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Exhumation as a matter of fact

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ABSTRACT

The results of 371 autopsies, following exhumation, were evaluated. On average, the time elapsed after burial was 74 days, varying from 9 to 478 days. All exhumations were carried out for medical insurance reasons. In all cases these were exclusively male bodies, ranging in age from 27 to 87 years, with a mean age of 66 years. In 99.2% of the cases, the issues in question could be clarified. The morphological findings (both macroscopic and microscopic) were gathered and the maximum post-mortem period after which these could still be demonstrated was established and compared with those described in literature. The existing, so called, catalogues of expectation, could be expanded and augmented. An Exhumation Database, compiling all previously published exhumation results, was constructed.

Keywords: Autopsy, Exhumation, Morphological findings, Post-mortem period, Catalogues of expectation

Introduction

An exhumation is carried out when issues, which can only be clarified by an autopsy and possible supplementary examinations, arise after burial.

Forensic indication, as in the case when a belated suspicion of an unnatural cause of death arises, makes an exhumation mandatory.[1] In such cases, an autopsy, ordered by the public prosecutor, is performed. This may also be a second autopsy.[2]

Exhumations are frequently requested when medical insurance problems arise.[3] Most cases are initiated by health insurances rather than by next-of-kin. Either the question whether an occupational disease was present and relevant to death has to be clarified, or the consequences of an accident need to be assessed. As a matter of principle, family members have the right to refuse a medical insurance autopsy, but often risk losing all financial claims they have on the insurance in consequence. This autopsy process and the role of the insurance company is specific to Germany.

When an exhumation is being considered, the ordering party would like to know how good the chances of clarifying the issues in question will be.[4] Particularly for an insurer, there is the question of profitability. Compared to an autopsy performed immediately after death, an exhumation brings additional costs for the excavation of the grave, transport, cleaning, medical examiner's fee and reburial.[5] Whereas important toxicological[6,7,8] and osteological evidence[9,10,11] can still be recovered after decades, the recovery of morphological evidence depends on the state of preservation of the corpse. Apart from the time elapsed post-mortem, there are different variables influencing decomposition, i.e. seasonal environmental factors[12,13], soil conditions[6], and coffin material.[14]

These influencing factors cannot be standardized and are difficult to represent statistically. For this reason, different work groups have collected morphological findings, together with the maximum post-mortem period in which they could still be demonstrated, in a so called "catalogue of expectation"[2,4,15,16] to supplement published case collections[12,14,17,18,19,20,21,22]. The most recent study dealing with previously undiscovered homicides in 155 forensic exhumations was conducted in Münster (Germany) in 2004.[23] In the years 1967 to 1998 the Department of Pathology, Occupational Associations Hospital, Bergmannsheil-Bochum performed 400 exhumations - all for medical insurance reasons. The collected morphological results from this study, including the maximum post-mortem period in which they could still be found, were gathered to elaborate the hitherto published insights. In addition, the success of autopsies following exhumation as a means for answering the issues in question was evaluated. Two aspects of this study, the pertinence to medical-insurance issues[24] and the microscopical findings[25], have already been published. This paper presents the bulk of the findings from the study and compares them to those documented in literature.

Materials and Methods

The basis for this evaluation were the documented files (autopsy reports and written evaluations) which were archived for all the autopsies performed by the Department of Pathology, Occupational Associations Hospital, Bergmannsheil-Bochum for the years 1967-1998. In addition, histological slides were available up to 1976. Criteria for inclusion in the study were the presence of complete autopsy protocols and evaluation reports.

371 cases could be included in the study. In three quarters of the cases, the deceased had lived and worked in the Ruhrgebiet, the biggest congested German urban area, and were also buried there. Since the Department of Pathology in Bochum is specialized at a national level in the performance of medical insurance autopsies, the other cases came from different regions of the Federal Republic of Germany. The corpses were all buried according to German burial laws. The cemeteries had variable soil conditions. Preparation of the corpses prior to burial, i.e. embalmment, did not take place. In most cases, the post-mortem examiner was not present during exhumation. Specifications about the soil conditions were not given for any of the cases. The autopsy was performed on site, at

the graveyard, if this was possible. Otherwise, the body was transferred to the Department of Pathology or another graveyard. In all cases, complete autopsy was performed with removal of organ packages.[26] After formalin fixation, representative parts of the organs were processed histologically. All slides were stained for EvG and HE, and histochemical stains were performed.

