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Analysis of 155 consecutive forensic exhumations with emphasis on undetected homicides

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Abstract A total of 155 consecutive forensic exhumations performed in Münster, Germany from 1967 to 2001 were evaluated retrospectively on the basis of the autopsy report, the police report and the death certificate. Histology and toxicology were performed in most cases. The post-mortem intervals varied from 8 days to 8 years. Compared to other countries, the autopsy rate was low (1.2–1.4%) and the exhumation rate high (0.016%): principle of reciprocity. The cause of death could be clearly determined in 103 cases (66.5%) and histology or toxicology were decisive in 40%. Some findings were discernable using immunohistochemistry after considerable postmortem intervals, such as acute myocardial infarction after 1 year and pneumonia after 2 years and a diazepam intoxication was determined after 4.5 years. Major deviations between the cause of death as stated on the death certificate and as diagnosed after autopsy existed in 57 cases (37%). A more detailed analysis revealed five subgroups. 1. primary suspicion of intoxication ($n=18$) confirmed in 6 cases including 3 homicides (with parathion, clozapin, diazepam) which are described in more detail. 2. primary suspicion of homicide other than poisoning ($n=51$) confirmed in 19 cases. There was a serial killing of 15 patients by injection of air. In the remaining 4 cases, a shaken infant, craniocerebral injuries from blows with beer bottles, a craniocerebral gunshot and a multiplicity of blunt force injuries were diagnosed. The latter two cases are described in more detail. Superficial external examinations and the low autopsy rate were 2 common reasons for the occurrence of “buried homicides” ($n=22$) – not a single forensic autopsy had been performed directly after the death of the victims. 3. primary

suspicion of medical malpractice ($n=39$). 4. accidents including traffic accidents ($n=30$). 5. clarification of the cause of death, circumstances or identity ($n=17$). Exhumations were frequently successful for recovering evidence which should better have been collected immediately after the death of an individual. Exhumations can also be regarded as an instrument to evaluate the quality of death certificates and death investigations.

Keywords Forensic autopsy · Exhumation · Post-mortem changes · Homicide

Introduction

Autopsy of a corpse in a state of advanced putrefaction was regarded as useless for a long period of time [12]. A different view did not gain acceptance until the end of the nineteenth century [12, 18]. This study provides an overview of our experience with a large number of forensic exhumations where special emphasis is laid on the detection of previously unknown homicides.

Material and methods

The autopsy files of the Institute of Legal Medicine, University of Münster, Germany, were checked for exhumation autopsies. A total of 155 exhumation autopsies from 1967–2001 were evaluated retrospectively. The case records of the Institute included the autopsy report, the police report, and the information on the original death certificate. In the large majority of cases, histology and toxicology were performed and in selected cases, clinical records and court files were also available. The number of death cases in the catchment area of the Institute was taken from regional health reports from 1991 to 2001.

Results

The vast majority of the exhumations were ordered by criminal courts or the prosecution department ($n=146$). In the remaining cases, social or private insurances ($n=7$) or

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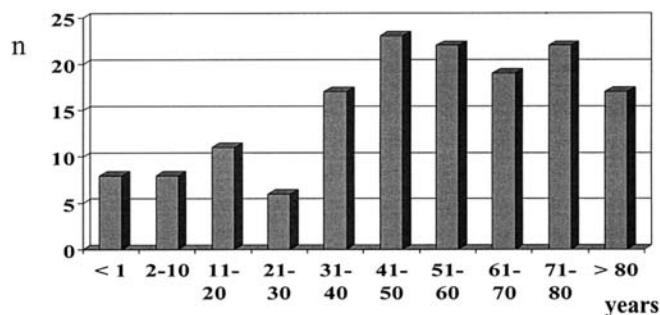


Fig. 1 The age distribution at the time of death of 155 exhumed bodies

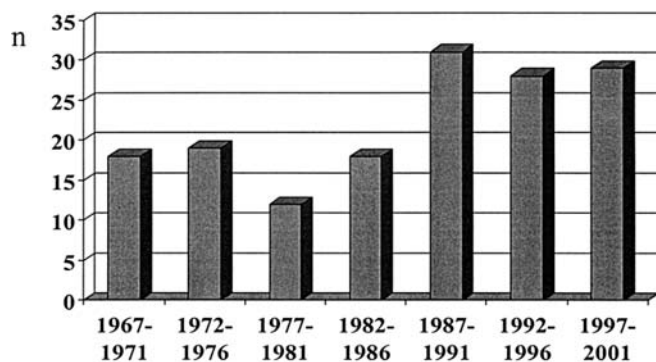


Fig. 2 The number of exhumations in 5-year intervals

private persons ($n=2$) ordered exhumations, mainly to solve questions of a causal connection after accidents.

