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Review on Effect of Contaminants on Determination of Blood Group

Panchadevi VV* **and Desai S**

Department of Forensic Science, Yashavantrao Chavan Institute of Science, Satara 415001, Maharastra, India

***Corresponding author:** Panchadevi VV, Department of Forensic Science, Yashavantrao Chavan Institute of Science, Satara 415001, Maharastra, India, Tel: +91-8530692205, E-mail: vaidehipanchadevi50@gmail.com

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Abstract

Blood is important trace evidence obtained from crime scene. The use of blood in forensic analysis is a method of identifying individuals suspected of committing some kind of crime. But most of the time blood is contaminated because of various reasons like inappropriate collection, packaging and preservation of sample, storage of blood for longer period of time. Therefore testing of such contaminated blood can cause false clinical result. Human identification is mostly based on determining the blood group. The reliability of blood grouping from contaminated stains have been always questioned in medico-legal scenarios. With this background contamination with bacteria, dust, rust, other possible contaminants etc will have any effect on blood grouping was analyzed by studying previous articles related to topic and the case studies. The study was done to know more about various contaminants and their effect on clinical result to give false negative or positive result. Blood grouping is an important identity in identifying crime; it is not reliable if it is contaminate. It is necessary to spread awareness of contamination of biological sample and their effect on clinical result as well as careful while identifying blood group in case of medico-legal issues. This detail study can be helpful to know the possibilities of blood group changing result variations and the current issues in clinical field.

Keywords: Blood; Blood group; ABO Blood Groups; Contamination

Introduction

Blood is most common and important evidence found in different types crimes [1]. The use of blood in forensic analysis is a method of identifying individuals suspected of committing some kind of crime [2]. There are different techniques are developed for identification of individuals from blood sample but mostly blood group technique is used for human identification [3]. There are 33 blood group systems representing over 300 antigens are listed by International Society of Blood Transfusion. The most common ABO blood group system was developed by Karl Landsteiner in 1901 [4].

Blood type is generally determined by presence or absence of antigens on the surface of Red Blood Cells. In addition antibodies are also present in blood plasma that recognizes their corresponding antigen. In ABO blood group system there are 4 blood groups; Blood group A, Blood group B, Blood group AB and Blood group O. There is another D antigen which is present on Red Blood Cell. Presence or absence of D antigen shows Rh+ and Rh- Blood type [5].

In forensics, blood have a most evidentiary value. Blood is either found on a crime scene or sometimes it is collected from suspects or a victim. Collection of blood from crime scene or from suspect and victim is a very important procedure in crime scene investigation [6]. After proper collection it is sent to the laboratory for further analysis. But the main issue is that, sometimes knowingly or unknowingly the 'contamination' occurs and further it affects on the analysis. The word 'Contamination' means the unwanted transfer of material from another source to a piece of physical evidence [7].

There are various reasons of blood contamination, the inappropriate collection of blood sample from crime scene or from suspect and victim, lack of proper preservation of sample, storage of sample in an inappropriate way or for a longer period of time, use of dirty tubes or glassware, contaminated reagents, weather and temperature effect, environmental effect etc. The most common contaminants of blood are dust, sand, fiber, rust, microorganisms most common Staphylococci present on the skin, wood particles etc. In this article we are tried to find other contaminants and possible ways which are causes to change blood group result.

Every year so many cases are remains unsolved due to either lack of evidence or false interpretation or contamination of evidence. Grouping of blood is not reliable, if the blood is contaminated. Also stored blood samples gives a some changes in the result of blood group. The result of blood grouping have value in medico legal cases. But sometime it may be a false result. And such a false result will be punish innocent and non-criminal person [8].

With this background, this paper is an attempt to check the reliability of blood group technique from contaminated blood sample, also to check the liability of stored blood sample. This article quite help the forensic practitioners in learning about issues related to clinical results, what are the possible contaminants of blood, how they affect for changing blood group results, is really the such result can be presentable in court as a strong evidence. Also the article is helpful for spreading awareness of contamination of biological sample and how we can minimize the clinical errors.

