

Chapter 2

Introduction to Forensic Medicine and Pathology

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Summary

The aim of this chapter is to explain what legal medicine is (from its background to the present), and forensic pathology in particular—what its objectives are, what forensic doctors do, and when, why, how, and for whom. Furthermore, the author aims to identify their main difficulties and expectancies.

Starting from the definition and going through a brief historical contextualization, this chapter reviews the types of autopsies, their objectives and, among them, the distinction between cause, manner, and mechanism of death, with unambiguous examples. The different systems of medicolegal organizations in several countries are also debated, with a more detailed presentation of the one considered most efficient. The state of the art throughout the world is analyzed toward/according to the future that needs to be built, often in conjunction with forensic anthropology, emphasizing the role of a fair legislation, organization, and above all, education and training.

Key Words: Forensic medicine; legal medicine; forensic pathology; autopsies; coroner; medical examination; cause of death; manner of death.

To investigate a medicolegal case without performing an autopsy can be compared to reading a mystery novel with last page torn out.

—Luke Tedeschi, 1980

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1. INTRODUCTION

Forensic medicine today is a large medical field that includes many sub-areas. However, generally, when one speaks or thinks about it, one associates it immediately with death, autopsies, and related problems. Yet, this is only part of legal medicine, as new approaches and subspecialties are realized because of the advances in medical sciences and sociopolitical changes around the world. Forensic anthropology and clinical forensic medicine are perhaps the best examples of these “new sciences.”

In a book that aims to build a bridge between two complementary sciences (forensic pathology and forensic anthropology) for anthropologists, medical doctors, and related professions, an introductory section to both sciences seems essential (*see* Chapter 1). What is forensic medicine (from its background to present), and what is forensic pathology in particular? What are its objectives? What do forensic doctors do? When, why, how, and for whom? What are the difficulties, and what is expected for the future? These are all questions that a nonmedical professional might ask and that the author attempts to answer in this chapter.

The origin of forensic medicine remains lost in a distant past, whenever the principles of medical sciences met those of law and justice (1,2). Perhaps it began with the Code of Hammurabi (1792–1750 BCE), which imposed sanctions for errors in medical and surgical practices. The same type of punishment also existed in Persia. Later on, the Visigoths promulgated laws that punished poisoning, infanticide, and homicide.

Described as a medical trunk that serves the administration of justice, forensic medicine has different branches. Forensic pathology is probably the most emblematic one. Known in many Latin countries as *tanatology* (from the Greek word *thanatos*, meaning “death’s god”), definitions of forensic pathology are often so broad that they would fit better into forensic medicine as a whole than in this single branch. For Di Maio (3), it is “a branch of medicine that applies the principles and knowledge of the medical sciences in the field of law.” An even larger conception of forensic pathology (4) considers it the study of diseases and injuries of the community, because it involves the knowledge of diagnosis and treatment in every medical specialty, but also requires information in many nonmedical areas, such as chemistry, physics, criminalistics and police sciences, motor vehicle and highway conception, politics, sociology, and even the way of life of a society. Closer to its objectives and limits, Williams et al. (5) define forensic pathology as a specialized branch of pathology (*pathology* being the study by scientific methods of disease and tissue injury) that relates within a legal framework to the effects of trauma, poisoning, occupational hazards, and natural disease.

Forensic dissections of bodies began in the 13th century at the University of Bologna in Italy by a surgeon and teacher of anatomy, Saliceto (6). Surprisingly, these forensic dissections appeared before the hospital autopsies that started by the end of the 19th century with Rokitansky, Virchow, and the advent of the pathogenesis of diseases and cellular pathology (6). However, some authors (7) consider the French surgeon Ambrosio Paré, who in 1575 began a real scientific period in France, the father of legal medicine. This paternity is divided with Zacchia, the Pope's physician, who taught in Italy and wrote in 1601 what can be considered the first medicolegal textbook (7). This was of decisive influence on the development of forensic sciences, as were the European codes of the 16th century (6): the Bamberg Code in 1507 and especially the Caroline Code in 1532, which obliged the courts to call specialized doctors to clarify forensic questions.

Nevertheless, the 19th century was indeed a reference for modern legal medicine, born formally in many countries, almost at the same time: 1855 in Austria (6), 1872 in Hungary (8), 1886 in Brazil (7), 1887 in Great Britain (9,10), and 1889 in Portugal (when legal medicine was first referred to as being legally organized [11]). This century was really a golden age for forensic medicine (1,11), which knew a quick but supported growth, especially in France, Italy, and Germany (11). Besides, in German countries, forensic matters were always carefully treated, as can be proved by the early beginning of teaching forensic medicine in some universities in 1720 (11). The posterior development of forensic pathology was processed in accordance with the legal systems and sociopolitical conditions of each country.

At the end of the 19th century, complementary sciences, such as toxicology and histology, were aggregate to forensic pathology, and from that union resulted the constitution of legal medicine institutes similar to the medicolegal units known today, where every type of expertise related to justice may be executed.

Later, in the second half of the 20th century, a new medicolegal problem arose in Europe and wherever roads and cars existed. The traffic accidents and the necessity of civil litigations of the injuries of the victims led to a new medicolegal subspecialty concerning living people: clinical forensic medicine. It started in Belgium and France with Derobert, Roche, Muller, and Rousseau (12). Supported by the Deliberation 75 (7) of the Committee of Ministers of the Council of Europe, an "expertise-type" was created (12,13) to achieve a global evaluation of consequences resulting from injuries caused by accidents to the body of an individual (as a whole being). This process was crucial for the financial indemnity of the injuries by insurance companies. These ideas, adopted in Portugal by Oliveira Sá, a great enthusiast of this new

discipline, were developed and “exported” to Spain through the excellent relationship he had with the forensic physicians in the neighbor country, where a huge development took place; however, it was more as a private medical activity than centralized in medicolegal institutions. The popularity of this new forensic area increased quickly because of the growing number of traffic accidents in the world. Once the Iberian Peninsula was “conquered,” the area extended to South and Latin America. The English-speaking countries were the last to develop this new specialty; it has been only within the last several years that the popularity of clinical forensic medicine has exploded in the United States and the United Kingdom.

