

**RAKTA DHATU IN AYURVEDA AND ITS CORRESPONDENCE TO CONTEMPORARY
FORMED ELEMENTS OF BLOOD ESPECIALLY PLATELETS AND FACTORS
AFFECTING BLEEDING TIME**Vartika Kashyap*¹ and M. B. Gaur²¹P.G. Scholar, Kriya Sharir, Ch. Brahm Prakash Ayurved Charak Sansthan, New Delhi, India.²Head of Department, Kriya Sharir, Ch. Brahm Prakash Ayurved Charak Sansthan, New Delhi, India.***Corresponding Author: Vartika Kashyap**

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ABSTRACT

*Dhatu*s are the entities that retain *sharira*, *mana* (mind) and *prana* (life). *Raktadhatu* is the second *dhatu* formed under influence of *agni*. *Agni* is the tissue fire performing transformation at cellular, tissue or organ level which corresponds to the action of enzymatic and hormonal activity. *Rakta* is the chief sustainer of life. All five properties of *panchmahabhuta* are expressed in *rakta*. For complete maturation of red blood cells, i.e. to attain *raktata*, various factors are necessary. After maturation, formed elements of blood perform distinguished functions. Out of these, platelets primarily perform the function of hemostasis. Primary hemostasis indicates the status of functionality of platelets. We are also able to appreciate the impact of various other factors like age, gender etc. on primary hemostasis assessed in present study by bleeding time.

KEYWORDS: *Rakta dhatu*, platelets, bleeding time.**INTRODUCTION**

The *sharir* (body) constitutes of *dosha*, *dhatu* and *mala*.^[1] There are three *doshas*, seven *dhatu*, and three *mala* that constitute *sharira*. *Dhatu*s perform the nutritive and maintenance function. *Rakta dhatu* is the second *dhatu* formed in sequence under the influence of *agni* (enzymatic activity). *Rakta* refers to blood while *rakta dhatu* consists of formed elements of blood i.e. erythrocytes (RBCs), leucocytes (WBCs) and thrombocytes (platelets) which constitute almost half of the volume of blood. In vivo, *rakta* does not exist exclusive of *rasa dhatu*.

Platelet accumulation at a site of vascular injury is a dynamic process. It decides the role of primary hemostasis in checking bleeding. Primary hemostasis is an indicative of platelet functions and their immediate metabolic response as well as vascular response towards an injury.^[2] The hemostatic parameter used for this in present study is bleeding time which is an in vivo hemostatic test of platelet functions.^[3]

The present study was conducted over 150 self declared apparently healthy volunteers in age group 20-40 years irrespective of gender. The study is focused upon ayurvedic and contemporary aspect of *rakta dhatu* w.s.r. to platelets and in vivo response of individual to vascular injury by primary hemostasis in relation to various factors like age, gender, diet and the season in which

bleeding time was assessed.

MATERIAL AND METHOD

Ethical clearance: The proposed cross-sectional study was presented in the form of a synopsis in front of the Institutional Ethical committee.

Literary source: Literary source for the present study was obtained from *Vedic scriptures*, classical texts of *Ayurveda*, sanskrit dictionaries, books related to modern medicine, articles published in reputed journals and also from various media like internet etc. followed by retrospective study of related research works.

Subjects: An observational study was done on 150 self declared apparently healthy individuals by simple random sampling in the age group of 20-40 years in PG Department of Kriya Sharir and IPD of Ch. Brahm Prakash Ayurved Charaka Sansthan, Khera Dabar, Najafgarh, New Delhi-110073 affiliated by Guru Gobind Singh Indraprastha University with prior approval of ethical committee.

Inclusion criteria

1. Healthy subjects of either sex.
2. Age 20-40 years
3. Individuals whose consent has been taken.

Exclusion Criteria

1. Volunteers suffering from any underlying disease.
2. Previous history of bleeding disorders & liver disease.
3. Taking any medication presently.
4. Addiction to any drug abuse or smoking that may hamper the physiological parameters.
5. Pregnancy.
6. Patient having trouble on seeing blood.

Study Design

It is a cross-sectional observational study. The proposed study has been planned in two steps i.e. literary study and Observational study. Observation was done by asking about age, gender, diet of the individual and the season in which Bleeding time by Ivy's method was assessed.