There were 97 males (63%) and 58 females (37%) and the age at the time of death ranged from 13 days to 92 years including 50 cases in the age group below 40 years (Fig. 1). The number of exhumations increased over the time period evaluated (Fig. 2). Table 1 shows autopsy and exhumation rates for two periods of time. The postmortem intervals varied from 8 days to 8 years (Fig. 3) with a mean value of 6 months.

The cause of death was clearly determined in 66.5% (66 natural deaths, 37 unnatural deaths). In these 103 cases, histology was decisive in 29% and toxicology in 11% including considerable postmortem intervals. Acute myocardial infarction could be proven after 1 year (Fig. 4) and bronchopneumonia after 2 years (Fig. 5) using immunohistochemistry. Diazepam was detected after 4.5 years. A major difference between the cause of death as stated on the death certificate and that determined after autopsy was present in 57 cases (37%) (Table 2).

Five subgroups were differentiated depending on the indication for exhumation.

Primary suspicion of intoxication ($n=18$)

This could be confirmed in 6 cases (33%) by detailed toxicology. Exhumation 1 month postmortem of a 43-year-old man found dead in the rear of his truck established a CO-intoxication and the technical expert then found a defect in the heating system. A suicidal doxepin intoxication was found in a 37-year-old woman after a postmortem interval of 2 years and various sedatives in another suicide after 3 months. The remaining three cases were homicides which are described in more detail.

Case 1: parathion

A 9-month-old boy died unexpectedly at home and sudden infant death was suspected on the death certificate. Several months later, the 3-year-old sister also died at home. A genetic disorder was suspected and a clinical autopsy performed. The pupils were very narrow and the stomach content was musty smelling and bluish. The main conversion product of parathion, paraoxon, showed a level of 70 $\mu\text{g/l}$ in blood and the cholinesterase was determined to be 0.29 U/l (normal: 4–8 U/l). After exhumation of the boy 8 months postmortem, 5.4 $\mu\text{g/kg}$ paraoxon was determined in material from the abdominal cavity. The mother then confessed that she had given both her children “a dash of parathion” dissolved in fluid. The toxicology results, however, indicated that she had administered larger amounts of the poison. She received a life sentence for murder.

Case 2: clozapin

A 19-month-old girl had been treated repeatedly in hospital for tiredness, paralytic episodes and breathing difficulties and finally developed respiratory arrest. Clinical autopsy established a focal bronchopneumonia as the cause of death. Similar symptoms occurred later in the 3-year-old sister and rare genetic disorders such as Romano-Ward or MELAS syndrome were considered. However, clozapin was detected in the urine during her ninth stay in hospital and also in the urine of the father. After exhumation of the dead sister 17 months postmortem, clozapin was determined in hairs up to a distance of 9 cm from the roots, thus demonstrating continued administration. The mother then confessed that she had administered 150 mg clozapin to her daughter before she died and that she had repeatedly given 50–100 mg of clozapin to both daughters to sedate them. She was sentenced to 5 years for manslaughter and grievous bodily harm and to compulsory detention in a psychiatric clinic.

Table 1 Autopsy rates (autopsies/fatalities) and exhumation rates (exhumations/fatalities) for two time periods

Time period	Fatalities	Autopsies	Exhumations	Autopsies/fatalities (%)	Exhumations/fatalities (%)	Exhumations/Autopsies (%)
1993–1995	103,266	1,284	18	1.2	0.017	1.4
1999–2001	103,092	1,394	17	1.4	0.016	1.2