This specialty has opened the window to economic independence for forensic practitioners (but not for pathologists). Close to victimology, this new area has extended to any act of violence on a living individual: aggressions, sexual assault, age determination, and of course, traffic accidents. Baccino (E. Baccino, personal communication) claims that forensic doctors should be called “violence medicine doctors,” as violence, whether lethal or not, is the common ground between those who commit it and those who suffer it. Violence is usually the result of complex interactions between offender and victim, and the evaluation of injuries is similar in living and dead bodies.

Taking these facts into account, some specialists (E. Baccino, personal communication) achieved the incorrect idea, not shared by the authors, that forensic medicine is becoming much more clinical than pathological.

2. *AUTOPSIES*

2.1. *Types of Autopsy: Clinical and Forensic*

There are essentially two types of autopsies—the clinical or academic autopsies done at hospitals and the forensic autopsies executed in the medicolegal settings. The aim of the clinical autopsy is to find out, clarify, or confirm diagnoses that remained unknown or are not sufficiently clear during the stay of a patient in a hospital or health institution. The forensic autopsy is performed under the supervision of a legal authority such as a prosecutor, a procurator fiscal, a magistrate, a judge, a coroner, medical examiner, or the police. The forensic or medicolegal autopsy primarily focuses on violent deaths (accidents, suicides, and homicides), although in many situations (35–40% according to the Portuguese experience), it also deals with natural deaths that should be the object of a clinical autopsy. Suspicious and sudden deaths, deaths without medical assistance, and deaths that are litigious or related to surgical or anesthetic procedures, must also to be clarified by a forensic autopsy.

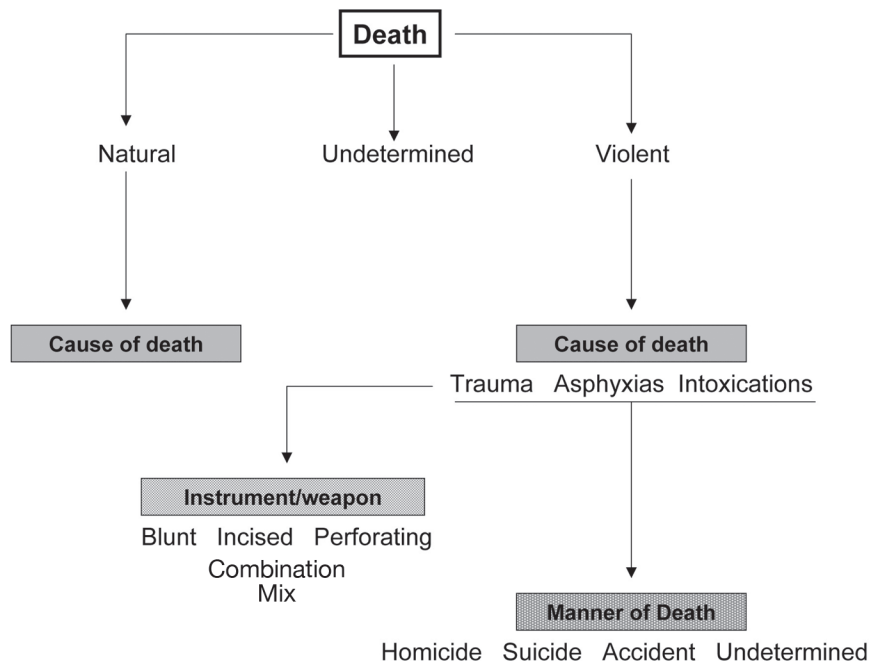


Fig. 1. Categorization of the main objectives of a forensic autopsy.

Usually in the majority of jurisdictions, relatives' permission is not necessary to carry out the autopsy. Eventual obstruction of justice is then avoided. In some regions, the forensic autopsies are divided in two categories (6)—criminal deaths (suspicious or because of murder, homicidal suffocation or smothering, infanticide) and noncriminal deaths (suicides, natural deaths, accidents, etc.).

2.2. Objectives of a Forensic Autopsy

The determination of the cause and manner of death has been considered during recent decades the classic objective of a forensic autopsy. Although not new, another goal emerged recently from ethnic conflicts and genocide as important as the first objective: the identification of the victim(s). Thus, cause of death and identification are essentially the two main objectives of a medico-legal autopsy.

When a typical forensic necropsy is performed on an identified corpse, a categorization of goals can be established (Fig. 1). To begin with, it is necessary to diagnose the cause of death and to distinguish it as either a natural or

a violent death, which can be achieved often at the same time at the autopsy table, solely based on macroscopy. If the case corresponds to a violent death, three possibilities arise: traumatic injuries, asphyxia, or intoxication. Next, traumatic wounds should be classified according to the instrument/weapon that produced them: blunt, incised and perforating, or a mix. “What was the weapon used?” is precisely one of the first questions the police officers usually ask the pathologist as soon as a crime investigation begins in order to plan the investigation. Incised wounds are produced by sharp instruments, whereas perforating injuries can be the result of different weapons, from pointed, sharp instruments to firearms. One should note that the nomenclature of these wounds is not precise in every country or language, which frequently yields additional difficulties in interpreting an autopsy report.

The final step of a violent death autopsy is the establishment of the manner of death (*see* Fig. 1): homicide, suicide, accident, or undetermined (as explained in Subheading 2.3.). Many cases (intoxications and natural deaths, for example) are not ascertained at the necropsy table and need further investigation, including complementary examinations.

An autopsy also has many other accessory objectives, such as the following:

1. To document (diagnose, describe, and measure) both external and internal injuries.
2. To detect external and internal abnormalities, malformations, and diseases.
3. To attribute the death to a particular event—the nexus of causality, a paramount issue in legal medicine.
4. To determine other causes that might have contributed to death.
5. To collect samples for histological, toxicological, microbiological, or other ancillary analysis.
6. To determine the time of death, when necessary and possible (6).
7. To determine whether a newborn had breathed or not.
8. To keep relevant organs, tissues, or samples as evidence.
9. To provide a full written report of the necropsy findings, giving a serious and competent medicolegal interpretation of the findings.
10. To return the body to the family as well presented as possible.