Methodology

1. A brief previous history of volunteers regarding any coagulation disorder, or consumption of any medication like aspirin, anti-histamine, indomethacin, phenothiazine was taken and were excluded from study.
2. Healthy individuals of either sex in age group 20-40 years were selected randomly. The enrolled volunteers were informed about the study and their voluntary participation was solicited. A written consent from volunteers was taken.
3. The haemostatic status of volunteers was assessed using Ivy's method for bleeding time (BT) assessment.
4. The age, gender, diet and the season in which test was done was assessed simultaneously and the results were explored.

OBSERVATION AND RESULT

Etymology of rakta

रज रंजने, तेन रंजनः रागवर्णयुक्तः रागकृत च धातुः रक्तं इत्यर्थो भवति |

Raj ranjane means to stain or something which imparts colour is called as *rakta*. Because this *dhatu* is red in color, it is called *rakta*.

Rakta is the chief sustainer of life. *Rakta* is a *teja* and *jala mahabhuta* predominant *dhatu*. So, one of the properties of *rakta* is *anushansheeta* (neither hot nor cold)^[4] The *pramana* (measure) of *rakta dhatu* is *Sanjali*,^[5] (the maximum volume one can bear in both hands brought together). *Acharyas* dictate maintenance of life processes & supporting the body as the main functions of *rakta*. In contemporary science, life supporting oxygen supply to entire body is conducted by blood. Therefore, it is considered one of the *pranayatna* by *acharyas*.^[6]

Contemporary aspect of rakta dhatu and formed elements w.s.r. to platelets

Rakta vahastrotas play an important role in metabolism of *rakta dhatu*. The principle organs are *yakrita* (liver) & *pleeha* (spleen)^[7] It is necessary to understand the importance and functions of *mula* (root) of *srotas*. Root alongwith supporting a tree also supplies nutrition to the whole tree. It is not the blood that is circulating but plasma is circulating. Heart is controlling the flow of plasma that is why it is *rasavaha strotomula* and not *Rakta vaha strotomula* contrary to what contemporary science believes in.

The formation of blood cells i.e. RBCs (erythrocytes), WBCs (leucocytes) and platelets (thrombocytes) is through *yakrit* (liver) and *pliha* (spleen). In case of any malformation of the *mula*, production of blood cells is impaired. For clinical purposes, liver and spleen are considered to be the controlling authorities. Bone marrow produces the cells but the regulation of production is under the control of liver and spleen. During the contraction of heart some blood is ejected (*vikshipta-vikshepochita karmana*) and then it moves like a pulse on an average of 72 times a minute. This circulation of plasma alongwith blood corpuscles is achieved as a result of contraction and dilatation of cardiac muscles. Thus heart is rightly called the *mula* of *rasavaha srotas* and not *rakta vaha srotas*.^[8]

Platelets

Hemostasis or *rakta stambhan* is the primary function of platelets. Platelets also known as thrombocytes, one of the blood cells, are minute disc like structures having size 1 to 4 micrometres in diameter.^[9] A committed stem cell that produces platelets is called *colony-forming-unit megakaryocyte* (CFU-M). Platelets have three important properties also known as the three A's:^[10]

1. Adhesiveness
2. Aggregation
3. Agglutination

In a healthy blood vessel under normal blood flow, platelets do not adhere to surfaces or aggregate with each other. However, in the event of injury platelets are exposed to subendothelial matrix, and adhesion and activation of platelets begins. Primary hemostasis refers to platelet aggregation and platelet plug formation. Plug formation is a process that includes adhesion, activation and aggregation.

Concept of rakta stambhana (रक्त स्तम्भन)

‘विष्टंभावे’^[11]

The literal meaning of *stambh* is to be fix, establish or erect. And *stambhana* means stiffening, making rigid or immovable, paralysing, stopping, arresting, styptic, astringent

Something which makes the resistance to the movements is called *stambhana*.

The process which surely prevents the mobility and flow of bodily substances is known as *stambhana* or astringent.

Properties of *stambhana dravya*

^[12] शीतं मन्दं मृदु श्लक्ष्णं रूक्षं सूक्ष्मं द्रवं स्थिरम् ।

The properties of *stambhana* or astringent therapy or drugs are cold, sluggish, soft, smooth, rough, subtle, liquid, stable and light.

