the reviewer's opinion of the COD and MOD. In addition, the agreement between reviewers was also calculated. The percent agreement was calculated for each reviewer in addition to simple kappa values to assess the agreement between reviewers. Kappa values are interpreted as follows: values less than or equal to 0 indicates no agreement; 0.01 to 0.20, none to slight; 0.21 to 0.40, fair; 0.41 to 0.60, moderate; 0.61 to 0.80, substantial; and 0.81 to 1.00, almost perfect agreement.[11,12] Agreement was also calculated for cases of suspected drug toxicity based on history/scene findings. In 43 of the cases, the decedent had some past medical history of illicit or prescription drug abuse, or the presence of drug paraphernalia was observed at the scene. In the remaining 17 cases, no history of prescription/illicit drug use was noted, and no drug paraphernalia was observed at the scene.

RESULTS

The percent agreement between the reviewer's COD and the actual COD was 73%. The percent agreement ranged from 66% to 80% for COD (Table 1). The percent agreement for MOD ranged from 70% to 85%. The average percent agreement was 80% for MOD between each individual reviewer and the case file (Table 2).

Comparing each reviewer to the case file, the kappa values for each of the reviewers were 0.71, 0.69, and 0.46 (Table 3). Because MOD is a good marginal variable for comparison (only 5 possible choices for reviewers: natural, accident, undetermined, homicide, and suicide), kappa values were also calculated to assess interreviewer agreement.[11,12] The interrater kappa values were 0.54, 0.61, and 0.53, indicating only moderate agreement between reviewers.

When the reviewers knew that the decedent had a history of drug use or drug paraphernalia was discovered at the scene, the percent agreement between the reviewer and the case file for COD ranged from 80% to 83%. In cases where the decedent did not have a history of drug use and no drug paraphernalia was discovered at the scene, the COD ranged from 40% to 80%. Kappa values to assess agreement between reviewers and the case file for MOD in cases with a history of drug use were 0.73, 0.39, and 0.28. Kappa values between reviewers and the case file for MOD in cases without a history of drug use were 0.43, 0.25, and 0.75 (Table 3).

DISCUSSION

When concern for a death due to drug toxicity arises from a given decedent's history or scene investigation, findings from the internal examination can offer clues to support a death due to drug toxicity, or show evidence of some natural disease, or show no significant gross or microscopic evidence of disease. In all 3 of these hypothetical scenarios, the internal examination has provided the forensic pathologist with information to assist in the interpretation of toxicological findings.

Our study does show that substantial agreement can be achieved without information from the internal examination between a reviewer and the correct COD/MOD from the case file in the set of sample cases; however, interreviewer agreement is inconsistent. More simply stated, the pathologists did not agree with each other very well, as 1 pathologist could get the correct answers for COD and MOD, but the result was not consistently reproducible with additional pathologists. This is demonstrated by the range of kappa values for agreement of MOD and the range of percent agreement for COD.

Furthermore, the reviewer with the fewest years of practice as a forensic pathologist correctly classified the COD in 80% of the cases. The reviewers with longer practice careers achieved scores of 66.6% and 71.6% when classifying the COD. The correct MOD was achieved 85% of the time by 2 reviewers and 70% of the time by the third reviewer. These findings suggest that additional years of practice may not offer an advantage to interpreting

TABLE 1. Percent Agreement for COD

	Reviewer 1	Reviewer 2	Reviewer 3
All 60 cases	71.6%	66.6%	80.0%
Overdose deaths	82.5%	80.0%	80.0%
Natural deaths	50.0%	40.0%	80.0%

TABLE 2. Percent Agreement for MOD

	Reviewer 1	Reviewer 2	Reviewer 3
All 60 cases	85.0%	70.0%	85.0%
Overdose deaths	92.5%	85.0%	82.5%
Natural deaths	70.0%	40.0%	90.0%

TABLE 3. Kappa Values for MOD

	Reviewer 1	Reviewer 2	Reviewer 3
All 60 cases	0.71	0.46	0.69
Overdose deaths	0.73	0.40	0.29
Natural deaths	0.43	0.25	0.75

the COD or MOD without an internal examination in selected cases, although 3 is a small number from which to infer a conclusion with confidence.