In certain necropsies, characteristic objectives of a particular type of expertise can be pointed out. When a firearm has been used, it is important to estimate the distance of the shot, the pathway of the bullet, to determine the entry or the exit wound, and the relative position between the aggressor and the victim.

In delayed deaths, it is necessary to establish the causality nexus between an original traumatic event (and correspondent lesions) and the supposed “natural cause” of death ascertained. For example, it is a common mistake that

general physicians certify “pulmonary embolism” as a natural cause of death of traffic accident victims who suffered traumatic injuries and died in the hospital with such a complication, obviously linked to the initial traumatic wounds.

2.3. Cause, Manner, and Mechanism of Death

Many people, including some specialists working in the area, have difficulties in distinguishing among cause, manner, and mechanism of death. *Cause of death* means any injury or disease that generates a pathological alteration in the body that leads to the individual’s death. Examples are esophageal carcinoma, a myocardial infarction, blunt trauma of the head, or a gunshot wound of the thorax.

The *mechanism of death* signifies the pathological alteration resulting from the cause of death: hemorrhage, infection, fatal arrhythmia. It is possible that a mechanism of death is shared by different causes of death: a hemorrhage may result from blunt trauma, stabbing, or lung carcinoma. The contrary is also true, as the cause of death can give origin to different mechanisms of death: a gunshot wound can produce a hemorrhage, but if the victim had survived, an infectious complication is the mechanism.

The *manner of death* (known in Latin countries as “medicolegal etiology,” where it is considered as another objective of the autopsy) means, in violent deaths, the distinction among an accident, suicide, homicide, or an undetermined death. Following the above-mentioned way of thinking, a manner of death can be the result of multiple causes and mechanisms of death. The classic example is the one of a gunshot injury (cause of death), which could be classified as the four manners of death: homicide (someone shot the victim), suicide (the shot was self-inflicted), accident (the shot was self-inflicted unintentionally), and undetermined (there are no witnesses to the events, and the autopsy failed to clarify the manner of death). Mechanism of death could be hypovolemic shock by hemorrhage or, if the person survived, a thromboembolic or infectious complication, such as a bronchopneumonia or peritonitis.

Cause and manner of death determinations often imply laboratory analysis and (always) information about the circumstances of death that can be determined by the police (or other authorities) scene report or by the forensic pathologist, if the pathologist was the one who recovered the body from the site. This is not always simple and easy because the pathologist’s statement not infrequently contradicts the scene report or the police story about the case. Moreover, families seldom accept suicide as the cause of death. That is why the pathologist must study each case carefully, must be well informed about



Fig. 2. Homicide without lethal injuries: minor traumatic wounds of the face, inner lips, and tears of the ears caused by the aggressor's bite. Death was attributed to sympathetic-adrenal stimulation on a victim with clinical favorable antecedents such as chronic ischemic disease.

the events surrounding the victim, and document the investigation cautiously to produce the final verdict.

Exceptionally, a natural cause of death can be considered a homicide. The author autopsied a man who was almost caught in his lover's bed by her husband. He ran to the loft of the house and was discovered some minutes later by the husband. After a violent argument, the men fought and suddenly, the lover died. Minor traumatic injuries, not enough to justify the death, were found (Fig. 2). Microscopic sections of the heart revealed a chronic ischemic disease, confirmed by the cardiologist of the victim. Death was attributed to a sympatheticoadrenal stimulation mechanism. This case turned out to be a case study in the courts, but finally, the accused aggressor was dismissed. Other authors have stated similar reports (3), but it is controversial and rare that a homicide is ruled only by psychological stress without any external or internal injuries.

In nonfresh cadavers, i.e., in different states of decomposition (closer to this book's subject), the pathologist and the forensic anthropologist are sometimes not able to ascertain the manner of death, especially in skeletonized bodies. These are the cases that remain undetermined.

Occasionally, a manner of death can be stated without determination of the cause of death. In a documented suicide committed by a nurse who injected

herself with an anesthetic product, the toxin was not detected by laboratory analysis. Macroscopy and histology were also nonspecific. However, the circumstances were so evident—the syringe found in the arm, the empty bottle in the wastebasket, and a farewell letter—that a suicide was ruled.

In a case within the context of this book, a young pregnant girl was murdered by her boyfriend, who confessed to the crime. She was buried in soil (*see* Chapters 5 and 7 for more detail on this case) and exhumed 2.5 mo later. The autopsy was conducted by a multidisciplinary team*, but it was impossible to confirm the cause of death because of the decomposition of the body—thoracic organs were skeletonized, and the larynx apparatus and hyoid bone were not found (14). However, the circumstances and all the information collected by the police pointed to a high probability that the death was a homicide.

3. *MEDICOLEGAL ORGANIZATIONS*

What kinds of deaths are investigated through a medicolegal necropsy? It depends on the country legislation: violent deaths, suspicious deaths or deaths of unknown cause, sudden deaths, deaths without medical assistance, deaths in institutions or in custody, or deaths related to surgical or anesthetic procedures. Apart from the latter and the violent deaths, many of the other deaths fall into the category of natural deaths, which represent the higher volume of work in the majority of medicolegal institutions. Many pathologists complain about it. However, one will be a good forensic pathologist and learn how to recognize a violent death only when one has performed many necropsies of natural deaths.

It is not the purpose of this chapter to make an exhaustive review of the medicolegal systems throughout the world, but to provide examples that illustrate the limits of medicolegal frameworks, pointing out the pros and cons, differences and similarities, realities and expectations.

3.1. *United States*

Medicolegal systems are different around the world. In the United States, the situation can vary within states from one county to another. However, there are two well-defined main systems, the coroner system and the medical examiner system (3,4).

* Team composed of the author, a forensic pathologist, and a forensic anthropologist, E. Cunha.

