Review Article

Biological Evidence Management at the Crime Scene: An Overview

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Abstract

Crime scene serves as the starting point for forensic science and can generate valuable data that must be meticulously, methodically, scientifically, and lawfully gathered. If the crime scene is not handled appropriately, it can become misleading and render crucial information useless, leading to an investigation on the wrong path. Forensic science has undergone a revolution thanks to the use of DNA technologies. Many times, due to the investigator's lack of scientific expertise regarding the proper collection, preservation, storage, and transportation of biological evidence, the investigator is unable to acquire accurate DNA analysis results, which reduces the value of the evidence in court. Purity, quantity, and rate of DNA degradation are just a few of the many variables that go into creating a decent DNA profile from a biological sample. We highlight and provide useful strategies and recommendations to assist medical, forensic, and law enforcement professionals in handling biological evidences for DNA analysis to prevent contamination, deterioration, and loss of biological evidence's value.

Keywords: Crime Scene, Biological evidence, Contamination, Forensic Science.

Introduction

The disciplines of forensic science and criminal investigation have undergone radical change since the development of DNA profiling technologies. In criminal and civil situations such as homicide, sexual assault, missing person identification, accidents, birth concealment, mass disaster, paternity/maternity determination, inheritance cases, immigration issues, etc., DNA evidence provides conclusive evidence. However, several requirements for the evidence must be met for the DNA profiling results to be successful. The scientist's downstream analysis is meaningless because these pieces of evidence were not properly collected, packaged, and preserved. Due to microbial development and environmental factors, all biological evidence is susceptible to degradation.To ensure that this evidence is retained so that relevant information may be gleaned from its analysis, meticulous collection and preservation are therefore necessary. Hundreds of different kinds of physical evidence

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are frequently brought into forensic science facilities for evaluation. The only kinds of evidence that can be exposed to DNA analysis are often those that are biological in origin.[1,2]

DNA analysis does not apply to other biological evidence types, including tears, sweat, serum, and other bodily fluids devoid of nucleated cells. Blood, semen, bodily tissue, bone, hair, urine, and saliva (Fig.1) all can be directly transmitted to a person's body or clothing, as well as to an item or crime scene. Liquid biological samples that have been deposited turn into stains and stick to the substrate or surface. By direct touch and deposit, non-fluid biological evidence like tissue, bone, or hair can also be conveyed. Through an intermediary medium, blood, semen, body tissue, hair, saliva, or urine could be transported to a victim, suspect, witness, object, or location. There isn't any direct contact between the primary source and the target surface during a secondary transfer. The intermediary for the flow of data could be a person, thing, or place. A secondary transfer does not always provide conclusive evidence of a person's involvement in a particular crime. Biological evidence that has been delivered directly or indirectly will stay on the target surface either through absorption or by adhesion. In general, solid-state evidence will stick while liquid biological evidence will be absorbed. The collection technique is heavily influenced by the status and quality of the biological evidence. In general, a sizeable amount of material should be gathered to guarantee the recovery of enough DNA for testing needs. However, as many chemicals are known to negatively impact the DNA typing process, it is crucial to limit the gathering of extra dirt, oil, fluids, and other material from the surrounding area. Each biological specimen must be stored under accepted forensic procedures. The samples should be delivered as soon as possible to the forensic lab after they have been collected. Items should be kept in a cool, dry area until they are submitted for testing to reduce specimen deterioration.[3,4]

Despite some published protocols and guidelines, few nations have formally adopted evidence management guidelines from the perspective of forensic intervention. Even after they are adopted, guidelines may differ between institutions, regions, and even the same nation.[5]

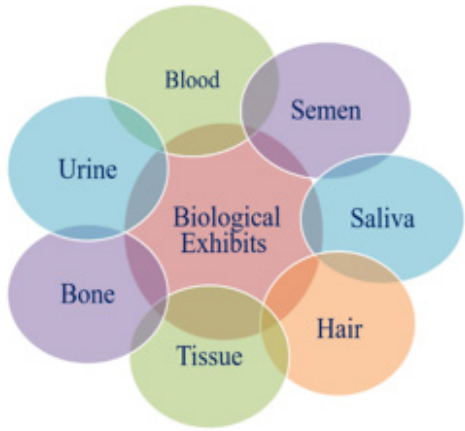

Fig. 1. Biological pieces of evidenceson the crime scene have been shown in the diagram.

