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Haemorrhagic Shock and its Management in *Sushruta Samhita*

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ABSTRACT

Ayurveda, recognized as the oldest holistic system of medical science, holds a comprehensive understanding of health and disease management. Contrary to the common misconception that *Ayurveda* is not suitable for emergencies and is merely an alternative therapy, ancient *Ayurvedic* texts provide substantial evidence of its applicability in acute medical conditions, including haemorrhagic shock. This narrative is notably supported by the works of *Acharya Sushruta*, often referred to as the father of surgery. He has not only described the importance of blood but also mentioned the measures to arrest bleeding. It shows that he was very well aware of the fact that severe haemorrhage may lead to death by hypovolemia. Also, while describing complications of traumatic wounds *Acharya Sushruta* has mentioned the signs and symptoms of shock. Haemorrhage may be due to injury to the liver, spleen, bone fracture, hemothorax, vascular injury, or severe bleeding on the table during surgeries which may lead to hemorrhagic shock during surgical procedures, he stresses the importance of maintaining hemostasis to prevent severe intraoperative bleeding and its complications. He outlined various methods to control bleeding, including the use of medicinal herbs, cauterization, and surgical techniques to ligate blood vessels. The *Sushruta Samhita*, details over 300 surgical procedures and 120 surgical instruments, showcasing advanced surgical knowledge. His surgical methods for managing wounds and fractures reflect a deep understanding of anatomy and surgical principles, many of which are still relevant today. so in this article, a review of ancient methods of management of hemorrhagic shock as described by *Sushruta* is being attempted.

Key Words *Haemorrhagic shock, Sushruta, rakta, Emergency management, Ancient methods*

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INTRODUCTION

The term "shock" refers to the clinical condition that occurs when there is insufficient blood flow to the tissues, leading to hypoxia and cellular dysfunction. This dysfunction can lead to a shift from aerobic to anaerobic metabolism, resulting

in lactic acidosis. The significance of blood, or "*Raktadhatu*," in the field of life science and particularly in surgery is emphasized in ancient texts. According to *Acharya Sushruta*, the proper functioning of blood is vital for sustaining life, and the body itself is rooted in *Rakta*, that is why it must be protected at all costs. The *Sushruta*

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Samhita and other texts on *Shalya tantra* provide numerous methods for nourishing and maintaining *Raktadhatu* and controlling bleeding. *Acharya Susruta* was the first to categorize and describe strategies for controlling bleeding under a specific category called "*Chaturvidha Rakta Sthambhana Upayas*."

Haemorrhagic shock is a common form of hypovolemic shock, characterized by decreased preload due to hypovolemia, leading to increased sympathetic activity and vasoconstriction. This vasoconstriction results in reduced mean arterial pressure, leading to ischemia, which can cause multiple organ failure, ARDS, hepatic failure, myocardial insufficiency, severe decrease in systemic vascular resistance, and ultimately, death. The term "haemorrhage" describes the loss of blood from a broken blood vessel. There are three different kinds of hemorrhage: capillary, venous, and arterial. Venous bleeding is darker in color and flows gradually, but capillary bleeding is bright red and frequently oozes quickly. Arterial bleeding is bright red in color and spurts in time with the pulse. Furthermore, the duration of a hemorrhage determines whether it is classed as acute, chronic, or acute chronic hemorrhage. The general treatment for haemorrhage aims to achieve two main outcomes: stop the blood loss and replenish the lost blood. Similar concepts are detailed in *Ayurvedic* texts as well.

Hemostasis:- The process of coagulation, which can stop blood loss from a damaged vessel and lead to subsequent repair, is the transformation of

blood from a liquid to a gel. Three crucial steps are involved in the process:

- 1) when a blood artery ruptures or the blood itself is damaged, a complicated series of chemical events involving over a dozen blood coagulation factors takes place in the blood. As a result, a complex of activated molecules known as a prothrombin activator is created.
- 2) The transformation of prothrombin into thrombin is catalyzed by the prothrombin activator.
- 3) The thrombin enzyme breaks down fibrinogen into fibrin strands that entangle platelets, red blood cells, and plasma, forming the clot. Position, packing, and pressure all contribute to hemostasis.

