

Forensic Medicine

Chief Compiler Chen Xinshan



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Chief compiler CHEN Xinshan

Huazhong University of Science and
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Abstract

In order to meet the needs of rapid development in communication of forensic medicine with foreign countries and the teaching of this course in English, China's first textbook of forensic medicine in English is compiled by 11 specialists in 8 universities of China, which includes the main contents of every branch of forensic medicine. This textbook, being a teaching material, emphasizes "basic theory, elementary knowledge and essential skills" and strives to be brief and concise (words with pictures), which, with 186 figures, can be used by undergraduates, postgraduates, foreign students in China and young forensic teachers for teaching and self-study.

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Chief compiler CHEN Xinshan

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Preface

Forensic medicine is a specific branch of medical science which applies the theories and techniques of medicine, biology and other sciences to help solve medicine-related problems in legal practice. It involves many aspects of a person such as injury, disability, disease, death, sexual function, mental state, working ability and ethics and plays an important role in interpreting scientific evidence for the investigation and trial of criminal cases and for the mediation and management of administrative cases and civil cases, including medical dispute.

In order to meet the needs of rapid development in communication and exchange of this subject with foreign countries and the teaching of this course in English, we compile China's first textbook of forensic medicine in English. The textbook includes the main contents of every branch of forensic medicine. This textbook, being a teaching material, not a monograph, emphasizes "basic theory, elementary knowledge and essential skills" and strives to be brief and concise (words with pictures), which can be used by undergraduates, postgraduates, foreign students in China and young medicolegal teachers for teaching and self-study.

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Owing to language differences and limitations of the authors' knowledge, it is unavoidable that there may be defects and mistakes in this textbook. Comments and suggestions are welcome from peer specialists and readers.

CHEN Xinshan
October, 2011

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Chapter 1 Introduction

Part 1 A Brief Introduction to Forensic Medicine

1.1.1 Definition of forensic medicine

Forensic medicine, also called legal medicine or jurisprudence, is a specific branch of medical science which applies the theories and techniques of medicine, biology and other sciences to help solve medicine-related problems in legal practice. It is a specific field in medicine which applies medical knowledge to solve legal problems. Routine tasks include finding out the cause of death (such as bullet wound to head, strangulation, sudden coronary death, etc.), the manner of death (for example, murder, suicide, accident, or natural), DNA identification, determination of blood type and analysis of toxic substance.

1.1.2 Relationship between forensic medicine and other academic disciplines

Forensic medicine is influenced by other disciplines of medicine and natural sciences, and also involves social sciences. A case in point is the development of gene technology that promotes the formation of DNA fingerprints used in forensic medicine.

1.1.2.1 Forensic medicine and medicine

Medicine is the science of diagnosing, treating, or preventing disease and other damages to the body and mind. It encompasses a variety of health care practices. Contemporary medicine applies health science, biomedical science, biomedical research, and medical technology to diagnose and treat injury and disease, typically through medication and surgery, and also through therapies as diverse psychotherapy, prostheses, biologicals, ionizing radiation and others. The term *forensic medicine* means a branch of medicine that interprets and establishes the medical facts in civil or criminal cases. The development of medicine influences forensic medicine deeply. There are many disciplines of medicine that have relationships with forensic medicine and developed into special branches of forensic medicine, such as forensic pathology, forensic toxicology, forensic psychology, forensic anthropology, forensic archeology, forensic entomology, forensic odontology, and forensic serology. There are also many medical technologies and other sciences adopted in forensic medicine, such as forensic microanalysis, marks of violence, computer forensics, criminalistics, DNA typing, DNA fingerprint, forensic scene reconstruction.

1.1.2.2 Forensic medicine and forensic sciences

Forensic science is the application of manifold natural sciences and technologies to solve

professional and technological problems in the matter of law. In practice, forensic science draws upon the principles and methods of all traditional sciences such as mathematics, physics, chemistry and biology. The term is sometimes used as a synonym for criminalistics. Sometimes it is simply called forensics. It encompasses many different fields of science, including anthropology, biology, chemistry, engineering, genetics, medicine, pathology, phonetics, psychiatry, and toxicology. But forensic medicine is one of the largest and most important areas of forensic science.

The related term criminalistics refers more specifically to scientific collection and analysis of physical evidence in criminal cases. This includes analysis of many kinds of materials, such as blood, fibers, bullets, and fingerprints. The task of criminalistics also includes handwriting and even voice identification. However, examining the scene of crime and pathological examinations are essential to forensic science. The rapid development of modern science and technology greatly improves and facilitates the development and perfectness of criminalistics.