Results

The average number of days after burial for the 371 exhumations was 74. The shortest period was 9, the longest 478 days. All bodies were male, aged between 27 and 87 years at death (average 66).

The majority of the issues in question concerned occupational diseases (93%). 12% of the issues were concerned with the consequences of accidents, either alone or in combination with an occupational disease. In 99.2% of the cases, a definite recommendation for the medical insurance questions concerning the right to compensation was achieved.

In all, 300 different diagnoses were established. For a better understanding, 181 diagnoses are presented in seven subdivisions (Tables 1-7). The results are listed in tables, together with their maximum post-mortem intervals. The longest post-mortem intervals listed for results previously described in literature, are included in the tables as a means of comparison.

Table 1. Tumor diseases

Morphological findings	Own results	Literature
Rectal carcinoma	458 days	26 days (17)
Hepatic metastases of rectal carcinoma	458 days	
Calcareous thyroid adenoma	227 days	3 months (4)
Lung cancer	202 days	1-2 years (15)
Pulmonary metastases of contralateral lung cancer	201 days	
Chest wall metastases of lung cancer	201 days	
Anaplastic adenomatous carcinoma of the lung	174 days	
Pleural mesothelioma	174 days	210 days (3)
Small cell lung cancer	170 days	
Hepatic metastases of small cell lung cancer (SCLC)	170 days	
Gastrocarcinoma	168 days	
Cortico-adrenal adenoma	165 days	
Submucous lipoma of the bladder	162 days	
Ductal pancreatic carcinoma	157 days	
Hepatic metastases of pancreatic carcinoma	157 days	
Hepatic metastases of gastric carcinoma	150 days	
Adenomatous carcinoma of the lung	148 days	
Prostatic cancer	127 days	2 months (3)
Cerebral metastasis of SCLC	113 days	
Sigmoidal polypus	102 days	
Carcinoma of the bladder	102 days	
Squamous cell carcinoma of the lung	101 days	
Hepatic metastases of squamous cell carcinoma of the lung	101 days	
Rectal adenocarcinoma	96 days	
Prostatic cancer	74 days	
Pulmonary metastases of prostatic carcinoma	74 days	
Carcinoma of the liver	74 days	
Pulmonary metastases of carcinoma of the liver	74 days	
Hypernephroma	74 days	
Colonic polypus	71 days	
Tumor of the brain (unknown character)	62 days	2 years (18)

Morphological findings	Own results	Literature
Renal adenoma	58 days	
Adrenal metastases of small cell lung cancer	55 days	
Duodenal polypus	50 days	
Pancreas head carcinoma	48 days	
Renal metastases of squamous cell carcinoma	47 days	
Adrenal metastases of squamous cell carcinoma of the lung	42 days	
Medullary gastrocarcinoma	39 days	
Cavernous hemangioma of the liver	38 days	57 days (15)
Squamous cell carcinoma of the tongue	33 days	
Silicotic carcinoma of the lung	31 days	
Plasmacytoma	30 days	
Glioma	29 days	
Renal metastases of lung cancer	27 days	
Scirrhous gastradenocarcinoma	23 days	
Adrenal metastases of gastric cancer	23 days	
Adrenal metastases of adenocarcinoma of the lung	16 days	
Angioma of the base of the brain with haemorrhagic cyst	15 days	

Table 2. Inflammatory diseases

Morphological findings	Own results	Literature
Lobar pneumonia	267 days	
Chronic bronchitis	240 days	2.5 years (4)
Acute pancreatic necrosis	240 days	
Bronchopneumonia	236 days	2 years (23)
Tuberculosis	236 days	10 months (14)
Chronic bronchiolitis	193 days	
Chronic cholecystitis	193 days	
Hemorrhagic cystitis	176 days	
Chronic pancreatitis	157 days	6 weeks (4)
Chronic pyelonephritis	149 days	6 months (4)
Splenomegalia	112 days	
Thyreoiditis	76 days	3.75 months (4)
Empyema after pneumectomy	61 days	
Reflux esophagitis	55 days	
Hepatic parasitisazion	51 days	
Deforming bronchitis	41 days	
Hip joint arthritis with destruction of femoral head	37 days	
Elderly appendicitis	35 days	4 weeks (12)
Intrahepatic cholangitis	30 days	
Aspiration pneumonia	27 days	