Hemostasis is achieved by pressure, packing, position and rest, operative procedures such as suturing, knotting, and cauterization, as well as by the use of local hemostatic agents like gelatin sponge, oxidized cellulose, collagen sponge, microfibrillar collagen powder, topical thrombin, bone wax, gelatin matrices, topical EACA, and topical cryoprecipitate.

Importance of rakta in sushruta samhita :-

देहस्य रुधधरं मूरं रुधधरेणैव धार्ययते । तस्माद्यरेन संरक्ष्यं रक्तं जीव इतत स्थितत् ॥ [. 14/44]

"Blood is the essence of life, nurturing vitality and sustaining existence. Its preservation is of utmost importance. The three fundamental bio-elements - *Vata*, *Pitta*, and *Kapha* - form the foundation of the body, much like a sturdy house resting on three pillars. When these elements

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become imbalanced, they can lead to detrimental consequences. Similarly, the fourth elemental force, *Shonita* (blood), plays a crucial role throughout the body's lifecycle, from its creation to its demise, and must be respected and protected accordingly.

"Outcomes of Haemorrhage :-

धातुयात्स्रुते रक्ते मन्द सञ्जायतेऽनर् । नवनश्च नरं
कोनंयातत तस्मात्प्रयत्नत् ॥ [. 14/37]

"Severe blood loss triggers a cascade of physiological imbalances, including impaired tissue function (*kshaya of dhatus*), diminished appetite, and a disturbed state of *Vayu (Vaata)*, leading to a state of bodily disequilibrium. *Vata* vitiation further exacerbates the situation by depleting *rakta dhatu*, resulting in a decreased red blood cell count. The cold and rough properties of *Vata* disrupt the *rakta dhatu's* vital function of nourishing and warming the body, ultimately leading to a weakened and fatigued state. The clinical manifestations of hemorrhage include:

- Impaired tissue function
- Decreased appetite
- Vayu disturbance
- Rakta dhatu depletion
- Decreased red blood cell count
- Cold and rough Vata properties disrupting bodily warmth and nourishment
- Weakness and fatigue.

अततप्रवत्तयते । तदततप्रवत्तुं
शिरोऽशितानमान्मयमधमन्थततशमरप्रादि ायवं
धातुयमिन्नकं नाघातमेकाङ्गवकारं तष्टृणादाहौ

हहक्कां कासं श्वासंनान्णुडुरोगंमरणंचानादयतत ॥ [.
30/14]

"The *Shusruta Samhita Sutra Sthana*, a foundational *Ayurvedic* text, devotes an entire chapter (Chapter 14: *Shonitavarnaniyamadhyayama*) to the significance of blood and the consequences of acute hemorrhage. Remarkably, the ancient *Ayurvedic* scholars recognized many complications of severe blood loss that align with modern medical understanding. These include:

- Headache
- Visual disturbances (blindness, *Adhimantha*, *Timira*/partial blindness)
- Tissue depletion or loss
- Neurological symptoms (convulsions, paralysis, hemiplegia)
- Sensory disturbances (burning sensation, loss of hearing)
- Respiratory issues (dyspnea, cough)
- Anemia
- Altered mental status (unconsciousness, dizziness)
- Life-threatening outcomes (death)

The *Ayurvedic* scholars' understanding of the severe consequences of heavy bleeding demonstrates a profound insight into human physiology and pathology, echoing the principles of modern medicine.

"***Shirobhitapa* / Headache (heating up of head), *Aandhyam* / blindness along with other ocular features like *adhimantha* (severe pain in**

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eyes or glaucoma) and *timira* (cataract) – Haemorrhage result in decreased blood flow due to which hypoxia occurs which leads to severe headache, tissue death. The stress response triggered by blood loss may lead to such symptom and overexertion.

***Dhatu kshaya* / body tissues – *Rakta*,** a vital bodily tissue, plays a crucial role in sustaining the body's functions. A deficiency in *Rakta* can severely compromise the body's ability to deliver essential nutrients and oxygen, leading to a cascade of debilitating effects. These include:

- Cognitive impairment and decline
- Attention deficits and disorders
- Emotional instability and mood disturbances
- Motor coordination difficulties
- Sensory impairments (visual and hearing)
- Generalized weakness and fatigue

The underlying cause of these symptoms is the reduced blood flow and oxygenation capacity, which disrupts the body's delicate balance and function. This highlights the critical importance of maintaining healthy *Rakta* levels to ensure overall well-being."

