SUŚRUTA’S CONTRIBUTIONS TO THE FUNDAMENTALS OF SURGERY

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Although it is not possible to enumerate all the achievements of Suśruta in this short review, it is apparent that surgical practice of Suśruta was of a very high order. Moral and professional qualities demanded of a practising surgeon were very exacting. Surgical training imparted to the students was of very original character designed to create active interest in the subject with highest regard to the welfare of the patient. The patient was to be cared like one’s own son. Exhaustive and precise directions given by him regarding the various surgical procedures, management of wounds and fractures are similar to those considered best today. He was conversant with the use of 750 drugs in various diseases. His contributions to plastic surgery, hemostasis and burns are of great fundamental importance.

The last few decades have witnessed a phenomenal progress of surgery. Operations of a magnitude not dreamt of a generation ago are commonplace now. No organ of the body is now exempt from the attacks of a surgeon’s knife. It has been possible only due to the incorporation of the advances in allied sciences in the practice of surgery. These advances have greatly increased our understanding of the basic physiology of our body and thus contributed to the safety of the surgical procedures. Amongst them anaesthesia, antiseptic and aseptic techniques are the important landmarks in the history of surgery.

With better understanding and increased knowledge due to these advances, certain fundamental principles have been brought into focus on which the success in surgery depends. A review of the history of surgery emphasizes the fact that successful surgeons were those who had understood and employed these principles either intuitively or through their astute observations.

Suśruta who lived in about 500 B.C. in India was much ahead of his time in expounding and practising the surgical principles of which the truth of many is only being realized now. He was one of the earliest exponents of surgery as an art and science. He not only made surgery an integral part of the general art of healing, he considered it superior to other eight specialities of medicine existing then:

अष्टात्त्विः शायुद्वेदत्वेवेशेतेवाविकममिन्नम् ...

He was the first and foremost surgeon and his Sāṃhitā is the only complete book of the ancient time which deals with the problems of practical

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surgery. Thus according to Bhisagratna* ‘to Suśruta may be attributed the
glory of elevating the art of handling a lancet or forceps to the status of a
practical science’, although in the West surgery was relegated to an inferior
position usually practised by barber surgeons till the eighteenth century.

Indian surgery was at its zenith in Suśruta’s time. In subsequent
centuries little, if any, has been added to Suśruta Samhitā beyond commentaries
to explain the difficult portions of the text. In the present communication
salient features of his surgical practice and philosophy will be described
to highlight his ethical and scientific approach in the training and practice of
surgery.

Training of surgery

He stressed the importance of observation and practical experience in
surgery. He may have been the first person to advocate dissection to gain
first-hand knowledge of human anatomy:2

तत्समापितः पिलायं जातनं हुनांशत्यभावा
शोचिस्लवा मूंतं समयस्त्रावृज्ञविनिलितः ।

Among the qualifications of a surgeon he insists on experience:3

तत्सभिषितस्तुत्पाकों दुष्टकर्मी स्वर्यंकुली ।

He compares the theory and practice to the two wheels of a cart4 and
denounces those practising surgery without training:

यस्तूर्यासो महिमान्दः स समयोऽयंशाने
आहवे कर्म निबोधु द्विचक्षु: स्मर्दस्योऽया ।

He has aptly compared the persons gaining knowledge only from the
books to the warriors who have never been to the battlefield and who run
away at the first sight of the enemy:5

यस्तु केवलशास्त्रं: कर्मस्त्परिलिखितः
स मूहुतयातुर्यं प्रायं प्रायं भीशरियाहवम्
यस्तु कर्मसु निर्णातो धार्मिक्षात्त्वस्यहिःकृः
स सत्तु पुजां नापनोति वर्न चाहिः राजतः ।

Similarly, Sir William Osler has said, ‘To study medicine without books is
to sail an uncharted sea, while to study medicine only from books is not to go
to sea at all.’

