Role of Blood Group Serology in the Detection, Identification and Investigation for Criminality in Bangladesh

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Blood is the source of life. Blood grouping is done from whole blood, red cell, plasma or serum. Forward grouping or cell grouping is done from cell. Reverse grouping or serum grouping is done from serum or plasma for the purpose of person identification, for transfusion of safe blood to patient for correction of anaemia, restoration of blood volume, transplantation either solid or liquid organ, for tissue typing and investigation in some sorts of transfusion reaction. Blood grouping has important role in the serological identification of disputed individual with biological relationship i.e. disputed paternity, maternity etc. Grouping is done not only from whole blood, red cell, plasma or serum, but also from body fluid such as seminal fluid, vaginal fluid, urine, saliva and gastric juice. We can also demonstrate the grouping from body tissue nail, hair, bone, dental tissue, soft tissue and also from stains. Blood and other body fluid collected from victim and also from criminal has important role in the identification and investigation of criminal cases. If we know the blood grouping of criminal beforehand and preserved the grouping sample from all the listed criminal for grouping and DNA typing and also for future need then we can able to identify the criminal after criminality as because criminal always put some evidence on the victim about his offence during criminality. It will thus help our investigating department for the detection, identification and investigation in the case of criminality.

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Introduction

History of blood transfusion is a fascinating subject. Before the origin of medicine itself ancient civilization recognized that blood was the source of life.[1] Blood group antigens are genetically controlled and passes from offspring to offspring, following Mendelian inheritance.

There are about 400 blood group antigens and about 73 blood groups in present notation, of them 23 are known as tabulated form. Blood grouping is done for compatibility testing, cross matching, safe supply of blood for trauma, surgery and anaemic patient.[2] Blood group has important role in the serological identification of disputed individual with biological relationship. i.e. disputed paternity, maternity, kidnapping etc.[3] We can do blood grouping from cell (forward grouping) and serum (reverse grouping) or from whole blood. We can also perform grouping from body fluid. Such as saliva, tears, sweats, urine, gastric juice, vaginal fluid, seminal fluid etc. Other than body fluid detection of blood grouping antigen is done from body tissue, bone, nail, hair, dental tissue and stains. Blood-grouping antigen present in the stains has important role in identification of victim and investigation of criminal cases. In one example Dr. Leone Lattes in Italy developed a reagent to determine blood group even after a bloodstain had dried. In one

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famous medico-legal case, he secured the release of a man, who the police believed had murdered his wife, pointing to a suspicious bloodstain on his coat. Dr. Lattes showed that the blood type did not match the wife's but was his own, confirming the man's story that it had come from a bleeding nose. In Russia two men acquitted of murder charges after it was found that blood on the dagger' belonging to one of them did not match that of the victim.[4]

The blood group agglutinogens can be demonstrated in stains on clothes due to semen, sweat, saliva, nasal secretion, urine and faeces in persons who are "secretors". This may be a corroborative evidence of the accused.

The specificity of various blood group combinations is like that of the fingerprints. When an individual has some rare blood group, he can be identified with certainty. But when they are of common type, they are not of use. In case of grouping from bone new bone will give the better result. Stained should be collected as early as possible. In case of grouping from nail of 6 months age will give good results.[8]

Materials Used for Grouping

Following materials are used- a) routing grouping of blood and grouping from stains b) bone c) dental tissue d) hair e) nails f) soft tissues and g) DNA fingerprinting

About 150 mg of blood-stained material or about 75 mg of dried blood and the control free from stain should be available for grouping test. The agglutinogenic specificity of blood stains is retained, even though the red cells are not intact, if the stains are properly preserved. ABO retain their agglutinogenic specificity within 3 to 5 weeks. Bone and dental tissue will be fresh, hair shaft will be about 6 cm in length and nail will be about 3-6 mg.[5]

Provision for investigation

Forensic science deals with problems of identity and blood group are excellent aids to these pursuits. The area in which investigation contribute valuable evidence are the identification of stains from body fluid and valuable information can be obtained about the origin of blood stains in case of crime. There should be provision for reinvestigation of blood group serology in the area where there is murder, rape, kidnapping and hijacking i.e. any blood stains found on suspect's clothing and/or weapons, accused as well as victims or test revels other than blood stain such as nail, hair, bone, dental tissue, soft tissue, urine, saliva, gastric juice, seminal

Table I. Results of blood grouping in a case of assault

Victim (July)			A_1	$M^{\varsigma}N^{\varsigma}S^{\varsigma}$			$_{c}C^{\varsigma}Dee$				
PGM 2-1											
Victim(October)	A_1		MS-			^{cc}Dee			PGM 2-1		
Accused	A_2		MS+			$_{cc}$DEE			PGM 2-1		
Results of stain groupings.											
	A	B	H	M	S	D	C	E	c	PGM	Frequency
Shirt of accused	+			+		+			+	2-1	1 in 1000
Glass	+			+		+			+	2-1	1 in 1000
Pocket of accused +			+	+	+	+		+	+	2-1	1 in 100

