



## Review Article

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### HEMOSTATIC PROCEDURES BY SUSHRUTA: A CONTRIBUTION TO PRESENT SURGICAL PRACTICES

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#### ABSTRACT

Management of good hemostasis during surgery is one of the key components which provide multiple advantages to surgical team as well as to the patient for early recovery. Since ancient days lot of importance has been given to hemostasis and further various techniques along with their practices are described in one of the para-surgical procedure bloodletting therapy (*Raktamokshana*) by *Acharya Sushruta*. These hemostatic methods are four *Sandhana* (Binding), *Skandana* (Clotting), *Pachana* (Dusting the *Bhasma*/ ashesh) and *Dahana* (Cauterization). However, selection of the technique depends on the type of surgery, bleeding, haemostatic agent availability and patient condition. In this regard in contemporary medical science described its mechanism in three steps by vasoconstriction, temporary blockage of a break by a platelet plug, and blood coagulation, or formation of a fibrin clot and also various methods of hemostasis along with their indications according type of hemorrhage. The hemostatic methods in Ancient system of Indian medicine has described precisely by *Acharyas*. In present conditions these methods need to analyze about mechanism along with indications as per the conditions of bleeding. The *Sandhana* procedure mainly causes vasoconstriction along with bridging of injured vessel, *Skandana* helps in clotting and *Pachana*, *Dahana* procedures may useful in coagulation blood. Hence it is very important to analyze the hemostatic methods described in ancient Indian science, which will help for better understanding and their practice for the development of medical field in present era.

**Key words:** *Raktasthambaka*, *Hemostasis*, *Sandhana*, *Skandana*, *Pachana*, *Dahana*

#### INTRODUCTION

World is advancing, science is expanding its wings in every field however basic principles in health care still remains unchanged. *Ayurveda* is one of the most ancient systems of the medicine in the world. It is a highly evolved and codified system of life and health science based on its own unique and original concept and fundamental principles. Further this system of medicine considered *Dosha*, *Dhatu* and *Mala* as the root of *Sharira* (body)<sup>1</sup> and these are having its own functions respectively for continuity of life. *Dhatus* are responsible for sustenance of life<sup>2</sup>. *Rakta Dhatu* is one of the most important *Dhatu* without which life is endangered. The *Kshaya* and *Vridddhi* of all the *Dhatu* depends on *Rakta Dhatu*<sup>3</sup>. In this regard famous ancient surgeon *Acharya Sushruta* considered *Rakta* is one of the important *Dhatu* and mentioned as synonymous to life<sup>4</sup>. According contemporary medical science hemorrhage is classified in to three types 1) Arterial hemorrhage 2) Venous hemorrhage 3) Capillary hemorrhage. In arterial hemorrhage the features are bleeding is bright red blood, spurting as a jet which rises and falls in time with the pulse. In Venous hemorrhage is a darker red, a steady and copious flow and in capillary hemorrhage is bright red, often rapid, ooze. Further it is classified in to primary and secondary hemorrhage. If bleeding occurs at the time of injury or operation or within 24 hours or after 7-14 days is called as primary or secondary hemorrhage respectively. In this condition the complete hemostasis is achieved by medical and surgical procedures<sup>5</sup>. The mechanism of hemostasis is complex which involves blood changing from a liquid to a gel by three major steps: 1) vasoconstriction, 2) temporary blockage of a break by a platelet plug, and 3) blood

coagulation, or formation of a fibrin clot<sup>6</sup>. Further achieving complete hemostasis is considered the first stage of wound healing. Generally, heparin like molecule and thrombomodulin are prevent platelet aggregation with nitric oxide and prostacycline in intact endothelial linings of blood vessels. During endothelial injury the endothelial cells stop secretion of coagulation inhibitors but secrete von Willebrand factor (blood glycoprotein involved in hemostasis) which initiate the maintenance of hemostasis.

In this regard *Acharya Sushruta* described management of hemorrhage during the *Siravedhan* (bloodletting therapy)<sup>7</sup> where patient will have the symptoms of *Vata prakopa*, and loss of appetite etc. in excessive hemorrhagic conditions, still if patient is neglected may go into the fatal complication<sup>8</sup>. In this context, only *Acharya sushruta* described four hemostatic measures viz. *Sandhana*, *Skandana*, *Pachana* and *Dahana* which can control the hemorrhagic condition.