The qualifications of the surgeons set down by him are practically the
same as would be recommended at the present day. It was a matter of
great importance to decide whether the candidates of medical careers conformed
to the high ideals. Physical, intellectual and moral requirements were quite
stringent. The moral code for the teachers was also not less stringent. The
pupil-teacher relationship was a covenant between the two. Any unrighteous

move on the part of the teacher made him liable to sin and futility of his knowledge. There is no denying of the fact that enforcement of these criteria in the selection of teachers and students in the medical colleges would improve a great deal the standard of medical education and practice.

_Yoga_

He introduced for the first time a plan for the training of a surgeon to achieve dexterity in performing basic surgical procedures on experimental models named _Yoga_. In the absence of animal surgery these models served extremely well to arouse the interest of the student and give a permanent mental impression of the basic surgical procedures. They will be subsequently described along with the description of these procedures.

Methods of diagnosis

His method of diagnosis, though connected with the humoral theory in general, was not restricted to speculations. He gave explicit instructions regarding the history-taking and physical examination of the patients. The patients or their family were to be interrogated concerning symptoms, the patients’ habits and their deviations in disease. The physical examination included the use of all the five senses. Inspection, palpation, (direct) auscultation, use of taste and smell were all included⁶ (Fig. 1):

![METHODS OF DIAGNOSIS](image)

Fig. 1.

This is basically the same as the method used these days. As an example of his careful observations may be mentioned the inference of sweetness of urine from attracting ants and flies:

मलिकोपपर्णय....
Primary healing of wounds

Management of wounds occupies a prominent place in Suśruta's work. Very few modern or ancient authors have given such an exhaustive treatment of the wounds. In principle, wounds were treated by methods considered best today, i.e. thorough cleansing and closure by suture. He has given explicit instructions to clean the wound of dust, hairs, loose pieces of bones and other foreign bodies before suturing to avoid suppuration\(^8\) (Fig. 2):

\[
\begin{align*}
& \text{पाँडुरोमन्ता दीनिन चलम्स्य भवेच्छ यत्} \\
& \text{अहोतानि मतोमुनि पान्यबुंर्ग्वृं क्रमम्} \\
& \text{रुज्जव विविषा: कुर्युस्तमादितानु विशोधायेच्}
\end{align*}
\]

**PRIMARY SUTURE OF WOUNDS**

![Primary Suture of Wounds](image)

Fig. 2.

It is significant that, for centuries till Lister's time, surgeons and patients alike welcomed the formation of 'Laudable Pus' and actually employed several measures to produce it. Ambroise Paré and few others in the sixteenth century had observed that healing can occur without the formation of pus although no significance was given to it. Thus Suśruta was among the few who recognized primary healing and advocated it.

Sixty procedures of wound management

Sixty procedures have been described for the treatment of wounds emphasizing the fact that injury forms the basis of surgical procedure and a thorough knowledge of its management forms one of the fundamental requisites of surgery. These measures encompass the management of wounds from the earliest manifestations of inflammation to its complete healing including the cosmetic aspects regarding the colour, surface and growth of
hairs. Although based on *tridoṣa* theory, Suśruta has given an excellent concept of the pathogenesis of the disease, including wounds in six stages. Four stages of internal derangements have been described even before the manifestation of the characteristic features of the disease. Therapeutic measures adopted in these stages could avert the disease. These 60 procedures included the management for all stages of the disease process.

*Three stages of surgical procedure*

Every surgical procedure was a phased programme of three parts, pre-operative measures (*pūrva karma*), operative measures (*pradhāna karma*) and post-operative measures (*paścāt karma*) (Fig 3):

<table>
<thead>
<tr>
<th>पूर्वकर्म</th>
<th>प्रधानकर्म</th>
<th>पश्चातकर्म</th>
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<tbody>
<tr>
<td>(1) PREPARATION OF PATIENT</td>
<td>SURGERY</td>
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<tr>
<td>(2) PREPARATION OF THEATRE</td>
<td>EIGHT SURGICAL PROCEDURES</td>
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<td>(3) PREPARATION OF INSTRUMENTS</td>
<td></td>
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</tbody>
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Fig. 3.