The properties of *stambhana dravyas* are more or less in close vicinity to properties of *kapha dosha* i.e. *Sheeta*, *Manda*, *Mridu*, *Shlakshan*, *Ruksha*, *Sukshma*, *Drava*, *Sthira*

Relation of *rakta dhatu* and haemostasis

The coagulation factors essential for clot formation are synthesized in liver. Spleen filters & cleanses blood, creates new blood cells in fetal life and stores platelets which are released in case of severe bleeding. *Rakta dharakala* also plays significant role in formation and storage of *rakta dhatu*. The endothelial layers of blood vessels are considered as *rakta dharakala*. The normal endothelium degrades adenosine diphosphate and inhibits platelet aggregation. Injury to endothelium leads to expression of adhesive molecules & procoagulant activities leading to formation of clot.^[13] Clearance of activated clotting factors by Kupffer cells of the liver

also keeps haemostasis under control.^[14] This is an important function of liver in *rakta dhatu* metabolism.

Bleeding time (BT)

Bleeding time is the time interval between skin puncture and the spontaneous, unassisted (without pressure) stoppage of bleeding. Bleeding from small vessels stops automatically within a few minutes due to low pressure in blood vessels alongwith other factors. BT is an in vivo test of platelet function.^[15]

Bleeding time tests the platelet plug formation and the condition of the microvessels i.e. arterioles, capillaries, venules.

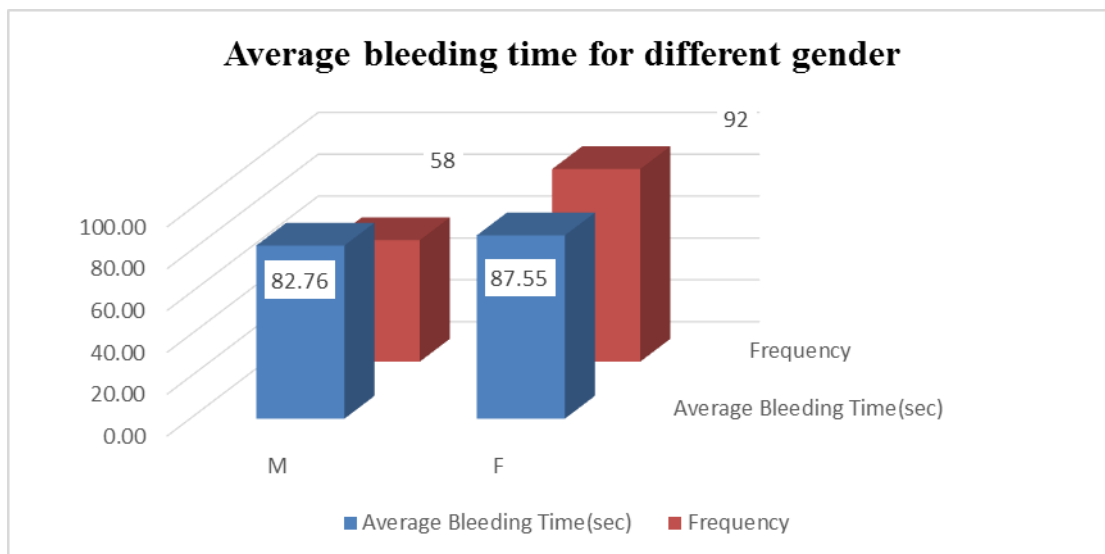
Factors effecting Bleeding time in present study

Gender and Average BT

Table 1.1 Showing average bleeding time in relation to gender.

| Gender | Average Bleeding Time(sec) | Frequency |
|--------|----------------------------|-----------|
| Male | 82.76 | 58 |
| Female | 87.55 | 92 |

We encountered 58 male subjects and 92 female subjects. In male subjects, the average bleeding time was 82.76, whereas in female subjects, the average bleeding time was 87.55. So, it can be said that female have more bleeding time as compared to male.