1.1.3 The objectives of forensic medicine

As mentioned above, forensic medicine interprets and establishes medical facts in civil and criminal cases. The main tasks of forensic medicine are as follows:

1.1.3.1 To provide scientific evidence for condemnation and penal discretion of criminal cases

Forensic medicine provides clues for investigating criminal cases which also serve as evidence in court. For example, someone assaults another person with a knife. The type and injury grade of trauma should be evaluated by medical examiners. The conclusion will be used in court for determining the verdict.

1.1.3.2 To provide scientific evidence in civil disputes

Many cases in daily life are civil disputes, not criminal cases. During these entanglements, if it leads to damage, deformity, illness or death, he or she needs to be examined to obtain the scientific evidence for solving the disputes. For example, somebody quickly died from a fight in a civil tangle. Did the victim die from the trauma or a natural disease that he already had which was induced by the trauma? It relates directly to the mediation outcome of the civil dispute.

1.1.3.3 To help identify individuals and find out causes of death and features of accidents

Almost every day different accidents take place in the world, such as various road traffic accidents, traumas during work, mass food poisoning or other accidental poisoning. No matter what kind of accidents happen in daily life and during industrial or agricultural production, transportation or tourism, injury or poisoning, medical examiners must join and assist in finding out the facts and provide scientific evidence for the cause, features and responsibility of the accidents and insurance compensation for relevant departments.

A typical example is flight accidents. In this case, dozens or even hundreds of passengers may die. The medical examiners need to handle many victims in a short period. Their job includes identifying individual victim by using DNA fingerprint technology, knowledge of forensic anthropology and forensic archeology. The same is true of railroad traffic and highway traffic accidents.

1.1.3.4 To provide scientific evidence for law enforcement agency to investigate and mediate medical malpractice

Medical malpractice is professional negligence by act or omission by health care providers (doctors, nurses, etc.) and causes injury or even death to the patient. The fact must be found out no matter whether there is a death. If the medical tangle involves death, the autopsy must be done first to find out the cause of death and to recognize the responsibility so that it is possible to mediate the case scientifically and rationally.

1.1.3.5 It must be timely reported to the health prevention and administration departments when communicable diseases and occupational poisoning are found

Forensic pathologists could find that someone died from infectious diseases or occupational poisoning, and they should report in time to the corresponding departments so that they could take relevant action to prevent the disease and poisoning and to reduce the spread of diseases and loss as quickly as they can.

1.1.4 Significance and necessity for medical students to learn forensic medicine

It is necessary for medicolegal students and medicolegal workers to study forensic medicine, but why is it also necessary for medical students to learn forensic medicine?

1.1.4.1 To help reveal crimes

As a doctor or one of the medical staff, he or she has the responsibility and obligation to assist case investigation of police or other relevant departments. If he or she on duty finds the patients suspicious, they should not be regarded as normal patients. For example, one day, a man raped a girl and was bitten in the finger or other parts of his body, he could go to a clinic or a hospital to be dressed; when the doctor on duty met this man, he or she should report to his or her superior or police and take control of this kind of special patient and do not let him get away.

1.1.4.2 To be invited as an examiner

Some appraisals of forensic medicine need special experts to join in. Therefore, some doctors and experts may be invited to be appraisers.

1.1.4.3 To be a witness

For the injured in criminal cases, a doctor may be an important witness. In this case, the doctor has the duty and obligation to be a witness.

1.1.4.4 To prevent medical tangles and malpractices and to improve medical quality

Knowing various causes and features of medical tangles and malpractices by learning

forensic medicine is very helpful in enhancing the work sense of responsibility, improving medical service, preventing and reducing medical tangles and malpractices.

1.1.4.5 To prevent and solve medicolegal problems involved in work and daily life by applying the learned knowledge of forensic medicine

As every doctor could be involved in some medical tangles and malpractices, he or she should prevent and solve medicolegal problems involved in work and daily life by applying the learned knowledge of forensic medicine.

1.1.5 A brief introduction to the history of forensic medicine

1.1.5.1 The history of forensic medicine in China

The earliest records about forensic medicine are seen in *Li Ji* and *Lu Shi Biography* in the earlier Qin Dynasty (BC 770—BC 221), which contain noted trauma examinations. *Feng Zhen Shi* in the Warring States Period (BC 475—221) has recorded many contents about the examinations of corpses and living bodies, and it is the earliest criminal book with abundant medicolegal content. *Tang Lv*, the earliest feudal code of laws in China, was published in Tang Dynasty, in which the examination systems of both dead and living bodies are clearly prescribed.