Detailed instructions regarding the management have been given at each stage. Despite the surgical bias, Suśruta has advised surgical intervention only in cases of failure of medical management. He has stressed the importance of the proper time for surgery. He has cautioned against the dangers of postponing surgery as well as of too early intervention:

यशिष्टनिग्राममजातास्वयं पक्तमुमेकंते
स्वपचाविव पत्तवज्ञी तावसिदक्षेतरिचणि ।

*Pre-operative preparation*

Pre-operative measures were similar to those employed today. Of the 60 procedures mentioned earlier, the first 12 were intended to bring the body to as ideal a state as possible for a definitive therapy. Starvation or mild dieting was advised as indicated on the day of surgery. Administration of intoxicating beverages was advised to take off the sensation of pain of surgery.

Detailed instructions have been given regarding the preparation for the operation itself. Lists of articles to be collected and kept ready have been
minutely described along with the suitable day, time, lighting, etc. He has described 101 types of blunt surgical instruments and 20 types of sharp instruments. The instruments described by him have striking similarities to the instruments used today, including the nomenclature, e.g. Simhamukha yantra and lionjaw forceps. Proctoscope and other endoscopic instruments have also been described. The functions of the instruments described by him are practically the same as today, i.e. for facilitating observations, operative procedures and removal of foreign bodies.

Operation

Detailed descriptions have been given of the main surgical procedure itself. Eight basic surgical procedures have been described and encompassed all types of surgical manoeuvres. More than one technique could be used according to the necessity. The types of diseases amenable to each manoeuvre and technique have been given in detail.

Excision was advocated for moles, tumours, piles and enlarged tonsils, etc.:\(^1\)

च्छेद भगन्दर। ग्रन्थि: शैविकास्तिलकालक:...

That is, in lesions characterized by non-suppurating, hard and fixed swellings and necrosis of muscles, etc.:\(^2\)

अपाकेयु तु रोगेयु कठिनेयु स्तिरेयु च नायुंकोयादियु तथाज्ञेदनं ग्राम्मतमुच्यते।

Students practised this procedure on fruits with a hollow centre presenting different surfaces and resistances.

Incision was indicated in abscesses and other suppurative lesions:\(^3\)

अत्यपेयाः स्वरस्तमेनुथिरे तथा बीमास्त्रवस्त्रिपि गतिनिस्तु च रोगेयु ग्राम्मतमुच्यते।

Leather bags and bladder of the animals filled with mud or materials of various consistencies were utilized for practising incision by the students.

Puncturing/tapping: Veins, hydroceles and ascites were punctured or tapped:\(^4\)

बेल्या: सिरा बहुकिचा मूलवृद्धिकार०।

This was practised in dead animals and hollow stems of lotus. Much effort went into gaining dexterity to enter the vessels with precision and accuracy.

Scraping was done in chronic non-healing ulcers with hypertrophied lips and various other skin lesions:\(^5\)

कठिनायु स्वरुपाः अतिस्तूः शियमायासुः गुणः गुणः कठिनात्रासारापि बेलनेनाचरेयुद्धकः।
Animal hides with warty transformations as seen over the skin of joints were used for practising this procedure by the students. Delicate balance of knife avoiding injury to the underlying structures was emphasized.

_Probing_ was advised for diagnostic purposes in sinuses with foreign bodies, ulcers with small openings and pockets, and was practised ingeniously on hollow pieces of dry wood, or bamboo with holes:

एष्या नाइचः सशत्याक्षः रणा उपवाचिणाचः ये।

Pieces of stones were introduced in the cavities and the students were asked to probe, feel and tell the nature of foreign body in terms of size, number, fixity, etc.