***Aakshepaka* / Seizure –** Ischemic changes precipitate seizures when normal blood flow is disrupted, leading to oxygen deprivation and neuronal death.

***Ekanga vikaar* / Paralysis and *Pakshaghat* / hemiplegia –** After haemorrhage, ischemic cascade initiated by blood loss will result in neuronal death, irreversible loss of neuronal

function, and finally loss of function or neurological symptoms.

***Trishana* / Thirst –** Haemorrhage reduces the volume of blood and interstitial fluid, which activates parts of the autonomic and endocrine nervous systems and results in the development of behaviors related to obtaining and consuming fluids.

***Daha* / Burning sensation –** The body frequently "clamps down" on limb blood arteries when there is blood loss in order to reroute blood to vital organs. Burning or tingling in the hands or feet may result from the limbs losing oxygen.

***Hikka* / Hiccups, *Kasa* / Cough, *Shwasa* / Asthma dyspnoea–** Low blood volume means low circulating body fluid which means reduced oxygen carrying capacity and acidosis.

***Pandu* / Anaemia–** Blood loss from massive bleeding may cause acute and severe anemia.

Drugs to maintain Hemodynamics :-

Priyangu (*Callicarpa microphylla*), *Patanga* (*Caesalpinia sappan*), *Sarjarasa* (*Shorea robusta*), *Rasanjan* (Extract of *Berberia aristata*), *Salmalipushpa* (*Salmalia malbarica*), *Masa* (*Vigna mungo*), *Lodhra* (*Symplocos racemosa*), and *Yava* (*Alhagi camelorum*) are among the plants.

Mode of Action :-

Astringent medications, which are frequently used to control the release of blood serum or mucous secretions, can produce shrinking when applied topically to mucous membranes or tissue. This can be used for diarrhea, peptic ulcers,

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bleeding gums, and sore throats. Similar to this, astringents administered externally dry, firm, and protect the skin while also somewhat coagulating the skin's proteins. Currently, certain astringent medications, such as alum [$KAl(SO_4)_2$], are frequently applied locally to control bleeding during dental procedures. Ayurvedic classics identified this medication as *sphatika*, primarily having astringent properties and effective in healing bleedings. Although its tissue retraction and hemostatic qualities, this medication causes the gingival tissues to shrink more than those caused by epinephrine and exhibits strong tissue recovery.

Mode of Administration :-

These medications can be used both orally and externally. Powder can be used to dust an injury, and decoction can be used to saturate the affected region externally.

Primary treatment of haemorrhage :-

Methods of Bandaging (*Bandhana Karma*)
Acharya Sushruta describes fourteen different types of bandaging techniques that can be used to cover nearly every area of the body. *Kosha Bandha* (for the thumb and fingers), *Dama Bandha* (sling bandage), *Swastika Bandha* (spica bandage for joints, intermediate region of eye brows and breasts, palms, soles, ears), *Anuvellita Bandha* (spiral bandage for extremities), *Muttoli Bandha* (winding bandage for cervical region and penis), *Mandala Bandha* (circular bandage for round parts of body), *Sthagika Bandha* (stump bandage for dressing of tip of thumb, fingers, and

penis), *Yamaka Bandha* (twin bandage for double wounds), *Khatva Bandha* (four tailed bandage for jaw, temporal region, cheek), *Cheena Bandha* (eye bandage for corners of eyes), *Vibandha Bandha* (multi-tailed bandage for wounds of back)

Management of Haemorrhagic shock according to the different conditions :-

1. *Bhinna Vrana* (Wound with Excessive Bleeding)

In cases of *Bhinna Vrana*, excessive bleeding (*Rakta Pravrutti*) may occur from the rectum (*Guda Marga*), urine (*Mutra Marga*), or nose (*Nasa Marga*). To prevent complications, the following treatments are recommended:

A. Rectal Bleeding:

Administer *Vidarigandhadigana kashaya* with *draksha*, *grutha*, and *madhu* as an *Asthapana basti* (enema).