$^{\varsigma}$Test showed mixed field

and vaginal fluid etc. For example Table I illustrate the scope of test on blood stains. A man suffered from severe neck injury caused by an assault on him by means of a broken glass. Blood on a piece of the glass and stains on shirt and trousers of the accused were tested-the range of systems included ABO, MNS, Rh antigens D, C, E and the red cell enzyme system, phospoglucomutase (PGM). It is apparent from Table I that the stain on the shirt of the accused gave the same reactions as the blood found on the glass fragment and his combination of groups differed in two respect fro111 those of the accused himself in that they were both S negative and E negative. In making a comparison with the victim's pattern of blood types difficulty was for a time encountered because the victim had been so severely injured that it was necessary for him to receive an immediate transfusion of three units of blood. Where shown in Table I the tests should mixed field appearance indicating two red cell populations, one is of the victim's own and the other originating from the donors. This phenomenon was seen in tests for M, N, S and C. It was therefore not possible to be certain of the victim's blood types until some months later when the donor red cells had been eliminated from the circulation.

It can be seen that there is a significant probability that the blood on both shirt and glass originated from the victim. In this respect it was fortunate that the victim possessed the less common Rh_o so that his particular blood group combination was expected to occur in only 1 person in 1000 of the appropriate general population.

The finding of a small blood stain area in the accused person's trouser pocket giving a combination of reactions which accorded with his won blood groups led to the speculation that in assaulting the victim with the broken glass the accused might have injured his own hand which might then have been plunged into his pocked. Later the police confirmed that he had indeed sustained such an injury.[6]

Discussion

Routine grouping and grouping from stain

The agglutinogens of the ABO system are also in body tissues. In the tissues they appear in a lipoidal form. In about 80 percent of the people they appear in a water-soluble form and can be demonstrated in all the body fluids except the cerebrospinal fluid. They are not found in nerve tissue, epithelium, skin appendages, bone and cartilage. Persons who possess only the lipoidal form are known as 'nonsecretors' while those who possess a water-soluble form are known as 'secretors'. The capacity of secreting these antigens in body fluids is controlled by a pair of allelic genes Se and se, the former being dominant over the latter. The individuals with genotype Se Se and Se se are secretors and those with the genotype se se are non-secretors. Secretors possess H antigen on their red cells irrespective of their blood group of the ABO system. However, the amount of H antigen is the highest on the red cells of 0 group persons. The ability to secrete agglutinogens into the body fluids remains constant throughout and is transmitted as a simple Mendelian dominant. The agglutinins, a and b are also present in the body fluids. M and n agglutinogens are widely distributed in the body tissues in a relative water soluble form. The Rh agglutinogens are widely distributed in the tissues but are not found in the body fluids, except the amniotic fluid. This has role in identification of criminal e.g. by routine grouping of blood sample collected from both the victim and accused or suspected assailant clothing & other sources. If the blood sample of victim are of same blood group of sample collected from accused or suspected assailant clothing & other sources the result is conclusive i.e., accused is culprit. During

violence spouting of blood from accused or suspected assailant stained or plugged on victims body. If not same group the result is non conclusive i.e., spouted blood came from another sources, victims own blood if blood group is same of victims own.

Blood stains may be found on clothing and person of suspect. If the accused alleges that the stain is of his own blood, it will have similar blood group systems and haptoglobin. If the victim has similar characters, the test is not conclusive. If there is discrepancy in blood group of the stain and the blood of the accused, then the stain is
of some other person's blood. If the characteristics of the victim's blood coincide with those of the stain, an association is established between the suspect and the victim. Blood stain may be present at the scene of house breaking, e.g., on a broken window, if the culprit has cut himself. If the characters of these stains are similar to that of blood of the suspect, it establishes association. Blood stains may be present under the fingernails of assailant in a case of throttling. If there has been a struggle, blood stains derived from the accused may be found under the finger nails of the victim, due to scratching. Vehicles which have caused injury can be identified when they show blood resembling that of the victim.

Stains of clothes due to bugs, fleas, louse, mosquitoes, etc., are common. These stains are small in size and sharply angular in outline and are usually found on the inside of the garment. If the insects are crushed, fragments of the hair or scales of the insect and eggs may be found on microscopic examination.

