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Forensic Science Laboratory: A Review

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ABSTRACT

Forensic science includes those aspects of science which are helpful and useful for the purpose of law deals with the application of medical knowledge towards administration of justice. A forensic science laboratory undertakes the examination of physical evidence sent by Medical Officer or the scene of crime, so as to link a suspect to victim, to scene or to crime. Forensic scientists collect, preserve, and analyze the evidence such as knives, blood stain, firearm, tyre mark, suicidal note etc. during the course of an investigation. While some forensic scientists go to the scene of the crime to collect the evidence themselves, others occupy a laboratory role, performing analysis on objects brought to by other individuals. FSL has many divisions which play important role in any investigation such as toxicology, lie detection, fingerprinting etc are very helpful to decide any case for justice.

Key Words: *Forensic, crime, evidence, examination, FSL*

INTRODUCTION

In the Ayurvedic literature, so many references are available regarding the testing of the food and medicines on animal for evaluating their safety before administration to the human beings. In *Charaka*, some description is available regarding the animal experiment where in *Acharya Charaka* has stated for testing the *shuddha shonita*, it should be mixed with food and served to the animals such as crow or dog, if they eat, then it is *shuddha rakta* otherwise not[1]. *Sushruta samhita* has mentioned that any procedure which is to be performed on human beings should undergo trial on animals or other things, having similar characteristics[2]. Also in *kalpasthana* of *Sushruta samhita*, there is a similar discussion dealing with the observations of animal experiments by means detection of *visha* (poison) with the help of animals and birds. Presence of poison in the food can be suspected and guessed with the help of abnormal behavioral attitude of animals or birds on sight of poisonous food[3]. In ancient time our *Acharyas* used their toxicological knowledge to give justice to the kings or another person by protect from poison which was given by their enemy. In nowadays Forensic science includes those aspects of science which are helpful and useful for the purpose of law deals with the application of medical knowledge towards administration of justice[4].Forensic science laboratory provides services for scientific examination and evaluation of evidences. Doctors providing medico-legal services have to submit the exhibits/evidences collected during medical

examination to forensic science laboratory for analysis and evaluation of the exhibits. Therefore, it is necessary for the doctors that they should have some idea regarding the set-up, functioning and services provided by these laboratories[5]. A forensic science laboratory undertakes the examination of physical evidence sent by Medical Officer or the scene of crime, so as to link a suspect to victim, to scene or to crime. In our country, some of these laboratories are under the control of union government, while others are under state govt. In India there are seven central forensic laboratories in different states. The central FSL are at New Delhi, Hyderabad, Chandigarh, Calcutta, Bhopal, Pune, and Guwahati. Almost all the states have a FSL. In Maharashtra, there is F.S.L. At Mumbai, Pune, Aurangabad, Nagpur and Nasik[6].The first Forensic Science Laboratory in India came into existence at Calcutta for the State of West Bengal on 1st July 1952.

CFS Hyderabad is a centre of excellence in chemical sciences, CFSL Kolkata (the oldest laboratory in India) in biological sciences and CFSL Chandigarh in physical sciences. The CFSL New Delhi comes under the Central Bureau of Investigation. Chandigarh is a centre of used for finding forged documents also in this lab[7].

AIMS & OBJECTIVES

To study about Forensic science laboratory, their functions, structure, principles and techniques.

MATERIALS

The study material is collected from various text books of forensic medicines and toxicology as well as internet sources.

FUNCTIONS OF FSL[8]

1. To examine evidence material.
2. To help the investigating officer for scientific guidance in crime detection.
3. To help the investigation officer to collect evidences by visiting scene of crime.
4. To train the investigating officer for use of modern and sophisticated techniques in crime detection.

STRUCTURE OF FSL[9,10]**-**

1. Toxicology section- it undertakes chemical analysis of viscera and body fluids or suspicious articles. Forensic toxicology deals with medical and legal aspects of the harmful effects of the chemicals on the human body[11].
2. Serology- undertakes blood groups estimation.
3. Biological- undertakes identification of body fluids, hair and plant material.
4. Molecular biology- DNA finger printing section.
5. Physical- examination of physical evidence investigation.
6. Ballistic and explosive division - examination of firearms and explosive materials.
7. Finger printing division
8. Polygraphy division - lie detection.
9. Narcoanalysis division
10. Brain fingerprinting
11. Prohibition (Alcohol/narcotics analysis) division
12. Trace evidence division

13. Forensic acoustic-speaker identification
14. Cyber forensics
15. Documents analysis- examination of handwriting, type writing, forged documents and currencies.
16. Photography section.