Table 3. Fibrosing alterations and calcifications

Morphological findings	Own results	Literature
Endocardial scarring and fibrosis	478 days	
Anthracosilicosis	478 days	1.9 months (4)
Cholecystolithiasis	478 days	7.5 years (4)
Scars of the renal cortex	478 days	145 days (3)
Fibrinous pleurisy	304 days	623 days (15)
Omento-spleno-adheasion	304 days	
Subendocardial fibrosis	267 days	
Endocardial fibrosis	236 days	
Epicardial fasciation	236 days	3.5 weeks (4)
Interstitial pulmonary fibrosis	223 days	
Silicosis	196 days	
Periportal hepatic fibrosis	193 days	
Chronic perisplenitis	176 days	6 weeks (4)
Pleural plaque, hyaline	174 days	
Myocardial scaring	172 days	2.5 years (4)
Cicatrization of the papilla of the duodenum	168 days	
Nephrolithiasis	127 days	547 days (3)
Pulmonary siderosis	114 days	
Fibrinous peritonitis	114 days	10 years (7)
Urolithiasis with ureteroectasis	112 days	
Meningeal fascination with skull	94 days	
Cicatrication of the retropubical connective tissue	82 days	
Meningeal fibrous thickening	75 days	2 months (4)
Pancreatic fibrosis	68 days	59 days (15)
Thyroid calcification	62 days	
Prostatic calculi	62 days	
Splenofibrosis	36 days	

Table 4. Heart and vascular diseases

Morphological findings	Own results	Literature
Arteriosclerosis	478 days	7.5 years (4)
Pulmonary artery sclerosis with ectasia	478 days	2.5 years (4)
Right artrium dilatation	458 days	
Elderly coronary thrombosis	304 days	118 days (15)
Elderly myocardial infarction	304 days	145 days (3)
Aortal ectasia after syphilitic mesaortitis	304 days	
Right myocardial hypertrophy	267 days	
Left myocardial hypertrophy	240 days	
Cardiac liver	236 days	114 days (15)
Thrombosis of prostatic venous plexus	202 days	27 days (15)
Ruptured aortal aneurisma	193 days	
Endocardial thickening of right ventricle	184 days	
Pulmonary edema	184 days	2.9 years (20)
Chronic pulmonary congestion	182 days	109 days (3)
Pulmonary thrombembolism	168 days	13 months (19)
Insufficiency of the right artrioventricular valve (tricuspid)	152 days	
Hemorrhagic pulmonary infarction	151 days	6 weeks (4)
Cardiac spleen	151 days	6 weeks (4)
Auricle thrombosis	149 days	
Infarct of the spleen	122 days	
Cardiorrhexis and tamponade	97 days	69 days (3)
Foramen ovale apertum	94 days	
Arteriorenal stenosis, arteriosclerotic	92 days	
Granular kidney	92 days	
Thrombosis of vena cava inferior	88 days	
Mitral insufficiency	75 days	
Insufficiency of valvula aortae after chronic endocarditis	75 days	
Venous thrombosis of the leg	75 days	
Thrombosis of arteria subclavia sinistra	74 days	
Acute myocardial necrosis	72 days	1 year (23)
Pelvic thrombosis	71 days	

Morphological findings	Own results	Literature
Acute coronary thrombosis	67 days	118 days (15)
Pancreatic apoplexia with calcification	43 days	
Ulcus cruris	30 days	9 weeks (14)
Aorto-femoral bypass	22 days	