Use the same drugs with *grutha* and *ksheera* (boiled together) as an *Anuvasana basti* (enema).

Prepare a *Niruha basti* (enema) with *Priyangu*, *Rodra*, *Anjana*, *Gairika*, *Utpala*, and other drugs in equal parts, mixed with *grutha* and *sheeta jala*.

After *Ksheera Bhojana* (diet), administer *Anuvasana basti* with *Yasti Madhu Sadita Grutha*.

B. Urinary Bleeding:

Administer *Uttara basti* (enema) with *Priyangu*, *Rodhra*, *Anjana*, *Utpala*, *Gairika*, *Rakta Chandana*, and other drugs.

C. Nasal Bleeding:

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Adopt *Raktapitta Chikitsa* (treatment for nasal bleeding).

D. *Udara Beda* (Abdominal Distension)

When *Medo Varti* (fatty tissue) protrudes, prepare a *Kshara* (alkaline paste) from *Kashaya dravyas* and *Mrit* (beeswax). Fill the *Varti* with the paste, tie with a thread, and cut above the ligated part using *Agni Tapta Shalaka* (cauterization). Apply *Madhu* (honey) and perform *Bandhana* (binding) for the wound.

2. *Sira marma viddha lakshana* :-

When a *sira* (vessel) is injured, bleeding occurs, and the blood resembles *Indra Gopa* (a type of insect). To manage the bleeding:

A. *Agni Karma*: Perform cauterization using *sneha* (a type of oil or ghee).

B. *Atisrava Nirodha Karmas*: Adopt measures to control excessive bleeding.

C. *Siravyadha Karma*: After the initial treatment, if excessive bleeding (*Atiraktasrava*) persists, apply the following:

- Sprinkle a *churna* (powder) made from:

- *Rodhra*
- *Madhu* (honey)
- *Priyangu*
- *Patanga*
- *Gairika*
- *Sarja Rasa*
- *Rasanjana*
- *Shalmalipushpa*
- *Shanka*
- *Shukti*
- *Masha*

- *Yava*

- *Godhuma*

- Press the powder into the wound using your fingertips.

- Alternatively, sprinkle powder made from:

- *Bark of Sala, Arjuna, Arimeda, Meshashrunji, Dhava, and Dhanvana*

- *Ash of Kshauma*

- Powder of *Samudraphena* and *Laksha*

D. *Bandana*: Tie a bandage tightly using the *dravya* (substances) mentioned in *Sushruta Samhita*, 18th chapter.

E. Cold Therapy:

- Cover the patient with a moist cloth in a cold room.

- Apply cold poultices and pour cold liquids.

- Alternatively, burn the area with *kshara* (alkaline paste) or *agni* (fire) as described.

F. *Rakta Pana*: Administer *Rakta Pana* (a drink) made from:

- *Ena Harina*

- *Aurabra*

- *Sasha*

- *Mahisha*

- *Varaha*

- *Ksheera Bhojana* (a diet of milk)

3. *Post-Jalaukavacharana* (*Leech Therapy*)
Bleeding Management

If excessive bleeding (*Atiraktasrava*) occurs after *leech* therapy:

A. *Pariseka*: Perform a gentle pouring of:

- *Sheeta jala* (cool water)

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- *Kashaya dravyas* (decoction of medicinal plants)

B. *Pradeha*: Apply a paste made from:

- *Madhura* (sweet)
- *Snigdha* (unctuous)
- *Sheeta* (cooling) *dravyas* (medicinal substances)

C. *Dalhana's* Method: To stop the bleeding, *Dalhana* recommends:

- *Seka*: Pouring with *sheeta jala* (cool water)
- *Bandhana*: Applying a bandage with *vastra* (cloth)

4. Blood ingestion :-

Ayurvedic Approach to Blood Loss and Transfusion

Ayurveda follows the principles of *samnya* (generalization) and *vishesha* (specialization). In cases of *rakta kshaya* (blood deficiency) or blood loss, the traditional approach is to replace it with blood. In critical cases of hemorrhage, *Ayurvedic* practitioners would administer whole blood from animals like deer, antelope, camel, rabbit, buffalo, or boar for oral consumption. This concept, pioneered by *Acharya Sushruta*, aimed to minimize complications considering the resources available at that time.