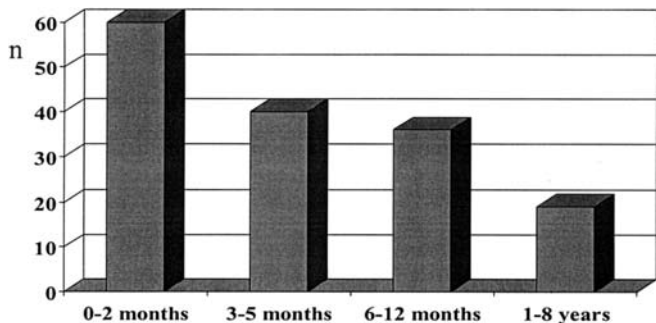


Fig. 3 Postmortem periods of the 155 exhumations

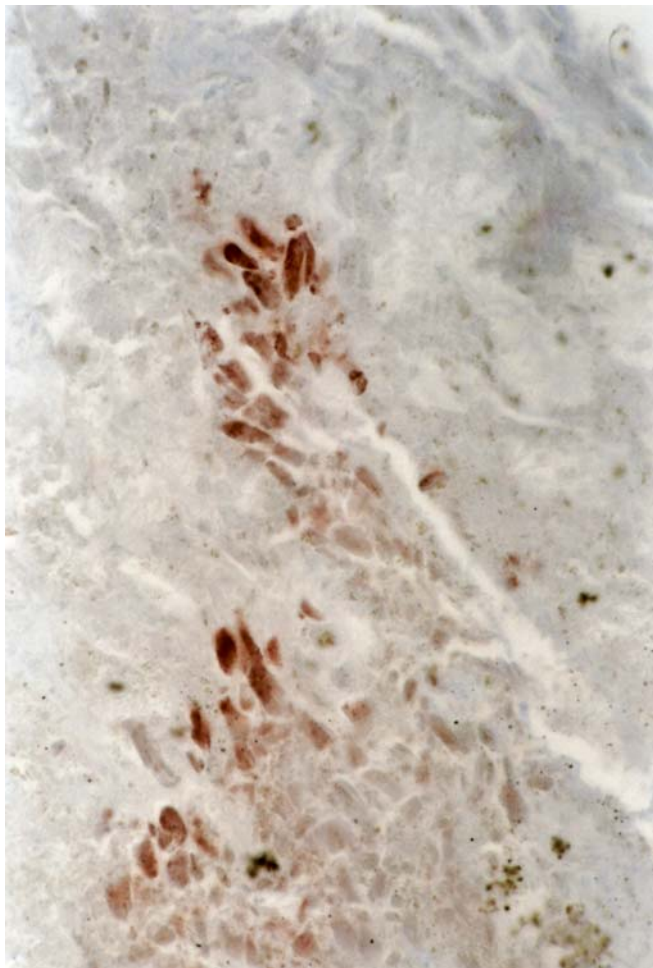


Fig. 4 Myocardial infarction: C_{5b-9} positive necrosis of myocytes in a 82-year-old woman after a postmortem interval of 12 months

Case 3: diazepam

A 48-year-old man with obesity and a moderate obstructive sleep-apnoe syndrome died unexpectedly at home. Rumors about an intoxication emerged slowly so that exhumation was not performed until 4.5 years postmortem. High pressure liquid chromatography determined diazepam in liver tissue (31 ng/g) and stomach content (119 ng/g) as well as desmethyldiazepam, a metabolite of diazepam and also an

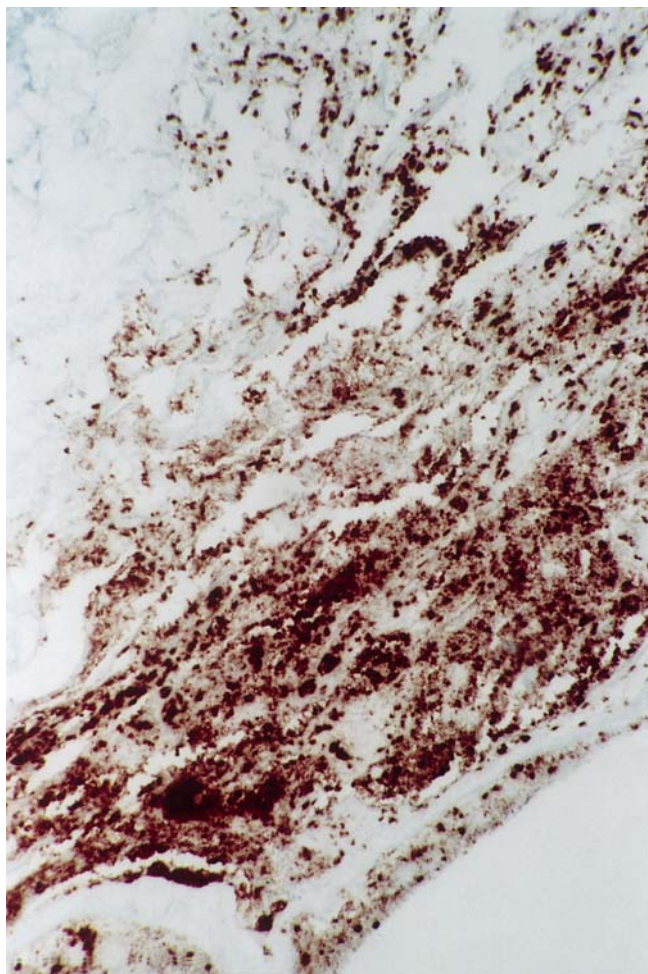


Fig. 5 Bronchopneumonia: dense infiltration of NP57 positive neutrophils in lung tissue of a 92-year-old woman after a postmortem interval of 24 months