The coroner system, inspired by the English feudal system (3), is based on the election of someone to the office of coroner. The coroner is in charge of determining the manner of death, with or without physician opinion, in accordance or not with the autopsy report. In the past, it was not necessary to be a physician, but in many areas today, it is required, even if the physician is not a pathologist. The training for coroners varies from none to 1 to 2 wk (3). The variation of the coroner's system is related to the fact that, in the past, the system was introduced in different areas of the British Empire in its pure "English" form, and the rules (and subsequent amendments thereto) of the Coroner's Act (in Great Britain) in recent years have not been adopted in the United States (10).

The medical examiner system introduced in 1877 in Massachusetts (2,3) continued to develop until 1918 when, in New York City, the first medical examiner was installed* (2,3). The medical examiner should be a physician experienced in pathology. The concept that can be found in the United States today originates from the New York system, with variations. In the modern systems, the chief medical examiner must be a forensic pathologist.

The medical examiner (in some states) works under the guidelines of the state government agencies or the public health department, either case leading to additional problems because technical and economic independence is essential to perform this work. On the other hand, a nonphysician cannot make medical determinations, no matter what training that person has (3). As a politically elected administrator, the coroner can easily be put under pressure to make a determination, whereas a physician must behave under rigorous ethical rules. Even if the coroner relies on a competent physician, the coroner may be replaced in the next election, for political reasons, by a more convenient person. Whatever the name of the system used—medical examiner, coroner, or medical examiner–coroner—the main issue remains the responsibility and the methods these authorities must assume to assure scientific and professional quality (4).

These systems do not provide a forensic pathologist on every scene examination because the number of forensic pathologists is not sufficient to do so. In the United States, it is attributed to lay investigators employed by the medical examiner's office, who decide whether a death is a medical examiner's case. When a death certificate cannot be obtained, the case is accepted by the office. These professionals then make a report. When the case is not accepted, a physician obligatorily revises the report. If there is a disagreement between the two parts (a rare possibility), the case will then be accepted. The medical examiner decides whether to perform only an external examination, a full autopsy, or other laboratory tests.

* It was not until the 1980s that the first "real" medical examiner system, including a central laboratory, was established.

3.2. Northern Europe

The medicolegal external examination system is also used in northern European countries such as Finland and Denmark (15,16). In the latter, the examination is made by a medical officer of health (in the presence or requested by the police), who decides if an autopsy is necessary (16). Presumed cause and manner of death are stated after the external examination, sometimes erroneously (as mentioned under Heading 6).

3.3. Turkey

A similar system is employed in Turkey (17): the prosecutor refers medicolegal deaths to forensic departments, where the medical doctor, after an external examination, may sign the death certificate with the prosecutor, unless a need for an autopsy is decided.

3.4. Great Britain

The development of legal medicine in Great Britain is inseparable from the coroner system (10) that was later adopted in the United States. It began with the election of county coroners in the 12th century and followed through the subsequent centuries, a slow development. The practice of forensic medicine dates from the 17th century, when the first autopsy was recorded, but the first book was published only in the early 19th century. The Coroner's Act of 1887 that regulates the actual British medicolegal system arrived late in comparison with the development of the specialty in Continental Europe (9,10).

The Coroner's Amendment Act of 1926 and other rules and orders updated the original Act. As a result, the coroners now deal with many natural deaths. The coroners are, in some areas, based on university departments, whereas in other regions, Home Office pathologists may be called for cases of homicide and suspicious deaths. Yet, the vast part of the coroners' cases (natural and noncriminal unnatural deaths) are dealt with by consultant pathologists of Britain's National Health Service in general hospitals (10).

3.5. France

In France, the external examination is always requested by the police or a prosecutor. However, a medicolegal autopsy may be ordered only by a prosecutor, who relies on his exclusive decision—French law does not have any provision with which to decide whether to order or deny a forensic necropsy. The general physician who certifies the death generally does not signal a “medicolegal obstacle” on death certificate. The forensic doctor, whose opinion is given later, usually confirms this statement. In this case, there is no autopsy. Therefore, the judicial investigation of a death is directed frequently

and easily toward a natural death, a suicide, or an accident, without autopsy (18). That is why, in France, suicides are seldom, unquestionably creating training problems (for example, one cannot perform a good autopsy of strangulation without having been trained by autopsying many suicidal hangings).

The situation is even worse when a fatal accident happens at work—the autopsy is commonly not executed (18,19). Lenoir refers to studies in which when autopsies were performed, in 32% of the cases, the examinations were performed between 3 and 6 mo after death (19), which means they were actually exhumations, extremely limited in terms of diagnostic value when compared with a recent autopsy. Recent autopsies of job accidents or professional diseases were less than 9% (19). Relatives' prejudice in terms of litigation by insurance companies is obvious.

3.6. Spain

In Spain, the *forense* is a kind of medicolegal examiner of a particular area of the country. The *forense* must be able to handle every type of medicolegal expertise from autopsies to psychiatric examinations of prisoners. To obtain the qualifications, medical doctors have to undergo a postgraduate training of 6 mo in all relevant forensic areas: pathology, toxicology, genetics, and law. A positive aspect of this system is good national coverage. On the other hand, *forenses* have excessive power because in practice, they are the ones who decide whether or not an autopsy must be made, and few are performed. Moreover, the minor training in so vast a scientific area is deficient and not appropriate.

3.7. Portugal

Portugal is known to have one of the best medicolegal organizations in Europe (D.N. Viera, personal communication).^{*} As a result, many countries wish to implement and “import” this system. That is the reason why it deserves a detailed presentation and a reference to Duarte Nuno Vieira, the “engineer” of this system, first and actual president of the National Institute of Legal Medicine (NILM).

The NILM, an autonomous administrative branch of the Justice Ministry, is located in the small central town of Coimbra and not in the capital, Lisbon (a good example of political decentralization of institutions). The NILM (Fig. 3) is composed of three main delegations (former independent legal medicine institutes): one in Coimbra and the other two in bigger towns, Lisbon

^{*} In 2003, in Bordeaux, the European Economic Community conference of Medico-Legal Institutes acclaimed the Portuguese system as the best in Europe.

