Forensic Science International 223 (2012) 353–358

Contents lists available at SciVerse ScienceDirect

Forensic Science International

journal homepage: www.elsevier.com/locate/forsciint

Forensic autopsies in a naturalistic setting in Norway: Autopsy rates and toxicological findings

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ARTICLE INFO

Article history:
Received 11 June 2012
Received in revised form 9 October 2012
Accepted 11 October 2012
Available online 3 November 2012

Keywords:
Forensic autopsy
Autopsy rate
Alcohol
Drugs
Post-mortem

ABSTRACT

Autopsies can give valuable information about the cause of death, and represent an important tool for obtaining valid cause of death statistics. In particular, they may shed light on the circumstances of death in ambiguous and criminal cases. To address the need for information on current autopsy practices, forensic autopsy rates in two counties in Central Norway over the period 2007–2009 were assessed. To investigate toxicological findings that could possibly remain undisclosed without the performance of an autopsy, the impact of alcohol and drugs in forensic autopsy cases from this material was evaluated.

The total forensic autopsy rate in this material was 3%. The forensic autopsy rates were low for natural deaths (1%), accidental falls (12%) and the heterogeneous category "other accidents" (21%), relatively high for accidental poisonings (84%), and less than adequate for road traffic accidents (57%). For suicides the forensic autopsy rate was 63%, and for recognized homicides 100%. The total forensic autopsy rate was higher for men than for women (5% vs. 2%), and decreased with age, being 38% in the age group <30 years, 23% in the age group 30–59 years, and 1% in the age group >59 years. Despite that Norwegian legislation and regulations regarding forensic autopsy requests are national, the forensic autopsy rates were generally lower in the county of Nord-Trøndelag than in Sør-Trøndelag, with most striking differences in suicide deaths (11% vs. 91%) and road traffic accidents (46% vs. 67%). This illustrates how autopsy rates, and possibly cause of death registries, might be susceptible to the influence of regional variations in law enforcement, with possible consequences for the quality and validity of cause of death statistics.

Of the forensic autopsy cases where toxicological analysis was performed (361 of 364 cases) a total of 71% had positive toxicology results; 12% were positive for alcohol only, 44% were positive for drugs only, and 15% were positive for both alcohol and drugs. The toxicology results suggest that alcohol and drugs are important factors in sudden unexpected deaths, and that a thorough and comprehensive toxicological analysis is called for when investigating these deaths. Mean BAC in alcohol positive forensic autopsy cases was 1.7‰ (median 1.6‰, range 0.29-4.1‰). The average number of substances detected in toxicology positive cases was 2.6 (median 2, range 1–10). The by far most frequently detected classes of substances were (1) benzodiazepines, (2) opioids and (3) alcohol.

1. Introduction

Autopsies can provide documentation of external or internal injuries, diseases and the presence of alcohols, drugs and other substances in body fluids and tissues. The autopsy can thus give valuable information about the cause of death to relevant health care professionals and the next of kin. Moreover, the autopsy is an important tool in the acquisition of reliable mortality data, which in turn is essential for valid cause of death statistics. National registries of causes of death are generated using the World Health Organization (WHO) International Classification of Diseases (ICD-10) codes [1] based on information given in death certificates issued by physicians, and reports from clinical and forensic autopsies. The value of autopsies as an important corrective for the determination of causes of death has been demonstrated in several studies [2–7].

Forensic autopsies can, according to law and provision in Norway, be requested by the police under given circumstances, e.g.

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http://dx.doi.org/10.1016/j.forsciint.2012.10.023

suspected accidents, drug-related deaths, suicides and sudden unexpected deaths [8]. In cases of suspected homicide or unidentified corpse the police is obliged to request a forensic autopsy [8]. Forensic autopsies may shed light on the circumstances of death in ambiguous and potentially criminal cases, providing essential information to police authorities and courts of law as well as medical examiners, and thus contributing to quality assurance in both the legal system and the health services. Furthermore, clear assessment of alcohol- and drug-related deaths requires quantitative post-mortem chemical and toxicological analysis [9], which in our region rarely is performed outside the forensic autopsy setting.