#### Hemostatic Measures

Coagulation is the process by which blood changes its state from liquid to gel. It potentially results in hemostasis, the cessation of blood loss from a damaged vessel, followed by repair. There are three essential steps in blood coagulation: 1) A complex cascade of chemical reaction occurs in the blood involving more than a dozen blood coagulation factors in response to rupture of the vessels or damage to blood itself. As a result, the formation of a complex of activated substances takes place which collectively called as prothrombin activator. 2) The prothrombin activator catalyzes conversion of prothrombin in to thrombin. 3) The clot

is formed when thrombin acts as an enzyme to convert fibrinogen into fibrin fibers that enmesh platelets, blood cells, and plasma<sup>9</sup>. In surgery hemorrhage is a common condition where proper hemostatic measures should be taken as per situation and instantaneously. In this regard various methods and procedures are developed in the contemporary medical science. In ancient Indian surgery also explained various haemostatic measures by *Acharya Sushruta* which are *Sandhana*, *Skandana*, *Pachana* and *Dahana* along with protocol for using these methods. Among those *Skandana* is first line of treatment of hemorrhage during surgery followed by *Sandhana*. If bleeding is still not controlled, then *Pachana* and *Dahana Karma* are to be applied respectively<sup>10</sup> or these methods should be used according to the type of bleeding and which are very much similar to the above explained mechanism according to contemporary medical science. In *Ayurveda* the hemostatic measures were explained briefly and these to be analyzed properly with present conditions which help for better understanding of the mechanism of hemostasis in the ancient surgical period.

#### **Sandhanakarma**

It literally means uniting<sup>11</sup>. In this context *Acharya Sushruta* described very precisely about procedure that uses the *Kashaya* (astringent) property drugs<sup>12</sup>.

#### **Present developments**

Bandaging, tying, suturing procedures suturing material also use to stop bleeding, its ties allow for skin to be joined back together allowing for platelets to start the process of hemostasis at a quicker pace. Application of a haemostatic clamp to a blood vessel and then ligation has to be done with a surgical ligature.

#### **Drugs**

Lodhra (*Symplocos racemosa*), Madhuka (*Madhuka indica*), Priyangu (*Callicarpa microphylla*), Patanga (*Caesalpinia sappan*), Sarjarasa (*Shorea robusta*), Rasanjan (Extract of *Berberia aristata*), Salmalipushpa (*Salmalia malbarica*), Masa (*Vigna mungo*), Yava (*Alhagi camelorum*)<sup>13</sup>.

#### **Mode of Action**

When mucous membrane or tissue exposed to astringent drugs if taken internally may cause shrinkage and are often used to check discharge of blood serum or mucous secretions. This can be utilized in sore throat, hemorrhages, diarrhea, or with peptic ulcers. Similarly, externally applied astringents cause mild coagulation of skin proteins, dry, harden, and protect the skin.

In present practices some of the astringent drugs like Alum [KAl(SO<sub>4</sub>)<sub>2</sub>] is common drug administered as a local application to stop the bleeding in dental surgeries<sup>14</sup>. This drug was described as *Phatika* in *Ayurvedic* classics having the mainly astringent property and useful in the bleedings<sup>15</sup>. This drug causes in shrinking the gingival tissues than epinephrine and it shows good tissue recovery, although its tissue retraction and hemostatic abilities are limited. However, alum has been recommended as a hemostatic agent and can be used as a substitute for epinephrine because it is safer and has fewer systemic effects<sup>14</sup>. Similarly, the astringent drugs described in the *Sandhanakarma* may have the effects like vasoconstriction or stimulating the prothrombin net formation which helps in trapping the platelets at the site of injury or absorb water from the tissue or helps in reducing the bleeding time.

#### **Mode of Administration**

These drugs can be administered internally and externally in the form powder for dusting over the injury, in the form of decoction for external dousing of the affected area.

#### **Possible Indications**

This procedure may be useful in capillary hemorrhages, tropical hemorrhages like abrasions, hemorrhage due to systemic illness like intracranial bleeding, bleeding disorders (*Raktapitta*) like thrombocytopenia etc.

#### **Limitations**

Hemorrhage is due to rupture of big vessels and indications of surgical intervention.

#### **Skandanakarma**

It means clotting or coagulation of blood<sup>16</sup> with the help of *Hima Dravya* (ice-cold things).

#### **Drugs**

Ice and cold items like water<sup>17</sup>

#### **Mode of Action**

The ice and cold materials constricts superficial blood vessels, allows coagulating the blood and helps in formation of the superficial tissue layers into a crust at the site of injury.

#### **Mode of Administration**

Use as external application.

#### **Possible Indications**

Visible bleedings and contusions

#### **Limitations**

This procedure is useful in external bleeding as primary therapy and limited to local injured area.