Finally, if forensic pathologists attempt to classify the COD and MOD in cases where the scene investigation or past medical history indicates illicit or prescription drug use, an internal examination may not be necessary. The findings of this study indicate that in a circumstance where scene investigation or medical history indicates evidence of illicit or prescription drug abuse, a pathologist could expect to accurately determine the correct COD by external examination only in 75% of the cases and the correct MOD in 80% of cases. These findings support previous studies that show investigation alone is less effective at predicting the presence of toxic substances in the blood/urine/vitreous of decedents in a medical examiner cohort than is investigation with an autopsy and toxicology testing.[13]

To an office overwhelmed with more deaths than the pathologists can adequately autopsy, the first question is whether 75% to 80% accuracy is acceptable. Creating a simple algorithm to record that the COD is a drug-related death if evidence suggesting intoxication is present from the investigation can achieve 75% to 80% accuracy in a general way. With such an algorithm and a tolerance of 75% to 80% accuracy, the second question may become, "Does an office need a forensic pathologist at all?"

In summary, determining the COD and MOD without performing an autopsy in cases of suspected intoxication is like flipping a weighted coin; one will call the correct diagnosis more often than not, but not nearly every time. Based on this study, we are satisfied that the accuracy provided from the extra work of autopsy justifies the additional time and resources required to perform a full postmortem examination for our office and, to our thinking, for the nation. Our own practice will be to continue to follow the NAME Autopsy Standards by continuing to autopsy suspected drug-related deaths.

REFERENCES

1. Peterson GF, Clark SC. Forensic Autopsy Performance Standards. *Am J Forensic Med Pathol*. 2006;27(3):200–225.
2. Clark SC, Peterson GF. History of the development of Forensic Autopsy Performance Standards. *Am J Forensic Med Pathol*. 2006;27(3):226–255.
3. Denton JS. National Association of Medical Examiners Bylaws (Amended September 12, 2016). Available at: http://thename.org.
4. Peterson GF, Clark SC. Forensic Autopsy Performance Standards (last amendments September 12, 2016). Available at: http://thename.org.
5. Davis GG & National Association of Medical Examiners. National Association of Medical Examiners position paper: recommendation for the investigation, diagnosis, and certification of deaths related to opioid drugs. *Acad Forensic Pathol*. 3(1):83.
6. Winklhofer S, Surer E, Ampanozi G, et al. Post-mortem whole body computed tomography of opioid (heroin and methadone) fatalities: frequent findings and comparison to autopsy. *Eur Radiol*. 2014;24(6):1276–1282.
7. Chen HI, Dejong J. Increased lung weights in drug-related fatalities. *J Forensic Sci*. 2017;62(6):1632–1634.
8. Lawler W. The negative coroner's necropsy: a personal approach and consideration of difficulties. *J Clin Pathol*. 1990;43(12):977–980.
9. Stuart GL, Shorey RC, France CR, et al. Empirical studies addressing the opioid epidemic: an urgent call for research. *Subst Abuse*. 2018; 12:1178221818784294.
10. Mathis SM, Hagemeier N, Hagaman A, et al. A dissemination and implementation science approach to the epidemic of opioid use disorder in the United States. *Curr HIV/AIDS Rep*. 2018;15(5):359–370.
11. Vetter TR, Schober P. Agreement analysis: what he said, she said versus you said. *Anesth Analg*. 2018;126(6):2123–2128.
12. Sim J, Wright CC. The kappa statistic in reliability studies: use, interpretation, and sample size requirements. *Phys Ther*. 2005;85(3):257–268.
13. Gruszecki AC, Booth J, Davis GG. The predictive value of history and scene investigation for toxicology results in a medical examiner population. *Am J Forensic Med Pathol*. 2007;28(2):103–106.