PRINCIPLES OF FORENSIC SCIENCE[12]-

- Scene examination
- Locard's exchange principle
- Evidence recovery
- Chain of custody
- Sample analysis
- Blood pattern analysis
- Damage
- Fingerprints
- Footwear
- Trace evidence
- Fire investigation
- Firearms

PHYSICAL EVIDENCE[13]-

It is useful as it helps to decide whether a crime is committed or to decide who has committed the crime. The evidences which are usually handled by the FSL such as weapons, firearms, bullets, blunt things, blood, seminal stain, saliva, hair, finger prints, clothes, foot print, documents etc which are very helpful to decide the crime.

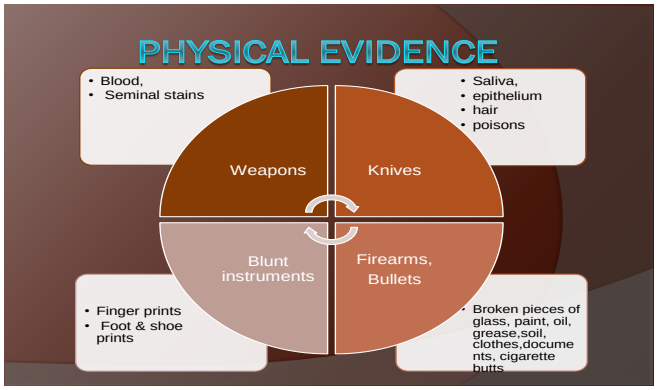

Figure 1 Various physical evidences

Examples:

1. In case of poisoning/ food poisoning-
   - Chemical analysis of viscera/ body fluids- to know nature of poison.
   - Chemical analysis of food/ utensils/clothes etc- is corroborative evidence.
2. In assault & murder-
   - Examination of weapon/ object to detect crime.
   - Blood grouping from blood stains on victim, hair in victim's hand, saliva on cigarette butts- identity of assailant.
   - Clothes examination- identification.
3. In burn deaths-
   - Examination of clothes/ skin- for smell of kerosene or petrol.
   - Examination of metallic objects, teeth & bones- for identification of charred body
4. In firearm injuries-
   - Examination of missile- to know the nature and type of firearm.
   - Examination of marking on missile- to know which gun was used in firing.
5. In hanging/ strangulation-
   - Matching of ligature
6. In drowing-
   - Detection of diatoms in body tissues and water.
7. In sexual offences-
   - Examination of vaginal fluid, blood/ seminal stains- whether crime committed.
   - Examination of hair, epithelium, blood grouping- identity of accused.
   - Examination of clothes & site of offence.
8. In vehicular accidents-
   - Blood grouping- for identification.

- Tyre marks- to know the vehicle.
- Grease, mud, blood, tissues, glass pieces, hair, paint etc. On vehicle-which vehicle involved in accident.
- Examination of clothes- site, identity of accused.

9. Identification-

- It is possible from finger prints, foot prints, hair blood, semen, clothes, bones, teeth and tissues.

10. Disputed paternity/identity-

- Cases settled by examination of blood groups and DNA finger printing

11. Burgalary-

- Examination of paint, algae, vegetable matter, glass fragments on his tools, clothes or body.

12. Forgery-

- Examination of documents, paper ink, pencil and type writer
- Erasures/ alterations/ obliterations- under U.V. Rays.
- Identification of handwriting.

ANALYTICAL TECHNIQUES-

1**. Chromatography**- it is an important technique to separation, identification and purification of a mixture. It is based on two different media stationary phase and mobile phase. The speed at which each substance is carried along by the mobile phase depends upon its solubility and its affinity for the sorbent. It is very helpful to detect poisons and chemicals. Thin layer chromatography Paper chromatography is used for the separation of protein and in studies about protein synthesis. Gas chromatography is used for alcohol, ester, lipid and amino groups[14,15].

2. Electrophoresis- it is a technique using separate mixture of ionic solutes by differences in their rate of migration in an applied electric field. The electrically charged protein components move on the phase plate and at the end, the plate is treated with coloring agent causes appearances of visible characteristic bands specific for a particular protein[16].