Bone

The determination of blood groups from bone tissue is more difficult than from other body tissues. In old bones, it is very difficult to determine the blood groups accurately. Carbohydrates, glycolipids and glycoproteins can be extracted as blood group substances from the bone-marrow. With fresh bone-marrow and spongy bone, blood groups can be determined with a relatively high accuracy. Bone samples should be collected from the regions rich in red bone marrow, i.e., the proximal epiphyses of humerus and femur. In compact bone blood group substances are thought to originate not only from bone cells but also from red cells in vascular systems. Mainly ABH blood groups are detected in the bone, but with compact bone, groups A or B are frequently misjudged as AB. MN, Gm, PGM, 6-PGD and esterase D (EsD) have also been detected. Bone grouping is of help in the detection, identification & investigation of criminal cases.

Dental

Absorption-elution technique is preferred for blood grouping of dental tissues including dentine, cementum and dental pulp. Enamel contains only traces of blood group substances and grouping is very difficult. Blood grouping of a denture and dental calculus is possible if the denture has been used for a long period of time due to the accumulation of saliva, cementum gives a weak reaction. Results are most accurate with dental pulp. Blood grouping of old teeth is possible if they are dry and not infected with bacteria. Heating at 200°C and over destroys blood group substances. Apart from ABO, PGM, AK, ADA and 6-PGD can be identified from the dental pulp. It thus helps the identification of crime & criminal

Hair

With absorption-elution technique blood groups can be determined by a single hair shaft about 6 cm in length. Blood grouping is practicable with scalp hair from foetuses and new born infants and also with grey scalp

hair. If hair is heated at 250°C it is impossible to detect blood groups. Hair left in water or soil for up to 6 months give good results. G6PD, PGM, esterase D, 6-phosphoglucomate dehydrogenase, glyoxalase and a-L fucosidase (FUC) types have been detected from hair roots with sheath cells which help the detection & identification of crime by testing hair in the clenched of victim and accused hands and other body surface.

Nail

Three to 6 mg nail is adequate to detect ABO groups. The human nails contain mainly ABN blood group antigens. MN blood groups have been detected in some cases. Marshall (1980) reported that proteins of human nail show a genetic variation with regard to both low-sulphur and high-sulphur protein fractions, which could serve as biochemical markers of individuality which demonstrated the identification of crime.

Soft Tissue

The mixed agglutination technique (the mixed agglutination reaction, MCAR) is useful for detecting ABH antigens on tissue cell surfaces in all kinds of soft tissues. This technique is suitable for the direct determination of blood groups on cell fragments adhering to weapons, bullets and clothing. Decomposed muscle acquires blood group antigens different from native one, and also many bacteria have blood group antigens similar to human ABH antigens.[7] It is highly significant in the detection identification and investigation of criminal cases.

DNA Fingerprinting

Direct analysis of DNA shows extreme polymorphism in many areas in genome. These areas are non-expressed sequences, and are known as "hypervariable regions" (HVR) of human genome. More than 1500 HVR's are present in human genome, which are examined. This method is as unique as fingerprints to an individual. Nucleated cells are the source of DNA for extraction from blood, semen, vaginal epithelial cells, tooth pulp, bonemarow, hair roots, muscle, skin, mucous membranes, etc. A sample is taken and from it the DNA is chemically extracted, purified and subjected to the action of restriction enzymes (RE) which are then separated on agar gel by electrophoreses. Next, the double stranded DNA are denatured into single strands and transferred from agar gel to solid nitrocellulose membrane by Southern Blotting technique. Then they are allowed to hybridize with radio-labeled single stranded DNA probe on the nitro-cellulose membrane. Excess probe is washed off and the hybridized DNA double strands are visualized as bands by autoradiography on X-ray film put in direct contact with probe labeled membrane. These bands are individual specific. It is possible to identify a person from a single human cell. The chance that two people will share the same DNA fingerprint is less than one in 1030 times. It can be applied for tracing pedigrees, proving paternity/maternity, to establish family relationship and identification of mutilated dead bodies from their tissue remnants with the help of DNA fingerprints of close relatives. It can also be applied for detection identification & investigation of criminal cases by establishing same DNA finger print between victim and accused, as because DNA has the molecular basis of inheritance and generate image of ban cling pattern.[8]

Conclusion

Murder, rape, kidnapping and hijacking are common normal phenomenon in this modern civilization and in our day to day life. Modern science creates new weapons creating newer type of offences but fail to reduce crimes and offences. We can reduce this by creating awareness among general people about offences and crime, strengthening their unity against crimes. By introducing blood group

serology in the detection, identification and investigation of criminal cases. Or by establishing forensic science laboratory in the country with 'collaboration between Transfusion Medicine Department and Department of Medical jurisprudence and toxicology under home ministry or with the help of other SARC countries or opening the department of criminology in our country.

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