Fig. 1-1 SONG Ci (Sung Tzu)
(1186—1249)

SONG Ci (1186—1249), a great forensic scientist of the South Song Dynasty, is one of the greatest forensic scientists in the world history of forensic medicine (Fig. 1-1). He published the book *Xi Yuan Ji Lu* (*The Washing Away of Wrongs*) in 1247, which is the earliest and most systematic book on forensic medicine in the world (Fig. 1-2, Fig. 1-3) and has been translated into several foreign languages.

The procedures of autopsy were explained in the Criminal Procedure Law in 1912, which is the watershed of ancient and modern forensic medicine. The first teaching outline of the compulsory medicolegal subject was

promulgated in 1954. In 1979, medical colleges and universities began to admit undergraduate and postgraduate students who studied forensic medicine, and held training classes to educate medicolegal teachers and other professional workers. The first national conference of forensic medicine was held in Xi'an in December, 1979. The national educational symposium of forensic medicine was held in Jinci, Shanxi Province, in 1983, which is an important milestone of modern medicolegal education history in China. On October 27, 1985, Forensic Medicine Association of China (FMAC) was set up in Luoyang, Henan Province. In the same year, the *Journal of Forensic Medicine* appeared in Shanghai. The *Journal of Chinese Forensic Medicine* was first published in Beijing in 1986.

Professor LIN Ji (1897—1951) is a founder of Chinese modern forensic medicine. He set

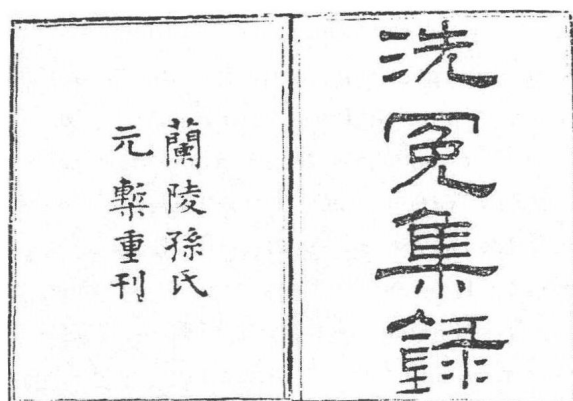


Fig. 1-2 The cover of *Xi Yuan Ji Lu*
(*The Washing Away of Wrongs*)

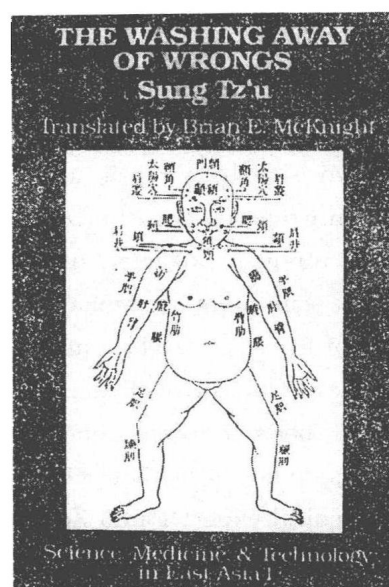


Fig. 1-3 The cover of *Xi Yuan Ji Lu*
(*The Washing Away of Wrongs*)
translated by an American

up the first Department of Forensic Medicine in Beijing University in China in 1931. He founded the first Institute of Forensic Medicine, started a training class of forensic medicine in 1932, published the *Journal of Forensic Medicine* (monthly) in 1934, and compiled some medicolegal textbooks and monographs.

At present, both the Ministry of Public Security and Ministry of Justice of China have medicolegal expertise organs. There is a forensic medical section or group in the public security bureaus, procuratorial organs and people's courts in every province, city and county respectively to perform forensic expertise. Additionally, other departments related to the railway, aviation and the forestry also have their own institutions of forensic medicine. Departments and faculties of forensic medicine have been established in more than 20 medical colleges and universities to foster medicolegal undergraduates and postgraduates such as done in Shenyang, Xi'an, Chengdu, Wuhan, Shanghai, Guangzhou, Taiyuan, Luoyang, Wuhu, Kunming and in other cities. The discipline of forensic medicine in China has made great progress in the past 30 years.

1.1.5.2 The history of forensic medicine in other countries

In about BC 2200, the famous Babylonia law (The Code of Hammurabi) first established the concept that doctor should take the legal responsibility for his medical malpractice. The law also defined other legal problems such as fornication, abortion and rape. The famous ancient Grecian doctor, Hippocrates (BC 460—355) has discussed the fatal problem of trauma. After the Roman emperor Julius Caesar (BC 102—44) was murdered, doctor Antistius found that there were 23 wounds in his corpse, among which a stab wound between his first and second ribs was the fatal one. This may be the first

recorded case in which a person died from trauma in Europe.