3. Spectroscopy- there are a lot of spectroscopy methods which is based on various effects of interactions between radiation and matter, among which vibrational spectroscopy deserves special attention, these methods are widely used for gathering structural information on biological systems investigations such as this helps identification of the various forms of haemoglobin[17].

4. Spectrophotometry-colorimeter, U.V. and I.R. spectrophotometry, mass spectrometry, emission spectrophotometry, atomic absorption spectrophotometry these are the various quantitative and qualitative analytical spectrophometer[18].

5. Neutron activation analysis- It is an isotope specific analytical techniques for the qualitative and quantitative measurement of chemical elements. In nuclear reactor, the trace element is irradiated with neutrons which causes radioactive decay and in this process gamma rays are liberated, which are measured and counted and it is adopted for measuring trace metals in biological samples[19].

6. Microscope- comparison microscope, dark-field microscope, electron microscope, fluorescence microscope, polarizing microscope, scanning electron microscope, X- ray microscope[20] are to magnify small objects that cannot be seen by the naked eye.

7. Lie detection-

Polygraph-

It is based on principle that if a person is telling lie, and if there is fear that the lie will be detected the emotional fear results in stimulation of sympathetic nervous system that causes physiological changes and some of these changes can be recorded[21].

Polygraphy process uses and record following parameters-

1. Blood pressure
2. Pulse
3. Heart rate
4. Respiration
5. Sweating
6. Psychogalvanic reflex.

Such phenomenon reflects emotional reactions which are use in detecting deception. It is popularly known as lie detector. The tracing made is called as polygram[22].

Narcoanalysis

Narcoanalysis is a procedure of investigation of mental content of a person done after application of a light general anesthetic drugs.

• This investigative technique is based on the principle that at a point very close to unconsciousness, the subject would be mentally incapable of resistance to questioning, and incapable of inventing falsehood that he has used to conceal his guilt.

• It involves administration of light anesthetic agents or drugs intravenously

• Drugs commonly used are

1. Thiopentone sodium (Sodium pentothal)
2. Scopolamine hydrobromide
3. Sodium secnol
4. Benzodiazepines

• Adverse effects of Thiopentone sodium include laryngospasm; shivering and delirium may occur during recovery.

It can precipitate acute intermittent porphyria in susceptible individuals[23].

Brain mapping

Brain fingerprinting determines if specific information is present in the brain of criminal regarding the criminal act. It is like seeking fingerprints at the crime scene and thus the name brain fingerprinting.

• Brain fingerprinting is an investigative technique to measure recognition of familiar stimuli by measuring electrical brain wave response to words, phrases or pictures that are presented on a computer screen.

• Brain fingerprinting technology is based on the principle that there are brain wave responses. Brain fingerprinting measures brainwaves functioning to detect awareness of crime-relevant information in order to distinguish between guilty and innocent suspects[24].

DISCUSSION AND CONCLUSION-

Sushrut kalpasthan has explained the usage of animals for the detection of poison. The presence

of the poison in food and drink can be suspected with abnormal behavior of certain animals and birds, example cuckoo birds lost its melody, peacock becomes restless and unstable, monkey defecates etc. In ancient time *acharyas charak, sushrut* used their knowledge about toxicity in animals such as dog, cat, peacock, parrot etc to know poison on the materials which was served to king. In this way they protect the king from their enemy and provide justice to them. These days several crime is going and Forensic science plays an important role in the criminal justice system by providing scientifically based information through the analysis of physical evidence. During any investigation, evidence is collected at a crime scene or from a person, analyzed in a forensic laboratory and then the results presented in court. Forensic scientists collect, preserve, and analyze scientific evidence during the can investigation. While some forensic scientists go to the scene of the crime for collecting the evidence themselves, others occupy a laboratory role, performing analysis on objects brought to them by other individuals. The evidences which are usually handled by the FSL such as weapons, firearms, bullets, blunt things, blood, seminal stain, saliva, hair, finger prints, clothes, foot print, documents etc which are very helpful to decide the crime. The analytical techniques like chromatography, spectroscopy, microscope etc are using to detect chemicals and poison regarding the crime as well as polygraph, narcoanalysis are also very beneficial to decide critical crime cases. The lie detector based on the theory that when a person tells a lie, it detected the emotion of fear results in stimulation of sympathetic nervous system which results in certain physiological changes, some of which can be easily recorded. In narcoanalysis the person cannot resist questions and also will not be able to give false answer, which he had been giving to conceal his crime. Hence this review article to understand FSL, their structures, functions and role in the justice.

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