Discussion

As we told in introduction, the use of blood in forensic analysis is a method of identifying individuals suspected of committing any kind of crime. Early twentieth century, Paul Uhlenhuth and Karl Landsteiner are the two scientist who showed that there some differences in blood between two individuals. Uhlenhuth developed technique to identify antibodies and Landsteiner showed that humans had different blood types called A, B, AB and O [9].

When Landsteiner identify blood types, they found out slight differences in antigens in a blood sample. In a body, those antigens are recognized by antibodies. After that, forensic scientists started to use the blood group technique to exculpate people suspected of any type of crime, and they also used it to determine the paternity of children.

Antigens Vs Antibodies

	Group - A	Group - B	Group - AB	Group – O
Antigens	A - antigen	B – antigen	A and B antigen	-
Antibodies	Anti - B	Anti - A	-	Anti - A , Anti - B

Landsteiner's account of blood types brought a new tool to forensic science in the early development of the field. Now a days, different techniques are developed for individual identification, but since blood grouping is widely used by forensic scientist because of less procedure and quick results are obtained.

In 2000, forensic science started to grow up. The people was started to know how the evidences can help to solve any crime. The importance of physical evidences was suddenly increased and different methods of collection, packaging of evidences were developed. With this, the issue of 'contamination' was first discussed in 2003 by Christopher Hillyer [10]. He told that when we collect any sample from crime scene, there are some chances of contamination of that evidences. He was firstly showed the risk of contamination. Some scientist worked and developed some preventive measures for crime scene contamination.

As like other evidences there are chances of contamination of Blood also. Blood is a trace evidence and found in most of the crime scenes. In some articles, the scientist showed the different contaminants of blood and chances of contamination of stored blood samples [11]. Sometimes the collected sample quickly analyzed and results are forwarded to the corresponding officers. But in some cases, due to complications in the case the blood samples are stored in a forensic lab for longer period of time and according to the need they are analyzed. In that case following points are important to consider.

Possible ways of blood contamination-

1. On crime scene
2. During collection and packaging of blood from crime scene
3. During transportation of blood
4. At a storage room
5. Collection of blood from victim or suspects

Possible contaminants of blood –

1. Temperature
2. Weather condition
3. Dust
4. Microorganisms
5. Foreign body
6. Unwanted transfer of any contaminant

How the blood sample can be contaminate –

1. lack of proper collection and packaging
2. use of contaminated containers or tubes
3. use of expired preservatives
4. lack of proper handling

5. lack of proper preservation
6. due to insertion of foreign body

In some recent articles, they have mentioned about bacterial contamination of blood sample. This contamination occurs when we collect sample from victim or a suspect. Mostly *staphylococci* bacterial contamination occurs. *Staphylococci* bacteria present on the skin of the humans. The epidermis layer of human skin contains *staphylococci* and *Bacillus* bacteria [12]. When we collect the sample of blood from victim or suspect by using siring there may be chances of mixing of these bacteria into the blood sample. One study was done related to bacterial contamination and its effect on blood stored in blood banks. So they observed the transfusion reaction which may result to change in blood groups [13].

There is another possibility of changing blood group of any person is that, when any person affected by any disease [14]. Takes some therapy's like organ transplantation or in case of cancer any breast therapy etc [15]. In that case foreign body inserted into body of that person, which causes to make some changes in blood group factor [16]. After some period which result to the changing of blood group of that person. This is medico legal proved and mentioned in some articles [17]. If we think in forensic perspective, in India the cases are run in court for longer period of time. In that case, if we tested the sample of such person who having disease and he was taking any therapy or treatment which causes to change blood group of that person. Then test result may show the false result. So, it is another way of contamination and here the 'foreign body' plays role as a contaminant.

One case is happened related to changing blood group due to foreign body insertion during the period of 1999 to 2010. The female of 36 year old having cancer and she had taken chemotherapy [18]. The foreign material or chemicals treated used for treatment were anthracyclin, docetaxol. The details of blood group change described in following Table 1

Blood group determination year	Method used	Result
1999	Slide test	A, Rh positive
2002 (after taking therapy)	Slide test	A, Rh positive
2009 (three tests)	Slide test (reverse and forward)	A, Rh negative

Table 1: Details of blood group change

This is how there is possibility of changing blood group after taking such therapy's and contamination of foreign materials. There is possibility of happening this in criminal cases where if the suspect or accused having certain disease and he was taken some treatment. During lab test his or her result showed the false positive or negative result, then there may be chances of punishment of other innocent persons in that case.