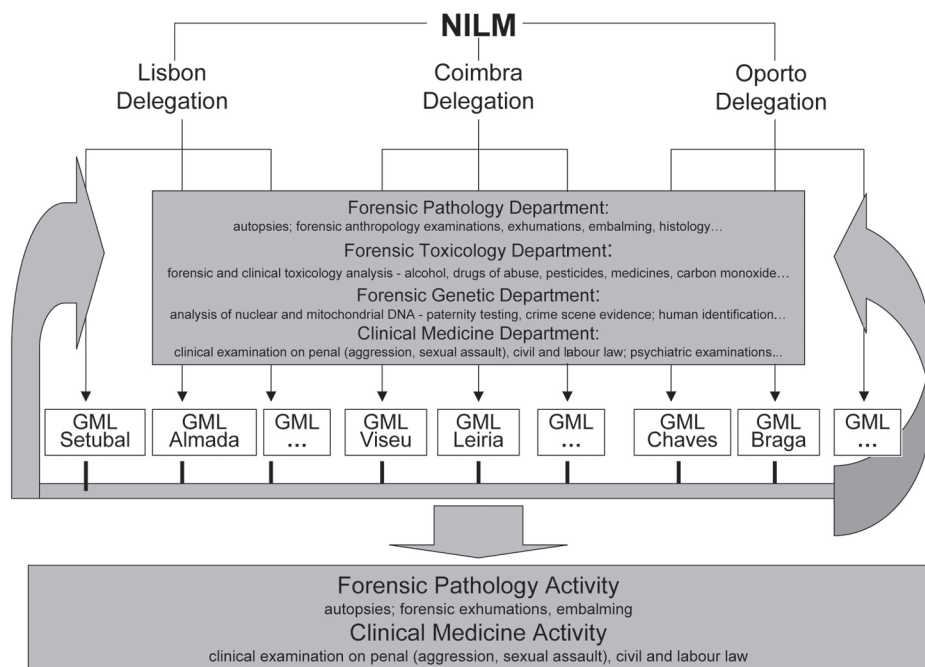


Fig. 3. The Portuguese National Institute of Legal Medicine (NILM). The regional forensic units (Gabinetes Médico-Legais [GML]) perform essential forensic activity, on pathology and clinical medicine areas, and depend technically on the main delegations.

and Oporto. These three delegations are complete “institutes,” meaning that almost all types of medicolegal expertise can be executed at each location. Each delegation is divided in departments as follows: forensic pathology (including histopathology), forensic toxicology, forensic genetics, and clinical forensic medicine (which includes the sexual abuse and psychiatry areas). There are also protocols with other institutions, such as the Anthropology Department of the Sciences and Technology Faculty to perform the anthropological examinations,* and hospitals to realize more specific examinations that can be requested during the medicolegal activity. Concerning forensic anthropological examinations, when a forensic pathologist has a nonfresh body as part of routine work, the assistance of forensic anthropologists can be sought (details about the *modus operandi* of this multidisciplinary work are described in Chapter 6). In some cases, when the remains are dry bones, the anthropologist

* The head of the Anthropology Department is E. Cunha.

can do the work. However, if a death certificate is necessary or if the cause of death can be determined, the pathologist is called to participate. This assistance covers nearly the whole country, with few exceptions related to cases dealt with by local practitioners with no communication to the NILM.

In forensic pathology and clinical forensic medicine departments, there are full-time medical doctors who are specialists in forensic medicine after a 5-yr training period, the normal duration of any medical specialty in the country. In the histopathology department, a fully qualified pathologist examines all the microscopic sections from the autopsies performed in the delegation and from the regional forensic units described in the following paragraphs. Biologists, biochemists, pharmacists, and chemists are qualified to work in the laboratories (toxicology and genetics) and they are trained on duty. A psychiatrist, an orthopedist, and a neurologist are part-time specialists who help and give scientific support to the medical examinations, more frequently in clinical forensic medicine departments. X-ray facilities with full-time radiology technicians, essential in all the medical areas, are available at any time; however, the radiologist medical specialist usually works on a part-time basis. The whole institution is managed by an administrative staff that has the inherent logistic facilities to work appropriately.

Regional forensic units called medicolegal offices (Gabinetes Médico-Legais [GML]), created in smaller towns to cover the entire country, aggregate the medicolegal activities of the localities (*see* Fig. 3). They have the minimum requirements to perform all medicolegal functions, such as autopsies, clinical examinations in civil litigation, and sexual or drug abuse, but no laboratories. Samples, when needed, are sent to one of the three main delegations mentioned previously. In these GML, there are medical doctors of other specialties, mostly general practitioners, who obtained (the majority of them) a postgraduate course of 90 h, including the practice of autopsies. It is something, but not sufficient. Thus, this is the challenge the NILM must face in the near future: to improve the quality of training of the “regional” specialists, because now there is a gap between the quality of the medicolegal services in the main delegations (good, at international standards) and the GML.

The main positive aspect of the Portuguese system is the law: all violent deaths or deaths whose cause is unknown are object of a compulsory necropsy.* The decision relies on the prosecutor, who takes into account the police report about the circumstances of death and the hospital information (if the deceased was admitted to a hospital). The prosecutor usually interviews the relatives in order to know the clinical antecedents or other relevant information about the

* Law 45/2004, Art. 18. Furthermore, this law provides that autopsies of immediate death after traffic or job accidents must be performed.

case. The prosecutor can always ask the forensic pathologist's opinion to decide whether a necropsy must be done. This system avoids Europe's and the United States' chronic problem: the decline in autopsy numbers. It provides a significant number of postmortem dissections for current times: about 6000 a year for a country with 12 million inhabitants. For 2002, the forensic autopsy incidence was 4.8% of total deaths, whereas in 2003 this figure was 5.1%.

Another service offered by the NILM is the round-the-clock assistance of a forensic doctor in the three main delegations and in many GML, to make scene examinations in case of violent deaths and to examine victims of aggressions (especially those with only minor injuries) or to observe victims of sexual assault, so biological evidence is not lost. This is an important community service, with very good results in terms of helping the criminal investigation that follows the events.