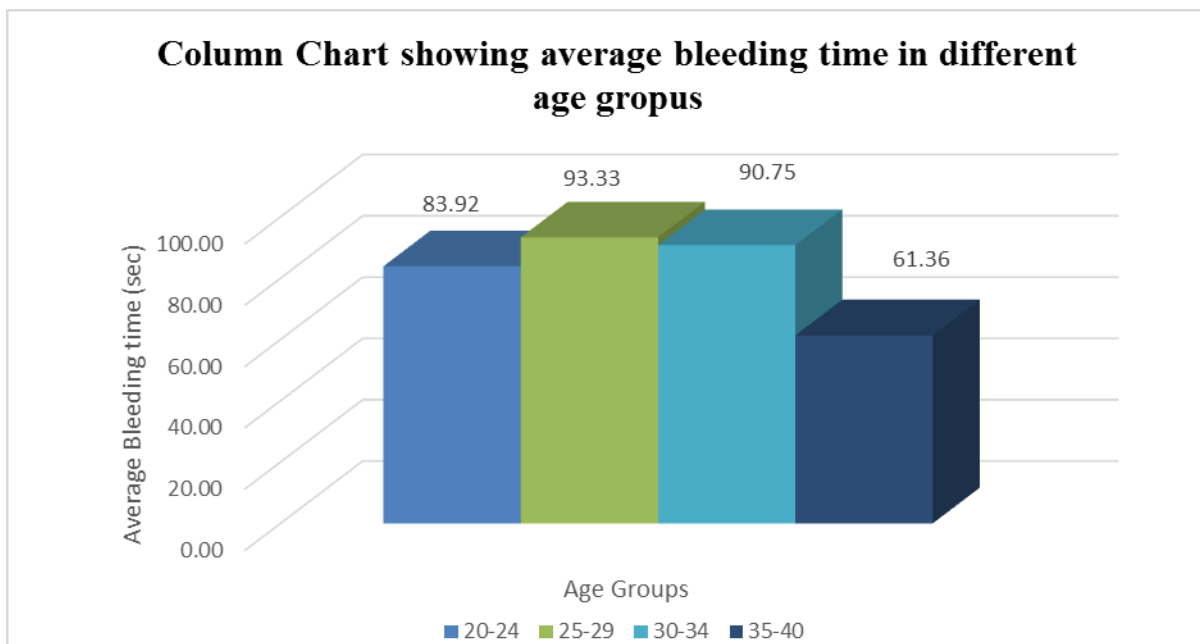


AGE AND AVERAGE BT

Table 1.2 showing average bleeding time in different age groups in years.

| Age Group | Average Bleeding Time (s) |
|-----------|---------------------------|
| 20-24 | 83.92 |
| 25-29 | 93.33 |
| 30-34 | 90.75 |
| 35-40 | 61.36 |

The average bleeding time was found to be maximum in age group 25-29 i.e. 93.33, followed by age groups 30-34 i.e. 90.75, 20-24 i.e. 83.92, and the minimum average BT was found to be in age group 35-40 i.e. 61.36.



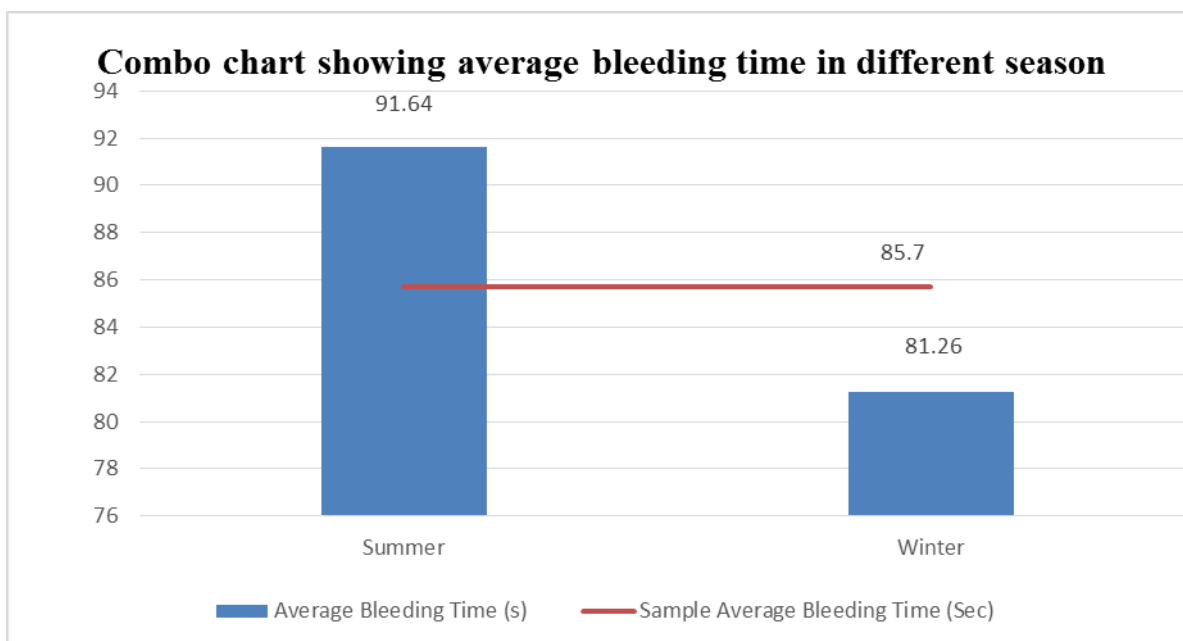
SEASON AND AVERAGE BT

Table 1.3: Showing average bleeding time in different season of study.