In AD 1100, the Law of Jerusalem prescribed that the judgement of a case needed help from doctors, the cadaver should be examined in the case of suspicious death and the examination findings, trauma and possible lethal weapons must be reported. Italian surgeon Lucca swore to be forensic appraiser in Bologna in 1249. In 1347, Montpellier Medical College in France was authorized to perform autopsies by the Pope.

The forensic medicine in modern times mainly grew up with the development of medicine, especially in human anatomy. French Ambroise Pare (1510—1590) was the founder of neoteric surgery and forerunner of forensic medicine. In 1575, he published the first book of forensic medicine in Europe, *Writing of Report and Corpse Asepsis*. The first systematic book of forensic medicine in Europe is *On Doctor's Reports*, which was compiled by Fortunato Fedele (1550—1630) who worked at Palermo University in Italy. In 1621, Italian medical expert Paulo Zacchia (1584—1659) published *Quaestiones Medicolegales*, in which Medico-legales was firstly named for this new subject by the author, which is the origin of the first English term of legal medicine. The first record of corpse examination in America was born in 1635. The earliest forensic autopsy was performed in 1665. Professor Mechaelis (1607—1667) in the Department of Pathology at Leipzig University of Germany started the lecture of forensic medicine for the first time in 1650.

In 1868, the first association of forensic medicine in France, Paris Association of Forensic Medicine, was founded. The first international conference on forensic medicine was held in Paris on August 12—14, 1878. In 1829, Germany published the first forensic medical journal, *Yearbook of Public Health and Forensic Medicine*, which was divided into two parts in 1921. The second part about forensic medicine was named *Yearbook of Forensic Medicine, Criminology and Scientific Police*.

In 1985, the specificity of DNA fingerprinting was first put forward by geneticist Alec John Jeffreys in the United Kingdom and used for personal identification of blood stain, seminal stain and hair. This is a great pioneering work in the history of forensic medicine and genetics. In the same year, American scientist Kery Branks Mullis invented the technique of polymerase chain reaction (PCR), which is widely used today.

Part 2 Different Subjects of Forensic Medicine

Just like other scientific subjects, forensic medicine has been divided into several more detailed and special branches and brought about some interdisciplines with the development of science, technology and society. At present, there are six main branches of forensic medicine.

1.2.1 Forensic pathology

As a basic and most important subject of forensic medicine, forensic pathology is a subject which studies the cause and manner of violent and non-violent deaths related to law

and other problems about death. It mainly applies the theory and technology of general pathology, but its object, aim and task of research and work are clearly different from general pathology. The main work of institutes or departments of forensic medicine in the world is *Forensic Pathology*. The main content of this textbook is related to forensic pathology, such as death and postmortem changes, mechanical injury, mechanical asphyxia, sudden unexpected natural death, thermal injury, electric death, medical tangles and malpractices and so on. As for poisoning, it belongs to forensic pathology in some countries and areas, but it has also been separated from forensic pathology as an independent discipline, forensic toxicology.

The research objects of forensic pathology are mainly the dead. The aims of examination and expertise are: finding out the cause of death, the manner of death (suicide, homicide, accident or natural), identification of instrument causing the trauma, timing of trauma, estimation of postmortem interval (PMI), the relationship between trauma and disease, and personal identification, etc.

1.2.2 Clinic forensic medicine

Clinic forensic medicine is a medical science which studies and solves the medical issues related to law in the living body by using the theory and technique of clinical medicine and forensic medicine. The object of its work and research is the living body. The contents include injury, disability, working capacity, disease, artificial disease or injury, abuse, sexual function and sexual crime and other physiological and pathological problems. Therefore, clinic forensic medicine is the closest to clinical medicine in the field of forensic medicine.

1.2.3 Forensic physical evidence (or forensic biology)

Forensic physical evidence is a subject which studies and solves the test and expertise of material evidence related to law by applying the knowledge and technique of medicine, biology and other natural sciences. The main contents include forensic DNA typing, forensic serology and parentage testing. Although the term of forensic physical evidence may be different in various countries and areas and divided into several different parts, their main roles are almost the same. In the recent 20 years, it is one of the most rapidly developed subjects in the field of forensic medicine following the development of molecular biology.