Evolution of Blood Transfusion

This ancient practice laid the groundwork for modern blood transfusion. Additionally, *Ayurvedic* texts describe alternative methods of blood administration, such as:

Rakta basti (blood enema) for conditions like *pandu* (anemia) or *raktaj* diseases (blood disorders) like *yonig* (gynecological disorders) Research and Efficacy

Research has validated the effectiveness of these methods in various scenarios, including:

- Iron deficiency anemia
- Thalassemia

Further research is needed to explore the potential benefits of these *Ayurvedic* approaches in modern medicine.

5. *Shiravedhana- Shiravedhana*: Counter-Cutting Technique

In cases of accidental or therapeutic cutting of a vein, the bleeding vein should be counter-cut once again near the original cut area. This technique, known as *Shiravedhana*, aims to:

Control bleeding

Prevent further blood loss Promote hemostasis (blood clotting), By making a small counter-cut near the initial cut, the bleeding vein can be effectively managed, and the risk of excessive blood loss reduced. This ancient technique demonstrates the ingenuity and practicality of *Ayurvedic* medical practices.

6. Ancient Indian Haemostasis Techniques

Acharya Sushruta, a renowned ancient Indian surgeon, described four haemostasis techniques to control bleeding during surgery:

A. *Skandana* (Thickening or Congealing): The first line of treatment for hemorrhage, which involves thickening or congealing the local blood to stop bleeding.

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B. *Sandhana* (Contraction): If bleeding persists, *Sandhana* is applied, which involves contracting the affected part to reduce blood flow.

C. *Pachana* (Chemical Cauterization): If bleeding continues, *Pachana* is used, which involves applying chemical substances to the wound to promote clotting and stop bleeding.

D. *Dahana* (Heat Cauterization): The final method, *Dahana*, involves applying heat to the wound to cauterize and stop bleeding.

These techniques, collectively known as *Raktasrava Nirodha Karma* (Methods of Management of Hemorrhage), demonstrate the advanced understanding of haemostasis in ancient Indian surgery.

A. *Skandana*- The Ayurvedic technique of *Skandana* involves using cold substances or medications to promote blood coagulation and clotting. This approach is used initially to control bleeding. Here's a breakdown of the method:

Skandana Technique:

1. Cold Medications: Apply cold medications or materials to the bleeding area to encourage clotting.
2. Cold Therapies (*Sheetal Upchar*): Use cold poultices, ice, or cold packs to increase blood viscosity and vasoconstriction.
3. Cooling Techniques: Cover the patient's body or wound with a moist cloth, pour cold liquids, or keep them in a cool atmosphere to promote clotting.

Benefits:

- Increases blood viscosity

- Promotes vasoconstriction
- Encourages clotting
- Controls bleeding

B. *Sandhana* :- An Ayurvedic technique to control bleeding by connecting wound margins, using astringent medications, and promoting union. If *Skandana* (cold therapy) fails to stop bleeding, *Sandhana* is employed. Astringent drugs and substances are used to:

- Constrict and unite wound margins
- Reduce internal bleeding and mucous secretions
- Shrink tissues and membrane. Various herbal powders and extracts, like *Lodhradichurna* and *Saladichurna*, are applied as wound dressings to promote hemostasis. These plant-based substances have been used globally in traditional medicine to control bleeding, leveraging bioactive compounds like tannins, saponins, and glycosides to stimulate coagulation, suppress fibrinolysis, and promote platelet aggregation.

Sandhana: connecting wound margins to control bleeding.

- Astringent medications: constrict and unite wound margins
- Herbal powders and extracts: promote hemostasis and bleeding control.
- Bioactive substances: tannins, saponins, glycosides, and phenolics.
- Traditional medicine: global use of plant-based substances to control bleeding.