| Season | Average Bleeding Time (s) | Sample Average Bleeding Time (Sec) | Frequency |
|--------|---------------------------|------------------------------------|-----------|
| Summer | 91.64 | 85.7 | 64 |
| Winter | 81.26 | 85.7 | 86 |

We assessed Bleeding time of 64 subjects in summer season and in winter season, we assessed bleeding time of 86 subjects. The average bleeding time of individuals in summer season was 91.64 sec., whereas in winter

season the average bleeding time came out to be 81.26 sec. So, it can be interpreted that in summer season, it took more time for bleeding to stop as compare to winter season.

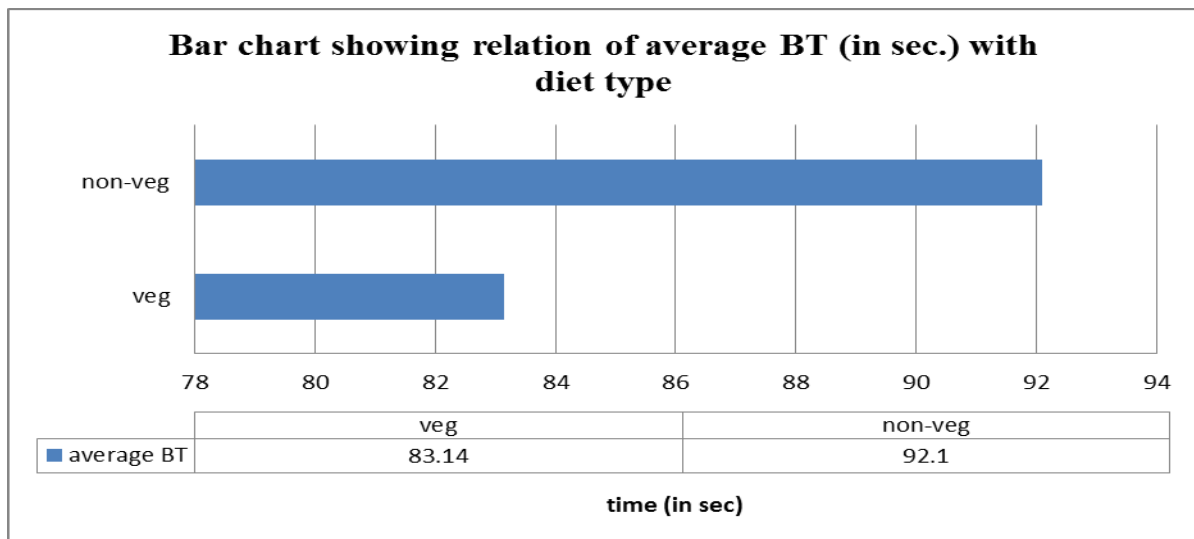


DIET AND AVERAGE BT

Table 1.4: Showing percentage of different diet groups in sample population and average bleeding time.

| Diet | No. of individuals | Average BT (in sec.) | Percentage % |
|----------------|--------------------|----------------------|--------------|
| Vegetarian | 107 | 83.14 | 71.33 |
| Non-vegetarian | 43 | 92.1 | 28.66 |

The average bleeding time is less in individuals having vegetarian diet i.e. 83.14 sec as compared to those taking non-vegetarian diet i.e. 92.1 sec.



DISCUSSION

Rakta dhatu is a *drava dhatu* as described by acharya Sushruta.^[16] *Rakta dhatu* exhibits additional properties i.e. *visrata* (strong smell), *dravata* (fluidity), *raga* (colour), *spandan* (palpation) and *laghuta* (lightness). *Drava dhatus* like *rasa*, *rakta*, *meda* are more prone to change in their attributes as compared to *sthira dhatu* like *asthi*, *mamsa* which are not easily affected by change in diet or lifestyle over short period of time.