There is another issue of changing blood group was observed with red cells extracted from old cadavers. Which was first discussed by Entickner, he extracted red blood cells from old cadavers many hours after death and analyzed the sample. He studied the stability of red cells agglutinogens and occurrences of false agglutinogens in stored blood [19]. After that so many scientists started to work on changing blood group after decomposition and on stored blood samples. To support the findings of Entickner, Gettler and Kramer strongly advised against the use of contaminated stains, as a result may be inconclusive [20].

This is how the contamination occurs in various ways. To continue the work on effect of contaminants the researchers did one experiment on effect of rust in blood sample on changing blood group. The study showed that rust (ferric oxide) did not show any effect on RBC's or agglutinogenic capacity and grouping. Chase [21] reported the existence of gram negative bacteria coccobasillus which affected the blood group A substance. Gilmore and Howe have studied the effect of aerobic soil microorganisms and cell free extract, which decomposes blood group substances [22,23]. When scientists starts knowing the bacterial effect on blood, they were started to finding other contaminants of blood. Related to this, one article published in 2013 forensic science journal, in that they do some research about identification of blood in presence of contaminants. They identified some contaminants like soil, dust in stored blood sample by using Raman spectroscopy. They observe some different spectra of the different contaminated samples of blood and suggest that there may be chances of false interpretation of analysis of such sample. These results may be unacceptable by the court [24].

With this background in 2015, Ashwini Narayan K, Manjunath MR, Kusuma KN did one experiment to study the effect of dust and detergent on blood [25]. They observed if the blood is contaminated with Dust, it may give result of changing blood group [26]. They also told that such results not liable to courts. The book 'human blood groups' by Geoff Danial, in this book he told about how blood group technique is helpful for solving crimes and also he mentioned about maintaining integrity of evidences because if we fail to proper collection and preservation of sample then contamination occurs which gives change in blood group result [27].

There are various emerging technologies in forensics for identification of blood. But when we move forward with this technologies we have to focus on what are the limitations and drawbacks of these techniques. To minimize these limitation either we have to develop new technologies or develop some preventive measures.

Some articles related to reducing contamination in forensics gives some preventive measures of crime scene contamination of blood [28-37].

How we can prevent contamination of blood on crime scene or collecting from victim or suspect -

1. Use standard procedure for collection.
2. Use sterilized containers or tubes for preservation
3. Use sterilized syringe during collection of blood from victim or suspects
4. Use proper preservatives if required to store the sample
5. Preserve in proper temperature
6. Ask the person about he or she had taken any foreign body insertion treatment or therapy before collection of blood sample.

When we study all are the possibilities of changing blood group due to any contamination, we need to enhance our knowledge about possibilities of false clinical results with respect to other laboratorical technologies used in forensics. There is need to spread more awareness about what are the possibilities of changing blood group of collected sample either from crime scene or from suspect or victim.

Conclusion

Blood grouping is very important technique in the field of forensics. By observing different papers, it can be concluded that in certain circumstances it may be misleading technique. Grouping by agglutination method is unreliable in case of decomposed or contaminated blood by dust, soil, rust, detergent, microorganisms or any other foreign material.

It is also found that there is possibilities of changing blood group of a person after certain period of time, who have taken any organ transplantation surgery or therapy treatment. Also stored blood samples from many years, can be give false positive or false negative result because of transfusion reaction. Therefore such results are not liable to courts. If presented in a court which causes to punish innocent person or making false judgment.

There is need to find other contaminants of blood which are responsible for changing blood groups. On other hand, we have to follow basic standards to avoid contamination and have to be careful while identifying blood groups in forensics.

Blood group analysis is no longer an important analysis for the forensic purposes as in most countries it has been replaced by DNA analyses but this article can helps to understand why blood group test is replaced and why it is not much applicable. This article may try to provide the future scope in blood group testing and forensic science.

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