#### **Pachana**

It means ripening or digestive measures<sup>18</sup> by using the *Bhasmas* (burned ash powder) to achieve hemostasis.

#### **Drugs**

In this context *mruduksharas* (mild potency alkali drugs) like *Shanka*, *Shukti*, *Kapardhika*, *Spatika bhasmas* can be considered<sup>19</sup>.

#### **Mode of Action**

According to the preparation it can be considered as caustic material obtained from the ashes after distillation and are mostly alkaline in nature. The application or dusting of the *Ksharas* in the affected area may digest protein of the local tissue by its property which stimulates coagulation of the blood. By its mode of action this method might be coined as *Pachana*. This procedure can be understood clearly while describing *Ksharakarma* in the management of hemorrhoids by *Acharya Sushruta*. In this disease after application of *Kshara* over the hemorrhoid, it becomes reddish black colour (*Pakwa jambuphal varna*) after some period<sup>20</sup>, which indicates that *Kshara* get absorbed through anal mucosal membrane and digests tissue protein later causes the coagulation of blood in the hemorrhoidal plexus. Hence applied area was turned to reddish black colour and hemostasis can be achieved in the hemorrhoids.

#### **Mode of Administration**

This can be used internally and externally as tropical application or dusting on the affected area.

#### **Possible Indications**

This procedure may be useful in capillary hemorrhages, oozing of the blood from sub-mucosal layer (eg. hemorrhoidal plexus), tropical hemorrhages like abrasions, incisions or hemorrhage due to systemic illness.

### Limitations

Hemorrhage is due to rupture of big vessels and indications of surgical intervention.

### Dahana

It means Burning combustion, conflagration, heat, cauterizing and cautery<sup>21</sup>. This is considered to be superior to above mentioned three procedures, if hemostasis is not achieved *Agnikarma* is the definitive option in controlling the bleeding<sup>22</sup>.

### Instruments

*Agnikarma shalaka*, Electric thermal cautery.

### Mode of Action

This procedure increases the local temperature which causes coagulation or damage of tissue protein and it may lead to constriction of blood vessels. Further it helps in clotting of the blood.

### Mode of Administration

Use as external application

### Possible Indications

Cauterization is useful for visible bleeding especially in capillary hemorrhage.

### Limitations

Hemorrhage due to rupture of big vessels and internal hemorrhages.

## DISCUSSION

In ancient classics of *Ayurveda* mentioned the blood is having the vital role to maintain the life. During the surgeries or accidental injuries or bleeding disorders, loss of blood may result in various complications. In this regards various advanced new hemostatic methods, procedures and drugs being discovered in modern science. However, in the *Ayurveda classics Acharya Sushruta* given prime importance and precisely mentioned four basic hemostatic methods *Sandhana*, *Skandana*, *Pachana* and *Dahana*. These methods to be analyzed with present hemorrhagic condition for better practical applicability.

The mode of action of the *Sandhana* procedure can be understood as a vasoconstriction and repairing of the damaged blood vessels. Broadly it can be used in capillary hemorrhages, tropical hemorrhages and systemic internal hemorrhages. Moreover, the drugs described in *Vranaropaka* (promoting wound healing) should be analysed in perspective of hemostasis as in wound healing the first stage is clotting of the blood and these drugs may cause initially hemostasis afterwards it promotes wound healing. The *Skandana* procedure helps only in the constriction of the vessels and clotting of the blood. Similarly, *Pachana* procedure may cause the homeostasis by coagulating and digesting the tissue protein with the help of *Bhasma*. In this context *Bhasmas* can be consider as the ashes which is having mild alkali property hence these are useful controlling the bleeding. Lastly procedure *Dahana* means cauterization of blood vessel which causes coagulation or damage of tissue protein and hemostasis will be achieved. In this way *Acharya Sushruta* has pointed out that hemorrhage can be arrested by apposition of the cut edges with stitches, application of styptic decoctions, by cauterization with chemicals or heat.

## CONCLUSION

Hemorrhage is a common problem which can be life threatening on many occasion if not manage actively and effectively. Therefore, management of hemorrhage has got major importance. In the present contemporary medical science various methods of hemostasis are developed. However, procedures described in Ancient Indian sciences by Acharya Sushruta are simple, easy and less invasive still more effective and having fewer complications. Also these procedures can be used in remote areas where there is scarcity of resources with maximum cost effectiveness. Hence hemostatic procedures like *Sandhana*, *Skandana*, *Pachana* and *Dahana*. can be implemented successfully in current surgical practices.

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