There is a close relationship between the three main delegations and the principal medicine faculties around the country, where the undergraduate teaching of legal medicine is done. Forensic medicine professors are usually jointly appointed by their own faculties and the NILM. The medical and law students of Portuguese universities have to follow a semester or 1 yr of a legal medicine course, and they are obliged to assist with at least two autopsies. This scientific support is also applied to magistrates, prosecutors, and judges, even in their academic training. The NILM and their professionals collaborate with all sorts of forensic training, from criminal police to mortuary technicians. Sometimes, it extends out of the country, as with the postgraduate courses the author with other Portuguese and Danish colleagues taught in Kosovo, under the United Nation auspices, to form Kosovar medical practitioners.

Finally, the medicolegal council composed of university professors of diverse medical specialties and law, representatives of the Portuguese Medical Council, and the directors of the three NILM delegations is a technical scientific consultant body. It assists the courts in medical issues that overcome routine forensic cases and that need deeper and specific studies or discussion, such as medical responsibility. Apart from the permanent members, other specialists may be called to give their opinion in a particular expertise. This council can be requested by the Minister of Justice, the General Prosecutor, the Supreme Council of Justice, and the President of the NILM.

4. QUALITY CONTROL AND FORENSIC PATHOLOGIST QUALIFICATIONS

The requirements about quality control of autopsies are not a recent issue, because in the 19th century, the Austrian decree of 1855 provided very detailed instructions for performing a medicolegal autopsy (6). It occurred in other

countries at the same time. In Portugal, a questionnaire and precise instructions were furnished by the famous Decree of February 8, 1900, which lasted until the 1980s, when the law was renovated and a new medicolegal organization implemented, with higher skills and standards.

Modern times necessitated harmonization of procedures, especially inside communities such as the Economic European Community. The United Nations approved in 1991 its model protocol of autopsy (UN Minnesota Protocol) (20), and then, Interpol standardized its Disaster Victim Identification protocol (21). The European Council of Legal Medicine promoted the "Harmonisation of the Performance of the Medicolegal Autopsy," which was approved in 1995 and used as a base to the Recommendation R(99)3 on the "Harmonisation of Medico-Legal Autopsy Rules and Its Explanatory Memorandum," adopted by the Economic European Community Committee of Ministers in 1999 (6,18). In fact, the European countries are obliged to incorporate these rules into their national legislation. However, it is not the case, as far as is known, in the majority of them. It is difficult to harmonize procedures, whereas harmonizing systems and qualifications are not.

The professional qualifications of those who perform medicolegal autopsies vary from place to place and from system to system. Sometimes, as in the United States, it registers regional and intraregional variations. From fully qualified clinical or anatomic pathologists with postgraduate training in forensics (United States, United Kingdom) (3,4) and forensic physicians with a full specialty in legal medicine (Portugal), to a minimal half-year training (*forenses* in Spain) or even no formation at all, every stage of qualification is possible.

In the United States, the chief medical examiner is required to be a board-certified forensic pathologist. The chief medical examiner is a physician who has accomplished a series of graduate medical programs and examinations involving the Residence Review Committee, the Accreditation Council for Graduate Medical Education, and the American Board of Pathology (3). A full year of forensic pathology ends this training program.

In the European Union, forensic medicine exists as a medical specialty in 20–25 of its member countries (22) with different training programs.

In Yugoslavia (1) and Portugal, after the completion of medical studies and 2 yr of general practice, physicians may specialize in forensic medicine for 3 and 5 yr, respectively. A similar medical specialization of 4 yr in forensic medicine can also be followed in the Spanish university hospitals. Only a few candidates make this choice; they need a couple of years to reach the same position as the *forenses*, who trained only half a year post-graduation.

To be a forensic specialist in Hungarian universities, one must take a postgraduate course of 4 yr. A valuable particularity of the Hungarian system is a compulsory short course for each specialist every 5 yr (8), a good example that should be followed in other countries.

In Belgium, legal medicine is a medical specialty recognized by law since 2002, requiring 5 yr of complementary studies (23).

Unfortunately, and apart from these programs and qualifications, there are in too many places people neither sufficiently skilled nor experienced performing important criminal necropsies (6,18). This is not exclusive of poor, undeveloped countries: it happens in Europe and even in the United States. Besides, it is more than an academic question because it determines a deficient administration of justice and creates the possibility for enormous and, sometimes irreparable, justice errors. *A bad opinion is often worse than no opinion at all*, because in the latter case, a magistrate is clearly conscious of the lack of support to his or her decision. With some of the absolutely certain statements of inexperienced pathologists seen, a judge will rely on apparently irrefutable arguments without any kind of scientific justification.

In all, education and training are the decisive battles forensic pathology must win in the near future.

5. THE STATE OF THE ART

The medicolegal systems changed in the last few decades. In the 1980s, law modifications in the United States allowed families to prevent autopsies that do not seem to be homicide, which meant that only autopsies of obvious homicides were authorized.

Every experienced pathologist knows that the problem is never with the cases that appear as homicides, but with those masked as suicides, accidents, or even natural diseases. According to Quatrehomme (18), Brinkmann estimated that for Germany in 1997, 1200 homicides a year were hidden as natural deaths, and that 11,000 of nonnatural deaths were classified as natural ones. The death of an old man found at home 3 wk after he had disappeared, supposedly dead of a natural disease, was attributed after the autopsy to a murder by a blunt trauma of the head (24). It is not always possible to recognize a homicide until an autopsy is performed. There are many examples of this, such as child battering syndrome, suffocations, traffic accidents that were, in fact, cardiac infarcts.

The changes in national legislations brought tremendous consequences everywhere they were applied: United States (25), Finland (15), Denmark (16), and France (26). The number of autopsies has diminished vertiginously

in many parts of the world. Diverse arguments have been exposed to justify this dramatic drop, such as the high cost of necropsies (15,25–27), lack of facilities, difficulties in attracting people to the discipline (15), the advent of the modern diagnostic methods (25,27,28), communication problems between pathologists and clinicians—a significant delay to know a necropsy result, the pathologist jargon, and the defensive position, family opposition because of fear of mutilation, religious objections, or economic interest, or other conveniences of morticians (27). Citing these negative approaches that contributed to the removal of the minimum autopsy rate requirement (20%) by the American Joint Commission on Accreditation of Hospitals, Clark (27) states that some authors consider hospital autopsies as inefficient, expensive, irrelevant, and unnecessary.