Table 2 Selection of cases where exhumation revealed a cause of death completely different from the one stated on the original death certificate

Death certificate	Exhumation
Pulmonary embolism	Suppurative meningitis
Cardiac death, Amyotrophic lateral sclerosis	Bleeding from gastric carcinoma
Fracture of base of skull	Pulmonary embolism
Haemorrhagic shock	Myocardial infarction

effective drug. The initial concentration of diazepam is unknown but was certainly higher. The clinical records showed that the man had never received benzodiazepines, which are strictly contraindicated in sleep-apnoe syndrome. Witnesses testified that relatives had been seen repeatedly grinding tablets in a mortar. Also, the man had suffered severe episodes of fatigue including difficulties to walk and speak, mostly after meals, during his last weeks and especially on the day he died. It was ruled out on the basis of the clinical records that the moderate sleep-apnoe syndrome alone could have caused death. However, sedatives such

as diazepam can lead to irreversible respiratory arrest in such patients. It was therefore concluded that the cause of death was respiratory arrest from diazepam in a vulnerable patient with sleep-apnoea syndrome.

Primary suspicion of homicide ($n=51$)

Suspicion of homicide other than intoxication was the reason for 51 exhumations and homicide was confirmed in 19 cases (37%). A male nurse confessed to a serial killing of 15 patients in a hospital by injecting air into peripheral veins; gas analysis from the right ventricle showed the presence of embolized air in several cases [2]. Violent shaking with typical intracranial haemorrhages was diagnosed in a 2-month-old boy 1 week postmortem and fatal craniocerebral injuries from blows with beer bottles were found in a 60-year-old man 1 week postmortem. The remaining two cases are described in more detail:

Case 4

A 33-year-old neighbour from a nearby farm was found dead lying in the stable of another farm. After external examination, a physician stated on the death certificate that the cause of death was “probably fracture of the base of the skull”. The police concluded that this was an accidental fall. A violent confrontation between the farmer and his son 2 years later led to renewed interest. Consequently, exhumation was ordered 2 years postmortem but instead of detecting a blunt force injury to the head, a deformed 5.6 mm lead bullet was recovered from the cranial cavity. The bony entrance wound was located in the back wall of the right orbita (Fig. 6). Fracture lines spread from here to the frontal bone as well as to the floor and roof of the orbita, which were both shattered (Fig. 6). The bullet was recovered from the posterior cranial fossa and the occipital bone was fragmented but not perforated. The father then confessed that he had engaged a killer who stated that he had fired a 5.6 mm rimfire rifle from a distance of 30 cm to the man he mistook for the son. He simply had killed the wrong person. Both the father and the hired killer were convicted of murder and received life sentences.

Case 5

A 50-year-old homosexual was found dead in his apartment in a state of advanced putrefaction. The cause of death was unknown but no autopsy was ordered. Rumors about a violent death emerged and 2.5 years postmortem an exhumation was finally performed. The partly skeletonized corpse showed a fracture of the greater horn of the hyoid bone, fractures of the 5th–7th ribs on the right side and of the 6th–11th ribs on the left side. In court, the suspect stated that the deceased had molested him and that he had reacted by beating and kicking him violently. The perpetrator was convicted of grievous bodily harm resulting

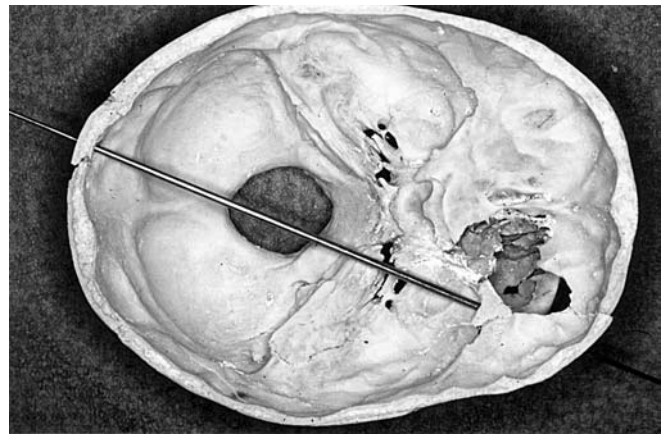


Fig. 6 Case 4: the base of the skull of the 33-year-old victim showing the shattered roof of the right orbita. The probe marks the bullet path which ended at the left occipital bone. The soft tissue entrance wound was located in the lateral aspect of the right eye

in death and sentenced to compulsory detention in a psychiatric institution.