C. *Pachana*- *Pachana* is an Ayurvedic technique used to achieve hemostasis through ripening or digestive measures, employing *Bhasmas* (burned

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ash powder) or caustic materials like ash or alkali. This method is utilized when *Sandhana karma* (wound contraction) fails. Here's a breakdown of *Pachana*:

Pachana Technique:

1. *Bhasmas*: Burned ash powder is used to promote blood coagulation and hemostasis.
2. Coagulation Effect: Drugs with coagulation properties are applied to adhere the wound and stop bleeding.
3. Alkaline Preparations: Alkalis and alkaline substances, like Ksharas, are used to:
 - Increase blood coagulation
 - Break down local tissue protein (when applied topically or by dusting)
4. Mechanism of Action: Alkaline preparations produce liquefactive necrosis by:
 - Denaturing proteins
 - Saponifying fats in the wound or ulcer .

D. Dahana- *Dahana* is an Ayurvedic technique that involves burning, combustion, heat cauterization, or cautery to achieve hemostasis. It is considered superior to the previous three methods (*Skandana*, *Sandhana*, and *Pachana*) and is the definitive option when they fail to control bleeding. Here's a breakdown of *Dahana*:

Dahana Technique :-

1. Heat Cauterization: Applying direct heat externally to coagulate and constrict veins, achieving hemostasis.
2. *Agnikarma*: The use of heat or fire to control bleeding, considered the most effective method.

3. Electric Cautery: In modern medical science, electric cautery is used to achieve the same effect as *Dahana*.

Indications:

- Failure of previous methods (*Skandana*, *Sandhana*, and *Pachana*) to control bleeding
- Severe bleeding that requires immediate attention

Dahana is an ancient *Ayurvedic* technique that has been adapted into modern medical science through electric cautery, demonstrating the evolution of medical practices.

DISCUSSION

The *Sushruta Samhita*, an ancient *Ayurvedic* text, provides valuable insights into the management of hemorrhagic shock, a life-threatening condition characterized by severe blood loss leading to hypovolemia and inadequate tissue perfusion. The text describes various methods to control bleeding, including *Skandana* (thickening or congealing), *Sandhana* (contraction), *Pachana* (chemical cauterization), and *Dahana* (heat cauterization).

The paper highlights the importance of *rakta* (blood) in *Ayurvedic* medicine, emphasizing its role in sustaining life and maintaining overall health. The authors discuss the consequences of severe blood loss, including tissue depletion, cognitive impairment, and neurological symptoms, which align with modern medical understanding.

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The paper also explores the use of herbal remedies and astringent medications to control bleeding, as well as the application of cold therapies and poultices to promote clotting. Additionally, it touches upon the concept of blood transfusion in *Ayurvedic* medicine, where whole blood from animals was administered orally to replace lost blood.

The authors emphasize the significance of *Sushruta's* contributions to the field of surgery and hemostasis, noting that his techniques, although ancient, demonstrate a deep understanding of human physiology and pathology. The paper concludes by highlighting the relevance of *Ayurvedic* principles in modern medicine, particularly in the management of hemorrhagic shock

- *Ayurvedic* medicine offers valuable insights into the management of hemorrhagic shock.

- *Sushruta Samhita* describes various methods to control bleeding, including *Skandana*, *Sandhana*, *Pachana*, and *Dahana*.

- *Rakta* (blood) plays a crucial role in sustaining life and maintaining overall health in *Ayurvedic* medicine.

Herbal remedies and astringent medications can be effective in controlling bleeding. *Ayurvedic* principles can complement modern medical approaches in managing hemorrhagic shock.

Overall, the paper provides a comprehensive review of the management of hemorrhagic shock in *Ayurvedic* medicine, highlighting the significance of *Sushruta's* contributions and the

relevance of *Ayurvedic* principles in modern medical practice.

CONCLUSION

Surgeons frequently encounter haemorrhage, ranging from mild to severe, in their daily practice. A thorough review of the literature reveals that *Ayurvedic* surgeons, particularly *Acharya Sushruta*, have long understood and documented the primary objectives of haemorrhage management: achieving haemostasis and restoring lost blood. The haemostatic techniques described in the classical texts of *Shalya tantra*, specifically the *Chaturvidha Rakta Sthambhan Upaya*, remain highly scientific, practical, and effective even in the 21st century, an era dominated by advanced technologies. Complete hemostatic measures are what the methods of *Skandana*, *Sandhana*, *Pachana*, and *Dahana* include. Surgeons who are knowledgeable about these techniques can efficiently manage bleeding, even with limited resources.

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