_**Extraction**_ was done to remove stones, loose teeth, impacted foreign bodies and dead foetus:

आहाय्योः शक्करास्त्राः दक्तक्रःमलोंग्रमः
शास्त्रानि मुद्गमान्यां वर्धनं निन्चितं युद्धः।

The students practised it by extracting the teeth of the dead animals and seeds of jack-fruits, etc., to enable them to appreciate the optimum grip and force and to remove the foreign body causing least damage to the surrounding structures (Fig. 4).
Various indications have also been given for blood-letting.

Suturing was advocated in recent clean wounds. Detailed instructions were given regarding the preparation of wounds for suturing. Chemical and thermal burns or wounds with retained blood or foreign body were not to be sutured:

\[
\text{न नात्येन ज्योत्वे व ज्योत्वे न मात्वाधिनः}
\text{नात्येन ज्योत्वे न मात्वाधिनः}
\]

The wounds were advised to be cleaned of all foreign matter to avoid suppuration. Suturing methods were also described in detail. Stitches were to be advised to be put neither too close or too far apart. Tension caused by stitches put far apart was to be avoided as also to the tissues getting cut through by its being too near:

\[
\text{नात्येन ज्योत्वे व नात्येन ज्योत्वे}
\text{नात्येन ज्योत्वे व नात्येन ज्योत्वे}
\]

Suturing could be of continuous, interrupted or of winding varieties. Three types of needles, viz. straight, curved and triangular, were described for suturing of the surgical wounds. Use of cloth, silk, leather, etc., were used as working models to practise suturing (Fig. 5).

\[
\text{SUTURING}
\]

\(\text{A) TYPES OF NEEDLES}
\]

1. कुत्त्रधुरां भाष्यम्
\text{ROUND BODY STRAIGHT}

2. व्याहुतः तिलखः
\text{TRIANGULAR STRAIGHT}

3. नन्दुवेदः
\text{CURVED}

\(\text{B) SUTURE MATERIAL}
\]

\text{COTTON / LINEN / SILK / HORSE HAIR /}
\text{TENDON / AND VEGETABLE FIBRES /}

\(\text{C) TYPES OF STITCHES}
\]

1. सेवांक चतुर्वेदः
\text{CONTINUOUS}

2. दशभन्धुः सम्भवतेः
\text{BLANKET SUTURE}

3. सुधि सहवनी शस्यः
\text{SUBCUTANEOUS}

4. विरुद्ध शरीर शस्यः
\text{INTERrupted}

\(\text{D) IDEAL STITCHING}
\]

\text{मात्र दूर ज्योत्वे व ज्योत्वे कर्माणि वालतेः}
\text{कुत्त्रधुरां ज्योत्वे शस्यः}
\text{अन्तर्गुटे निक्षुः बुधः}

\text{Fig. 5.}

These directions and experimental models regarding the types of surgical procedures, the care of wounds and modes of stitches can match in precision and clarity mentioned in any modern textbook of surgery. The utilities of
these instructions are as good today as they were in those days. It will be hard to improve upon them.

*Post-operative care*

Careful and minute instructions regarding sleep, diet, redressing are given systematically in the post-operative care. Numerous measures were taken to hasten healing.

*Bandages*

Various types of bandages have been described to suit the wounds at different locations of the body. The loose, intermediate or tight bandaging has been advised, keeping in view the type of wound and the season.
Fifteen different materials were used for bandaging. Knots were advised to be tied away from the wound. This detailed account on bandaging indicates the appreciation of the factors which help or retard healing. Students were given stuffed dummies to practise bandaging. The 14 types of bandages with their modern equivalents are listed below (Fig. 6):

1. *Kośa* was a sheath bandage employed for fingers and toes.
2. *Dāma*.
3. *Swastikā* bandage was a cross bandage used in joints.
4. *Anuvellita* was the spiral bandage for the extremities.
5. *Pratoli* was used to bandage penis and neck region.
6. *Maṇḍala* was a type of circular bandage.
7. *Sthagikā* was a sheath bandage for fingers, toes and penis.
8. *Yamaka* bandage was meant to cover two wounds simultaneously.
9. *Khatvā* was a four-tailed bandage for chin and face.
10. *Cīna* was probably a ‘T’ bandage employed in wounds of the perineal region.
11. *Vibandha* was employed for the trunk.
12. *Vitāna*, the cephalic bandage.