The formation of blood cells i.e. erythrocytes, leucocytes and platelets are controlled through *yakrita* and *pliha*. Haematopoietic system is the place where all the types of blood cells are produced. But all the organs pertaining to modern hematopoietic system have not been described under *raktavaha* strotas. The probable reason behind not considering bone marrow as *mula* of *raktavaha* strotas, however being the seat of hematopoiesis is that bone marrow or *saraka majja* is considered as a complete separate *dhatu*. Bone marrow is seat of formation of mature RBCs and other myeloid series cells only.

Besides raw material for erythropoiesis i.e. iron, proteins, folic acid, vitamin B12 etc. is maintained by liver. Further, disposal of dead and senile RBCs is done by spleen, thus justifying their role as of *raktavaha strotas*.

Hemostasis is the physiological process that stops bleeding at the site of an injury while maintaining normal blood flow elsewhere in the circulation. It includes several progressions like vasoconstriction, platelet plug formation, clot formation, clot retraction and clot lysis.

Platelet is the most crucial structure involved in haemostasis. In primary hemostasis, we study the functional aspect of platelet by assessing bleeding time or how quickly platelets are able to seal the site of injury. Here we will be discussing several factors such as age,

gender, season, and diet that had an impact on bleeding time in present study.

Bleeding time is increased in females which may be due to the presence of hormone estrogens because of increased estrogen in females which prolongs bleeding time and decreases plasma fibrinogen level. BT is probably decreased in males due to increased activation and aggregation of platelets.

The average BT in relation to age in present study didn't have any particular order. But it was seen that it was minimum in age group 35-40 years. The subjects in present study are all in *madhyavastha* category according to both acharya Charka and Sushruta.^[17,18] In *madhyamavastha*, dominant *dosha* in body is *pitta*. But the daily wear and tear of body with each passing day or year mentioned by *kshanabhangurvaad siddhanta* of *darshans* (philosophy) and ayurveda and *doshika* fluctuation is inevitable.

In the present study, it is seen that bleeding time is less in individuals having vegetarian diet as compared to those taking non-vegetarian diet. The effect of diet or nutrition on coagulation has not been studied extensively. According to study done on blood coagulation, it has been shown that low protein diet impairs blood coagulation in BHE/cdb in rats. In the groups fed with low protein diets, bleeding time exceeded 15 min, compared to a range of 3-6 min for the groups fed with high protein diets, although no effect on platelet and blood cell numbers was seen by dietary protein.^[19] This study corresponds to the present study done in vitro on bleeding time of human. It is a known fact that non-vegetarian diet is a richer source of protein than vegetarian diet. The present study does not support the fact that low protein diet impairs blood coagulation thus prolonging bleeding time.

The average bleeding time of individuals in summer season was 91.64 sec., whereas in winter season the average bleeding time came out to be 81.26 sec. So, it can be interpreted that in summer season, it took more time for bleeding to stop as compare to winter season.

Blood flow to skin changes with changing environmental temperature. Skin blood flow is only about 3 ml/min/100 g of tissue in cool weather. Great changes from that value can occur if required. When humans are exposed to high heating, skin blood flow may increase manyfold, to as high as 7 to 8 L/min for the entire body. Heat stress increases cutaneous vascular dilation because of deduction of neural activity of vasoconstriction, commitment of a sympathetic active vasodilator system, and direct effects of increased local temperature. Increased vasodilation increases bleeding time while vasoconstriction diminishes bleeding time. According to *Sushruta*, in cloudy, wind and cold weather blood become thick in viscosity and not comes out or comes in small quantity on *shiravedha* (bloodletting).^[20]

CONCLUSION

Rakta refers to blood while *rakta dhatu* consists of formed elements of blood i.e. erythrocytes (RBCs), leucocytes (WBCs) and thrombocytes (platelets) which constitute almost half of the volume of blood. In vivo, *rakta* does not exist exclusive of *rasa dhatu*. Among the formed elements, primary function of platelets is stoppage of bleeding at the site of injury. Platelet accumulation at a site of vascular injury is a dynamic process that integrates chemical and physical cues to promote cellular responses that are coordinated in time and space.

The template bleeding time is a method of assessing an important aspect of primary hemostatic capacity. It measures the time required to produce a functional platelet plug *in vivo*, in which plug occurs through the interaction of platelets with the subendothelial structures of a damaged vessel, leading to the arrest of bleeding. Depending upon platelet function, bleeding time varies in various individuals with factors like age, gender, diet and season in which bleeding time is assessed.

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