Autopsy rates are affected by many factors, such as manner of death, sex, age, region and legislation [10,11]. Low autopsy rates may reduce the quality and validity of cause of death statistics, and thus compromise proper knowledge about the status and trends in causes of death. In individual cases absence of autopsy data may increase the possibility of incorrect conclusions as to the cause and manner of death and, in the worst instance, failure to detect homicide [12,13]. Autopsy rates, particularly for clinical autopsies, have declined continuously over the last decades in many countries [14–19], to the concern of pathologists worldwide [18,20–23]. There has also been raised concern about shifts in autopsy patterns resulting in an increasing percentage of autopsies in external cause deaths and younger persons, possibly affecting the cause of death determination for important disease conditions in the higher age groups [19]. Finland has exceedingly high forensic autopsy rates compared to other countries after the implementation of a national authority for medico-legal affairs [24]. In Norway, no similar initiatives have been implemented. In our country the combined clinical and forensic autopsy rate has declined from about 9% to 7% from 2002 to 2010 [25,26]. The observed decline is explained by a decrease in the clinical autopsy rate from about 5% to 3%, as the forensic autopsy rate has remained relatively constant at just below 4% over this period [25,26]. Our knowledge of how the frequency of forensic autopsies relates to manner of death and demographical variables over time is limited.

To address the need for information on current autopsy practices, this article presents an investigation of forensic autopsy rates in two counties in Central Norway over the period 2007–2009. To survey toxicological findings possibly undisclosed without the performance of an autopsy, the impact of alcohol and drugs in forensic autopsy cases from this material is evaluated.

2. Materials and methods

All forensic autopsy cases ($n = 364$) from the two counties Sør- and Nord-Trøndelag in Central Norway (total population approximately 425,000) during the period 2007–2009 were reviewed and assessed with regard to manner of death, demographical data (sex, age, county) and toxicological findings. The data was registered in a database at The Regional Biobank of Central Norway, and managed using the same database and statistical software (Microsoft Excel 2007 and SPSS 16.0). Data on all deaths in the two counties over the same period was collected from the Norwegian Cause of Death Registry ($n = 10,862$). From these two data sets forensic autopsy rates by manner of death, sex and age were determined.

Manner of death is defined as the fashion or circumstances that result in death, and mainly corresponds to the underlying cause of death. The underlying cause of death is defined by the WHO as "the disease or injury which initiated the train of morbid events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury" in accordance with the rules of the ICD-10 [27]. Manner of death is commonly categorized as natural, accidental, suicidal, homicidal or undetermined. This categorization is also applied throughout this article, but since none of the forensic autopsy cases in this material were assigned an undetermined manner of death this category has been omitted.

Natural death comprises those dying of diseases, sudden infant death syndrome (SIDS) and cases of preserved bodies with unknown cause of death. Accidents are subcategorized into accidental poisonings (typically unintentional overdoses/intoxications and therapeutic misadventures), road traffic accidents (drivers and passengers of motor vehicles, pedestrians and bicyclists killed in accidents on public roads involving a motor vehicle), accidental falls (including both occupational fall accidents and fragile, elderly individuals dying in the lapse of

Table 1
Number of deaths and forensic autopsy cases in Central Norway 2007–2009, by manner of death, sex and age.

	Sør-Trøndelag			Nord-Trøndelag			Total		
	Deaths	Forensic autopsy cases	Autopsy rate	Deaths	Forensic autopsy cases	Autopsy rate	Deaths	Forensic autopsy cases	Autopsy rate
	n	*n*	%	*n*	*n*	%	*n*	*n*	%
Manner of death									
Natural death	6844	107	2	3419	20	1	10,263	127	1
Accidents	354	124	35	128	36	28	482	160	33
Accidental poisoning	60	50	83	17	15	88	77	65	84
Road traffic accident	30	20	67	24	11	46	54	31	57
Accidental fall	77	8	10	24	4	17	101	12	12
Other accidents	187	46	25	63	6	10	250	52	21
Suicide	70	64	91	38	4	11	108	68	63
Homicide	7	7	100	2	2	100	9	9	100
Sex									
Male	3447	227	7	1733	44	3	5180	271	5
Natural death	3200	81	3	1633	16	1	4833	97	2
Unnatural death	247	146	59	100	28	28	347	174	50
Female	3828	75	2	1854	18	1	5682	93	2
Natural death	3644	26	1	1786	4	0.2	5430	30	1
Unnatural death	184	49	27	68	14	21	252	63	25
Age									
<30 years	160	62	39	45	15	33	205	77	38
Natural death	105	13	12	22	6	27	127	19	15
Unnatural death	55	49	89	23	9	39	78	58	74
30–59 years	586	151	26	244	36	15	830	187	23
Natural death	470	54	11	195	7	4	665	61	9
Unnatural death	116	97	84	49	29	59	165	126	76
>59 years	6529	89	1	3298	11	0.3	9827	100	1
Natural death	6269	40	1	3202	7	0.2	9471	47	0.5
Unnatural death	260	49	19	96	4	4	356	53	15
Total	7275	302	4	3587	62	2	10,862	364	3