In order to preserve integrity throughout all stages of the investigation and litigation, biological evidence and materials should be gathered in a way that avoids contamination and deterioration. Tools and materials used to collect samples must be devoid of human DNA in order to prevent contamination. Due to the manufacturing process, disposable latex examination gloves, individually wrapped swabs, and other separately wrapped items are free of human DNA.[6]

Blood and bloodstains

Blood and seminal fluid can be highly likely matched back to an individual when employing the DNA profiling method of analysis. Currently, blood and some body fluids can be claimed to originate from a specific demographic group to which the individual belongs if employing the PCR method of DNA analysis or traditional serological procedures. Reference samples must always be taken from victims and suspects. These samples typically consist of liquid blood in most circumstances. A person's liquid blood should be taken from them by trained medical experts. If the subject had recently received any type of blood transfusion, the crime lab should be notified. In vacutainers using EDTA as an anticoagulant, two tubes of blood of approximately 5 ml each should be collected. A blood sample from a non-body cavity location, such as the heart or main internal blood veins, should be taken when collecting reference samples from postmortem people. The date, time, subject's name, location, collector's name, case number, and exhibit number should all be written on each tube.[7]

Blood on Crime Scene

Small items with wet bloodstains should be left to air dry before being retrieved. When being packaged and transported, care should be taken to protect the integrity of any bloodstain pattern. Wet bloodstains may be present on big, immovable objects at a crime scene. A clean gauze/cotton cloth should be used to transfer the blood. Cotton that has been stained with blood needs to air dry before being packaged in a paper container. Each item and container must have the appropriate label A clean (ideally sterile) syringe or disposable pipette should be used to collect liquid blood, which should then be transferred to a clean (preferably sterile) test tube. A clean spatula can be used to move a blood clot to a clean test tube. Blood clots or liquid blood can be absorbed by a fresh gauze/ cotton cloth and need to air-dry. If obtained, wet blood samples must be maintained in a refrigerator and preserved in a suitable anticoagulant. These samples need to be delivered as quickly as possible to the lab. The case number, item number, date, time, location, and the name of the evidence collector should all be written on the specimens.[8]

Dried bloodstains

Weapons, clothing, and other mobile objects with dried bloodstains should be collected individually by gathering the full item. Each item must be put in its own (paper) container, which must be securely sealed and labeled.Relevant documentation and sketches of the bloodstain pattern should be made. The tape can be used to lift the stain or it can be scraped off the item and onto fresh paper. The blood-stained paper or tape lifter can then be folded in a "druggist" fashion and placed inside a sealed envelope. The right labels must be on each item. If the bloodstain cannot be scraped off and the support object cannot be cut, the bloodstain may be eluted onto a clean cotton switch by rubbing the switch on the stained area while it is damp with sterilized saline or water. The switch is then placed in a paper pouch and given time to dry. The packet is then placed in a sealed, appropriately labeled envelope. Always get control by conducting the operation again on a nearby, blood-free section of the surface. If the bloodstain is on a material that can be cut, it can be removed by cutting a piece of the stained material with a clean, sharp object. Each cutting needs to be boxed and labeled separately. It's important to gather and package a piece of the item that isn't soiled as a control.[9]