**Prevention of infection**

Further, it goes to the credit of Suśruta that the flies and formation of worms (maggots) in the wounds have been correlated:

मधिका वर्णमालयः निर्दिष्टा वन्य द्रवीः।

**MODES OF INFECTION**

1. **A-** मधिका वर्णमालयः निर्दिष्टा वन्य द्रवीः।
   **B-** प्रसुद्धाद्र यस्मातिः स्वास्तिकः स्वास्तिकः स्वास्तिकः स्वास्तिकः स्वास्तिकः स्वास्तिकः।
2. **INGESTION** सह भोजनात्।
3. **INHALATION** विन्याससः।
4. **PHYSICAL CONTACT**
5. **INFECTED ARTICLES**

**Fig. 7.**
Similarly, the mode of spread of infectious diseases have been very well described by him. He has specifically mentioned the spread by body contact, sexual intercourse, inhalation, ingestion and the use of infected objects. Furthermore, he has mentioned leprosy, tuberculosis, conjunctivitis as the infectious diseases\textsuperscript{21} (Fig. 7):

\begin{quote}
प्रस्फूटायुक्तसंपर्कार्थविषवाचात् सहभोजनात्
सहस्पर्कार्थविषश्च सस्त्राधिकार्थगोपनात्
कुट्टे जवरस्थ शूष्कश्च तेनाभिव्यंद्व एव च
औपसनिकरोगाश्च संकामिति नारायणम्।
\end{quote}

It is not known what were his methods but one cannot but admire his penetrating observations and correct conclusions made long before Louis Pasteur and Lister in the nineteenth century dispelled the theory of spontaneous generation of life and established the contagious nature of diseases.

**Cosmetic aspects**

Cosmetic aspects of healed scars was also given due consideration in wound therapy. Measures to elevate depressed scars, depress-raised ones, restoration of normal colour and hairs have been dealt with in detail. A separate section termed *Vaikritapaha* was devoted for the purpose.

**Plastic surgery**

The contribution of Suśruta to plastic surgery can rightly be called outstanding. It is an established fact that Indian Plastic Surgery provided the basic pattern for Western efforts in that direction. Till the sixteenth century plastic surgery had made little advance. Its revival can be traced to a report from India in 1794. 'An illustrated account of a rhinoplastic operation upon one Cowasjee, a bullock-driver, was published in the *Gentleman's* magazine. This man had served as a driver with the English Army and was made a prisoner by Tipu Sultan who cut off his nose and one of his hands. A new nose was constructed on him by a native surgeon. This lead was quickly followed by a noted surgeon of London, Joseph Constantine Carpue, and he published his results in 1816 which is regarded as one of the greatest landmarks in the history of reconstructive surgery.'*\textsuperscript{5}\textsuperscript{*} The original description of Suśruta on Rhinoplasty is as follows:

'First the leaf of a creeper, long and broad enough to cover fully the whole of the severed or clipped off part, should be gathered and a patch of living flesh equal in dimension to the preceding leaf should be sliced off (from below upward) from the region of the cheek and after scarifying it with a knife swiftly

adhered to the severed nose. The physician should make sure that the adhesion of the severed part has been fully effectuated and then insert two pipes into the nostrils to facilitate respiration and to prevent the adhered flesh from hanging down.  