1.2.4 Forensic toxicology

Forensic toxicology studies poisoning caused by suicide, homicide or accidental disaster. It includes drug dependence, drug addiction, food poisoning and public hazards due to poison and poisoning which could lead to legal problems, such as drug side effects during medical treatment, etc.

The main problems involved in forensic toxicology include: Is someone poisoned? Which kind of drug is it? Is the quantity of poison in the body enough to cause poisoning or death?

When and how was the drug put into body? What are the pathological changes? What is the manner of poisoning (suicide, homicide or accident)?

1.2.5 Forensic toxicological analysis

Forensic toxicological analysis is a branch of forensic toxicology which detects the drug in order to provide important evidence for the expertise of poisoning or death from poisoning through qualitative and quantitative test for the suspicious materials including blood, stomach contents and organs such as liver, kidney, etc.

1.2.6 Forensic psychiatry

Forensic psychiatry is a subject which studies the psychopathy and mental health related to law. The main contents of the work and research include: Is the suspect's mental state normal or not? If not, what kind of psychopathy does he or she have? Is he or she controlled by the disease when committing a crime? In what degree of duty and behavior ability should the suspect be responsible for his crime?

Other branches of forensic medicine include forensic anthropology and forensic dentistry and so on.

In addition, there are other subjects and specialties related to forensic medicine, forensic science and criminalistics according to the subjects and specialties of several past international triennial conferences on forensic science. The following list gives some specific subjects and specialties of 4 international triennial meetings of forensic science, including the fourteenth in Tokyo of Japan in 1996, the fifteenth in Los Angeles of USA in 1999, the sixteenth in Montpellier of France in 2002 and the seventeenth in Hong Kong of China in 2005 (Table 1-1).

Table 1-1 The disciplines discussed at the recent 4 meetings of the International Association of Forensic Sciences (IAFS)*

| 14th Meeting (26—30 Aug. , 1996, Tokyo, Japan) | 15th Meeting (22—28 Aug. , 1999, Los Angeles, USA) | 16th Meeting (2—7 Sept. , 2002, Montpellier, France) | 17th Meeting (21—26 Aug. , 2005 Hong Kong, China) |
|--|--|--|---|
| | | Age | |
| | Analysis of Explosives | Aging Wound | |
| | | Anthropology Others | |
| Biochemical Markers & Forensic Serology | Biochemistry & Molecular Biology | Arson and Explosives | |
| Blood Stains and Body Fluids | Blood & Breath Alcohol | Ballistics | |
| Clinical Forensic Medicine | | Clinical Forensic Medicine | Clinical Forensic Medicine |

| 14th Meeting (26—30 Aug. , 1996, Tokyo, Japan) | 15th Meeting (22—28 Aug. , 1999, Los Angeles, USA) | 16th Meeting (2—7 Sept. , 2002, Montpellier, France) | 17th Meeting (21—26 Aug. , 2005 Hong Kong, China) |
|--|--|--|---|
| | | | Computer Forensic and Digital Evidence |
| Crime Scene | Crime Scene | Crime Scene | |
| Investigation | Investigation | Investigation | |
| Criminalistics | | Criminalistics | Criminalistics |
| | Digital Evidence | Digital Evidence | DNA Profiling and Serology |
| | Drug Analysis | Drug Sample Profiling | Drugs of Abuse |
| | | Embalming | |
| | Engineering | Engineering | Engineering Sciences |
| Evaluation & Statistics | Evaluation & Statistics | | |
| Education, Law and Ethics | | Electrical Injuries | |
| | | Entomology | |
| | | Ethics | |
| | | Evaluation of Genetic Evidence | |
| | | Experts | |
| | | Ethics | |
| Fingerprints and Other Impressions | Firearms & Toolmarks | | Fingerprint Detection & Identification |
| Firearms and Toolmarks | Fires & Explosions | | Firearm/Toolmark |
| Fires and Explosions | | | Examination and Identification |
| Forensic Anthropology | Forensic Clinical | Forensic Anthropology | Forensic Anthropology |
| Forensic DNA Typing | Medicine & | | & Human Identification |
| Forensic Engineering | Forensic Nursing | Forensic-Genetic Use | Forensic Biology |
| Forensic Drug Analysis | | | Forensic Education |
| Forensic Pathology | | Forensic Pathology | Forensic Entomology |
| | | | Forensic Nursing |
| Forensic Odontology | | | Forensic Odontology |
| | | | Forensic Pathology |
| Forensic and Clinical | | Forensic Psychiatry | Forensic Psychiatry |
| Toxicology | | | Forensic Sci. in China |