Semen and seminal stain

Semen evidence should be documented with notes, photos, videos, and sketches. Liquid semen should be transferred to a clean, sterile test tube using a clean syringe or disposable pipette. Maintain the specimen's temperature in the refrigerator, and send it to the lab as soon as you can. As an alternative, liquid semen can be absorbed and transferred to clean cotton fabric. The cloth is then air-dried before being appropriately packaged, sealed, and labeled. Seminal stains on underwear, clothing, bed sheets, pillows, and other mobile things must be gathered in their current state. If an article has a wet stain on it, the stain must be allowed to completely air dry before the object is collected. The stained area should be cut using a scalpel or scissors if the stain is on a large, cutable object. If the stain is on an inflexible, non-absorbent surface, it should be scraped onto clean paper with a clean scalpel before the paper is folded into a druggist-fold container. A fresh paper container should be used to package each item separately. The packing of each item must be appropriately labeled and sealed.[10]

The victim of a sex offense should be sent to the hospital very away, and an examination should begin right away. Any wounds the person has should be documented with photographs. If required, oral, vaginal, and/or anal swabs should be collected from the victim as quickly as possible, and they should be air-dried for an hour in a moving air source. Since the body starts dissolving the different parts of seminal fluid through drainage, enzyme activity, pH, etc., they should be taken as soon as possible. The swabs need to air dry for at least an hour while being blown by a fan. This can be done by the hospital's doctor, or after the investigator picks up the kit from the doctor, they should take it right away to a safe location and let it air dry. The reason for this is that the moisture in the swabs encourages the growth of germs, which might reduce their usefulness as evidence.[8,11]

Muscle Tissue, Organ, or Bone

Each piece of evidence needs to be noted down, photographed, sketched, or recorded on video. With a spotless set of forceps, you can pick up such pieces of

evidence. Place each item in a tidy container without any additional fixatives. Each container needs to be carefully labeled, sealed, and kept in the freezer. The laboratory should get the evidence as quickly as possible. If the body has decomposed when reference samples are being taken from postmortem subjects, in addition to the blood sample, try to gather as many of the following specimens: a piece of deep muscle tissue, tissue from a specific organ (such as the heart or brain but not the liver or kidney), 2-4 intact molar teeth (if identification is a problem, make sure mouth x-rays have been taken), and a sample of compact bone (e.g., femur). The specimens should be taken far from the area of the damage (i.e., if head injury, do not take sample of brain tissue). Samples should be frozen right away and should not be preserved in any way (e.g., formalin). The same guidelines apply to the collection of urine, saliva, and other bodily fluids as they do to blood and blood stains. [12]

Strands of Hair

Humans lose 100 head hairs on average per day, and as hair is easily transferred during physical contact, it is frequently used as forensic evidence to establish connections between individuals and a crime scene. If a root sheath is present, DNA testing using PCR technology can determine that this hair originated from a specific subset of the suspect's population. Microscopically, it can be determined that the hair shares traits with the suspect's hair and is comparable to that if there isn't a root sheath. Hair discovered at the scene should go in a paper packet and then an envelope. 15-20 representative hairs from the suspect must be delivered to the lab for comparison if a microscopic investigation is necessary.[13]

Conclusion

The success of DNA profiling depends on a number of factors, including the rate and degree of DNA degradation, the quality of the DNA in the sample, and other factors. The scientist's downstream analysis is meaningless due to the inappropriate collecting, packaging, and preservation of the evidence. Therefore, additional care must be taken to avoid contamination problems when locating, gathering, and safeguarding DNA evidence. In the past few decades, there has been a significant increase in the use of DNA technology in criminal investigations. DNA testing has been shown to be a very effective tool for both prosecution and defense. DNA evidence has made the crucial connections that have led to numerous convictions all around the world. The ability of DNA to exclude is also noteworthy. DNA evidence that is not positively identified, recorded, gathered, and kept, might not eventually be useful to a criminal inquiry. If evidence collection and preservation are not prioritized more, the forensic community may not be able to use this tool to further the interests of justice.

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