Table 5. Traumatically caused injuries

Morphological findings	Own results	Literature
Osseous defect of iliac wing	478 days	
Rib fracture after resuscitation	114 days	
Decubital ulcer of sacrum	111 days	
Elderly cortico-cerebral defect with cyst	94 days	
Site of iatrogenic puncture (jugular vein)	77 days	
Urethraectasis (pars prostaticus)	58 days	
Previous meniscus removal	58 days	
Partial diaphragmatic rupture	49 days	
Hepatic rupture	49 days	279 days (3)
Elderly renal rupture	49 days	
Subarachnoidal hemorrhage	20 days	201 days (16)

Table 6. Other findings which may obtain the state of a cause of death

Morphological findings	Own results	Literature
Emphysema	478 days	2.5 years (4)
Stenosis of the papilla of the duodenum and choledochus duct dilatation	240 days	
Bronchiectases	236 days	115 days (3)
Hepatic cirrhosis	236 days	1 year (17)
Fatty degeneration of the liver	230 days	10 years (7)
Scabbard trachea	172 days	133 days (15)
Gastric ulcer	170 days	157 days (15)
Atrophy of renal cortex	169 days	
Saffron liver	168 days	
Duodenal ulcer	156 days	
Pulmonary dystelectasis	129 days	
Gastric erosions	129 days	139 days (3)
Unilateral atelectasis	114 days	
Tarlike stool	112 days	
Ileus	112 days	
Nephrydrotic Kidney	112 days	
Pleural effusion	94 days	
Varicosis of the esophagus	39 days	
Hydrocephalus externus	30 days	
Cerebral pressure impression of brain tissue	22 days	

Table 7. Other findings which may be important for identification purposes or further diagnostic measures

Morphological findings	Own results	Literature
Trabeculated bladder	478 days	2.5 months (21)
Prostatic hyperplasia	478 days	2.5 years (4)
Dermal scars	478 days	7.5 months (4)
Renal cysts	240 days	
Spondylchondrosis	240 days	
Full bladder	236 days	
Esophageal diverticulum (traction)	201 days	
Nodular goiter	129 days	
Inguinal hernia with fascination of the hernial sac	127 days	
Renal shrinkage	124 days	3 years (17)
Inguinal hernia without fascination of the hernial sac	114 days	
Ichthyosis	96 days	
Previous obduction	86 days	
Unilateral atrophia of the testicle	74 days	
Tattoo	72 days	
Inguinal testicle	60 days	
Dorsovolar atheroma	51 days	
Chemial eczema	51 days	
Paraesophageal hernia	49 days	
Psoriasiform lichen	30 days	

Discussion

In the present study, the, as yet, largest case collection of exhumations was available. The largest previously described collection contained 200 cases, but was, however, not evaluated systematically.[22] The most extensive study with a catalogue of expectations contained 131 cases.[16] Apart from the extensive number of cases, the presented case collection is unique, compared to cases in literature, in that all exhumations were performed exclusively to clear medical insurance issues. The second distinction is that only male bodies were investigated. Surprisingly, 99.2% of the medical insurance issues could be resolved. Even after a period of 478 days after burial, usable macroscopic and pathological anatomical diagnoses could be obtained. The existing catalogue of expectations could be expanded and augmented with the obtained results.

Of course, even the aid of a catalogue of expectations does not permit a definite prognosis for the success or failure of a planned exhumation. However, the documented maximum post mortem intervals do show whether an expected diagnosis is still feasible, and with which expected

frequency it can be found for the post mortem intervals (PMI). Corresponding soil conditions for findings and PMI were neither noted in this study nor in literature. In principle, therefore, it can be assumed that the best possible conditions existed for each constellation of finding and PMI in the catalogue of expectations. For a given case, an estimate is made possible, which can be corrected upwards or downwards, according to the available details on the resting conditions.

Since it is an arduous task to consult all the previously published catalogues of expectation, case collections and reports for a given case, an Exhumation Database containing all published results has been online since 2003 (Please click here for visiting the link).

In spite of an apparently optimistic prognosis, within the limits of the presented post-mortal periods, for autopsies after exhumation one should not forget that macroscopic, and particularly, microscopic, evidence[25,27] deteriorates with each post-mortem day. Thus, exhumation should and can only be a second best solution, even if it can bring light into many cases by supplying essential information for the resolution of forensic and insurance medical issues.

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