Another non-negligible reason also mentioned by Tedeschi (25) is the very little motivation of clinic pathologists to perform postmortem examinations: it is a long task, done while facing bad ergonomic conditions (e.g., standing up, bad odors, an unclean work with a relative risk of contagious disease) and socially not recognized. They prefer the “clean” biopsies of surgical pieces or other more interesting researches. Nevertheless, the question is not only the motivation, but also the inability to answer the question of “Why did he die?”, because of the inefficient approach hospital pathologists use to explain the cause and manner of death (4). Taking into account this last development of clinical pathology in the world, it is predictable that, in the near future, clinical pathologists will not be able to perform any type of autopsy.

However, in accordance with many authors (15,29), the authors in this book believe that autopsies (either clinical or forensic) are still necessary to control and correct causes of death and to distinguish the violent deaths under the initial label of natural deaths. It should by no means be substituted by external medical examinations.

In this context, the accuracy of the mortality statistics if autopsies were carried out in well-defined populations must not be forgotten in order to permit the health authorities of each country to adopt adequate measures of preventing and controlling disease, which is, unfortunately, not always the case. This has a perverse result on the society: the mass media bomb the public with official statistics as soon as a particular clinical entity (such as sudden cardiac death) occurs, ignoring that they are not, often, trustable. For example, in a large sequence of 1595 patients, Ambach et al. (28) demonstrated that a clinical diagnosis of myocardial infarction based on the modern methods, including typical symptoms, electrocardiographic abnormalities, and enzymology, failed after autopsy in 28% of the cases. Myocardial infarction is overdiagnosed in clinics (28), resulting in mortality statistics 15% higher than

the reality. Shockingly, murder by strangulation was found among this series, reinforcing that the *autopsy represents the best opportunity for clinicians to check their diagnostic certainty*. In 1076 consecutive unselected hospital autopsies, Clark (27) proved the efficiency and usefulness of the hospital autopsy: 90% of positive determinations for dead on arrival and 9% of significant findings not obtained by other testing methods. He also demonstrated that the fear of some clinicians to be involved in civil litigation because of eventual malpractice is unfounded—a few cases were revealed by the autopsy, and not one was introduced as evidence. On the other hand, families are comforted by the 90% confirmation of clinic information and very satisfied with the 9% of cases clinically unclear that the autopsies ultimately explain. This diminishes many malpractice claims. In terms of real costs, using the College of American Pathologists units, Clark (27) arrives at a cost similar to previous authors (\$930 per case), concluding that it is not an inexpensive procedure, considering that 200 autopsies (the usual rate for a single pathologist) might prevent 10 malpractices. Hospitals' and physicians' malpractice insurance carriers should consider the autopsy as a valuable investment and should share their costs.

However, pretending to reduce forensic pathology to the restrictive limits of the “little” Europe or North America should be considered a chauvinist position to which the author, by no means, subscribe. In fact, the notorious decline of autopsies in the Old World, probably related to the improvement of the citizenship rights and a general awareness of the human rights by the population, is specific to the so-called developed countries. In Central and South America for instance, autopsy numbers have not declined, and maintain a high level because of the violence those countries face. In São Paulo, Brazil, an average of 40–50 necropsies of all sorts of violent deaths is performed each day in only one of the five local forensic institutes. In Bogotá, Columbia, the institute does not close on weekends because they could not face the accumulation of cadavers on Mondays. In this part of the world, the quality of expertise presents a problem. However, there are good exceptions. The Medicolegal Institute of Bogotá (Colombia) reaches a quality level that many departments of the United States and Europe would like to have. The challenge for the high standard forensic community is to export the know-how to these countries in a global effort to train their human resources. It has already begun in Brazil with Portuguese scientists, and in Argentina* and other Latin American countries with Spanish specialists. However, it is limited to

* Recently, a delegation of the American Academy of Forensic Sciences took charge of a whole Saturday in a National Meeting of Legal Medicine.

the congress or scientific meetings level, which is not enough. This effort needs much more than someone that travels and shows, in different conferences, some pieces of “academic” science. It needs effective cooperation from those who work in the field, perform autopsies everyday, and have the experience and the doubts related therewith. They should cooperate and work there, in short or medium missions with local physicians, helping on a daily basis formation. Unfortunately, this objective is far from being attained. At the same time, it could also be an outstanding opportunity to form professionals of countries like Portugal, where violent deaths are fortunately not frequent: 1 mo spent in a South American institute is equivalent to 4 or 5 yr of local training.

6. THE FUTURE: A CHALLENGE FOR ALL

Quality and training, that is, education, is indeed one of the three major platforms on which forensic pathology needs to build in the future, the other two aims being good legislation and organization. This challenge, on a scientific and quality level, has been emphasized by renowned specialists (3,4,6,18). Truth, work, and experience are crucial to triumph over the well-known bane—reinforced by Saukko and Knight (6)—that in many countries, those who teach forensic pathology in universities have not worked on the field for years, sometimes for decades. *It is impossible to be a credible and convincing teacher unless one has continuing practical experience on the subject* (6). As Arsenio Nunes, a venerable professor of legal medicine in Lisbon in the 1950s said, “Never teach things where you don’t dirty your hands everyday.”

To build on the other platforms (legislation and organization), it is crucial to prove the usefulness and advantages of legal medicine to communities, governments, and politics, and of course, to opinion makers, such as the mass media.