Possible medical malpractice ($n=39$)

After exhumation, histology, analysis of the medical records and, if appropriate, toxicology, no indication for medical malpractice was discovered in 32 cases (82%). In 7 cases, the cause of death on the death certificate was stated completely incorrect (compare Table 2) but some diagnoses were difficult to make and the causal connection between these false diagnoses and death could not be established with the degree of certainty necessary in criminal law.

Accidents including traffic accidents ($n=30$)

The focus in this subgroup was on the reconstruction of the events and on the causal connection between accidental injuries and death, especially after considerable survival times. The questions prompting the exhumation could be answered in 26 cases.

Clarification of cause of death, circumstances or identity ($n=17$)

This rather heterogeneous group included the exhumation of a 76-year-old man 7 months after death. The son had insisted on having seen an occipital laceration but instead of a skin defect, a suicidal parathion intoxication was found.

Discussion

It was reassuring to find that the large majority of exhumation autopsies was successful. The information deficit orig-

inally prompting the exhumation could be answered completely in 102 cases (65.8%) and at least partially in most of the remaining cases. It should be noted that exclusion of findings such as absence of bone fractures can also be important. Histology and toxicology produced essential findings in 40% of the cases. Surprisingly good results of histological investigations after exhumation have been reported before [1, 6, 7, 12, 15, 17, 18]. In this investigation, very useful immunohistochemical antibodies were C_{5b-9} for myocardial necrosis and NP57 for granulocytes, which have both been shown to be robust and relatively resistant to putrefactive changes [9]. Thus, even advanced post-mortem changes are no reason to refrain from additional investigations which can also include, if appropriate, DNA analysis for identity or paternity testing [5, 8, 10, 11, 13].

So-called expectation catalogues of possible findings after long postmortem intervals have been published [1, 6, 17]. However, there is no linear relationship between the length of the postmortem interval and discernable findings [1, 12, 16, 18, 19]. Such expectation lists, therefore, are unreliable and an exhumation attempt appears justified in practically all cases.

A surprising finding was the high number of exhumations ordered because of suspicion of homicide ($n=61$ including homicidal intoxication) and especially the high rate of confirmation ($n=22$, 36%) achieved by exhumation autopsies. Most of these “buried homicides” discovered by exhumation share 2 typical features:

- If an unclear manner of death had been stated on the death certificate, the primary police investigation had remained superficial and no autopsy had been performed. In natural deaths according to the death certificate, a few clinical autopsies were done but forensic aspects were mostly ignored (e.g. case 2).
- It was always a lucky coincidence which later attracted attention to the case again. If the killer hired by the farmer would not have killed the wrong person but the son (case 4), if the mothers in cases 1 and 2 would not have repeated the poisoning or if they would not have had another child, there would have been no suspicion, no exhumation and no evidence.

The real number of undetected homicides is difficult to estimate but the cases reported definitely represent just the tip of the iceberg. One reason for “buried homicides” is the system of postmortem examination. Every physician in Germany is bound by law to externally examine a corpse and to fill out the death certificate but many lack the knowledge and experience in thanatology and maybe also the interest to do so according to established standards. A second reason is the low autopsy rate: only 1.2–1.4% of all fatalities were autopsied by a specialist in Legal Medicine (Table 1) compared to 3.4% in Munich, Bavaria [3]. The exhumation rates show the opposite relationships: 0.016% of all fatalities were exhumed in Westfalia (Table 1) compared to only 0.0067% in the Munich area [3]. Correspondingly, exhumations are extremely rare in Scandinavian countries where the autopsy rates are high [4, 14]. It can be concluded that the principle of reciprocity [4] is

still valid: low autopsy rates are associated with high exhumation rates and vice versa.

In summary, exhumations are an adequate and frequently successful tool to recover evidence which should better have been collected immediately after the death of an individual. At the same time, exhumations can be regarded as an instrument to evaluate the quality of death investigations. A high rate of exhumations is indicative of superficial investigations.

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