A similar operation for severed lips has been described. Apart from these well-known operations Suśruta has described 15 methods of repairing ear lobes (Fig. 8). He was not only a craftsman, he perfectly understood the underlying principles and emphasized it in his book. The importance of adequate blood-supply as well as of perfect hemostasis in the graft bed has been correctly emphasized. Thus Suśruta can truly be called the originator of plastic surgery.

**PLASTIC SURGERY in ANCIENT INDIA**

**Fig. 8.**

*Four hemostatic methods*

Hemorrhage is the primary problem in any of the surgical procedures and if it is not controlled quickly and safely leads to shock and sometimes
even to death. Regarding importance of blood, Suśruta says it is the basis of the body, so it should be preserved carefully: 23

देहस्य शिबिरं मूलं शिबिरेण चावते
तस्मातत्रेण संरक्षयं रक्तं जीवं इति रिष्टितः।

To arrest hemorrhage he has described four methods:

(i) Sandhāna—involving co-apptation of broken edges and ligaturing. This has been given as the first method and even today ligaturing of the bleeding vessel is the commonest method to stop hemorrhage.

(ii) Skandana—where ice was used to lower the temperature thereby resulting in decreased blood-supply to the part.

(iii) Pācan—the use of medicated powders—styptic—which presumably helped the process of coagulation. Use of gel foam can be compared to this method.

(iv) Daha—where cauterization of the blood-vessel was done to arrest hemorrhage. Cauterization and styptics are still the common means of stopping hemorrhage, besides ligation, today.

It may be seen that he included all methods of stopping hemorrhage known today.

FIG. 9.
Concept of thermal injuries

Another significant contribution of Suśruta though less known is in the concept of thermal injuries.

Classification of burns has gone through several modifications in modern surgery and some controversies about it still exists. Only recently all thermogenic injuries, whether cold or hot, have been included in the classification of burns as it has been confirmed that their basic pathology is similar. Suśruta more than 2,500 years back had included the lesions caused by excessive cold and lightening under burns. It underlines his remarkable insight and understanding of basic pathology (Fig. 9).

He was not only a great surgeon, he was an expert physician and botanist as well. As mentioned earlier, he employed surgery only when absolutely necessary. He has insisted that the knowledge of internal medicine, among others, is a qualification of the surgeon.24

एक शास्त्र मधीमानो न विद्याशास्त्र निस्त्रयम्
तस्त्राऽद्वृत्तः: शास्त्रं विज्ञानीपत्यिक्षकः।

His voluminous pharmacopoea of more than 750 drugs bespeaks his command of other branches of the science. Thus, in him, we find an ideal surgeon. We can legitimately be proud of Suśruta’s contributions to the science and art of surgery even though it has been underrated and largely ignored by the medical historians of the West.

In view of his magnificent grasp and understanding of the fundamental principles of surgery, it may be worth while to re-explore his work further with an open mind. It is possible, we may come across some nuggets and gems to benefit the suffering mankind today which was Suśruta’s sole aim of practice of surgery.

References

1 Suśruta Samhitā, Sū., I, 18.
2 Ibid., Sā., V, 47.
3 Ibid., Sū., XXXIV, 19.
4 Ibid., Sū., III, 53.
5 Ibid., Sū., III, 48, 49.
6 Ibid., Sū., X, 4.
7 Ibid., Nī., VI, 13.
8 Ibid., Sū., XXV, 18, 19.
9 Ibid., Sū., V, 3.
10 Ibid., Sū., XVII, 10.
11 Ibid., Sū., XXV, 3.
12 Ibid., Ā., 33, 34.
13 Ibid., Ā., I, 34, 35.
14 Ibid., Sū., XXV, 10.
15 Ibid., Ā., I, 38.
16 Ibid., Sū., XXV, 11.
17 *Śūrata Samhitā*, Sū., XXV, 11, 12.

Note: For making the references, *Śūrata Samhitā*, published by Satyabhama Bai Pandugang, Nirmaya Sugar Press, Bombay (1945), has been consulted.