First, the advantages that result directly from the objectives of a forensic necropsy itself should be pointed out: it is an excellent tool for a better administration of justice, helping police, prosecutors and courts, and serving the community as a whole. Some authors (29) cite a 4.5 % margin of error in the manner-of-death determinations in a series of clinical autopsies. However, when referring to medicolegal autopsies, the percentage increases to 23.4% (16) when compared with the information given by the medical external examination* and the police. This rate of error has much more serious

* In Denmark, an external examination is carried out, and if the police report is in accordance, autopsy can be ruled out.

consequences than clinical errors because it induces legal and insurance implications. Most of the 23.4% of erroneous determinations of death were because of an unknown mode of death. However, if those were excluded, there remained 7.6% of women and 6.9% of men whose autopsies revealed wrong determinations; 6.5% of presumed accidental deaths were natural deaths; 7.5% of natural deaths were accidental; 4% of natural deaths were suicides; and one case was an homicide (*see* Heading 5., in which a similar case of homicide initially labeled as a natural death is discussed). In another series of 600 consecutive cases of forensic necropsies, a 10% margin of error in determining the mode of death and a 29.5% error margin in the cause of death were found (16).

Called “detectives in white coats” (4), forensic pathologists are clearly special practitioners who must be prepared to answer questions in nonmedical fields, such as criminology, criminalistics, engineering, highway design, police science, political science, chemistry, atmospheric physics, electricity, toxicology, and genetics, to list only some. In addition, the forensic pathologist must have a comprehensive awareness of the specificity of the community within which the work is being done in terms of religion, government, society, and politics. No other branch of medicine faces such a stimulating challenge. The contribution of forensic pathology to the community is then relevant, overlapping the direct determination of cause and manner of death—it prevents injury or disease in the whole community (4). In Great Britain, after many incidents of people asphyxiated inside refrigerators, the apparatus was obliged to possess an opening from the inside (6). Rural tractors were mandated to possess a protecting roof to avoid possible traumatic asphyxia by thoracic–abdominal compression when the vehicle overturned on the driver. Immunizations and prophylactic therapies were determined by the findings at autopsies of infectious diseases (4). For individual well-being, forensic pathology contributes to support decisions based on the cause of death, about fortunes, litigations in traffic accidents, or individual rights against police or political power. The forensic pathologist is expected to defend his or her report in court, to discuss reports of colleagues, to know the effects of cardiopulmonary resuscitation or of a particular therapeutic, to study mechanics of motor vehicles, or simply to comfort, as the author does often*, a mother who suddenly and unexpectedly lost her child, victim of sudden infant death syndrome.

A medicolegal autopsy brings still more medical advantages and benefits. The ones presented here are not imaginary, hypothetical, or unrealistic

* In a sudden infant death syndrome research multidisciplinary project conducted after a decade at the Coimbra Delegation of the NILM.

pros of this activity, but true and palpable outcomes of the author's daily medicolegal work on necropsies.

If the department has good practice and is known as a highly skilled center, then it will grant permanent experience for qualified pathologists and provide excellent opportunities for training younger medical doctors. The author's delegation in Coimbra is repeatedly asked to offer stages not only for national physicians, but also to professionals from different countries, such as Brazil, Spain, those in Latin America, Italy, Angola, and Kosovo. The institute is also open to law students, prosecutors, and judges who have the opportunity to assist to autopsies as a part of their academic formation.

Teaching anatomy on the cadaver is also done by the specialists with whom the authors work. Some of them (also professors of anatomy) enhance the basic preparation for a good forensic pathologist. Tedeschi (25) suggests that third-party carriers must reimburse the true scientific worth of the autopsy to the medical knowledge.

Concerning investigation, a huge field of opportunities is open, and not only for medicolegal research. There is a wide variety of investigations in different areas that uses the cadavers themselves (like the sudden infant death syndrome project already mentioned or another project in the northern Portugal dealing with sudden cardiac death) or the samples collected, such as the research in pathology, toxicology, pharmaceuticals, orthopedics, neurology, tanatochemistry. In fact, the author and colleagues collect—strictly following Portuguese law*—samples for scientific purposes (investigation projects, masters or doctoral theses). This “redelineation” of the autopsy has also been pointed out by other authors (25) and can be extended to the wide world of the biomechanics of traffic accidents and to physiological, pharmacological, and toxicological research.

It has also been an excellent opportunity for surgeons, who sometimes ask permission to train special surgical techniques on “our” cadavers: samples, such as the petrous portion of temporal bone, are constantly being requested for the practical courses in the middle ear surgery. It is also an opportunity to check the quality of the hospital and the medical care, as many of their necropsies are performed in the authors' facilities.[†] Some doctors, especially sur-

* Law 12/93 and the decree 274/99 regulates the collection of organs and samples of dead donors.

[†] Despite the positive aspects of Portuguese law, it presents some limits: it permits the family to refuse a clinical autopsy—if stated—until 12 h after the death. As this almost always happens, the physicians “transform” a clinical autopsy into a forensic one, informing the prosecutor it was a death of an unknown cause.

geons and intensivists, usually ask to assist in autopsies of cases they have treated, to clarify clinical doubts. Abundant literature states a margin of error of clinical diagnoses, confirmed by autopsies, ranging from 18 to 50% (15,26,29).

Finally, the Coimbra Delegation of the NILM developed a protocol with the orthopedic department of a national public university hospital to collect bones for transplantation. This process shows how a medicolegal department can serve its community. In addition, other organs, such as kidneys, heart, liver, bone marrow and tissues (corneas, cartilage, skin), can be taken (25). This close relationship among forensic institutions, hospitals, investigation centers, and the community gives a strong feeling of satisfaction to be useful to society, erasing the overlapped and old-fashioned idea that legal medicine is only “the science of the dead.”

7. CONCLUSION

Wright and Tate wrote, “Forensic pathology is the last stronghold of the autopsy” (4). Whatever man does, wherever he is living, deaths will continue to occur, often by violence, errors, or mistakes. Forensic pathology is expected to explain these deaths and to propose measures that might have prevented unnecessary deceases. In such a way, forensic pathology might be considered as “community and public safety pathology” (4).

The future will be written with education, legislation, and organization, a magic triangle the author thinks more important than financial support to face the challenge of forensic pathology in the complex and difficult days ahead. The stronger and the more powerful forensic pathology is, the more solid will be the bridge with forensic anthropology, to face the diverse multidisciplinary missions for which they are employed, day after day, in many parts of this ever-changing world.

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