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Review Article
Published: 05 Jun, 2019

Journal of Dentistry Forecast

Intraoperative Haemorrhage in Periodontal Surgeries - A Review

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Abstract

In Periodontology, various surgical procedures are performed in day to day practice. Intra-operative haemorrhage is one of the major surgical complications encountered in day-to-day surgical practice. The morbidity and mortality associated with surgical haemorrhage are considerable and it remains a restraining factor for advanced surgical procedures. Intra operative haemorrhage may sometime cause significant complications and may even lead to alarming events. Evaluating amount of blood loss during surgery has clinical significance. Clinicians should know the amount of blood loss during the surgical procedures to detect and treat any aberrant changes immediately. There are different techniques, which could be used for measuring intra-operative bleeding. This review compiles various ways to measure intra-operative blood loss to update and alert clinicians about its consequences.

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Received Date: *11 May 2019*
Accepted Date: *31 May 2019*
Published Date: *05 Jun 2019*

Citation: *Jirafe S, Ansari S, Gattani D, Shende S, Khetal N. Intraoperative Haemorrhage in Periodontal Surgeries - A Review. J Dent Forecast. 2019; 2(2): 1023.*

ISSN 2643-7104

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Introduction

Delivery of patient care encompasses a wide range and variety of challenges, one of which is unexpected clinical bleeding. Clinical bleeding can be presented during surgery or several days after the procedure. In both situations, the clinician will need to take immediate action to control the hemorrhage and stabilize the patient [1].

Haemorrhage associated with surgery is a common problem which requires proper management. This includes accurate determination of blood loss, establishment of effective hemostasis, and replacement of fluids when indicated. A flap approach is commonly used for the treatment of periodontitis and regenerative procedures. Although such surgery may be routine, little attention has been directed to the extent of hemorrhage occurring during this type of procedure [2].

Significant loss of intra-vascular volume may lead sequentially to hemodynamic instability, decreased tissue perfusion, cellular hypoxia, and organ damage and may even cause death [3].

An adult human has 4-7 liters of blood in his/her circulation; thus, the loss of 350-500 ml of blood might be negligible which occurs even in the case of blood donation. However, when loosing 30% (or more) of the blood volume, symptoms of hypo-volemic shock might develop. In 1953, De Wardener *et al*., said that if oligaemia is not corrected in such patients they are liable to sudden post-operative hypotension [4]. Stanton and Lyon stressed the importance of adequate replacement of whole blood during and after surgical operations [5].

Methods to Measure Blood Loss during Surgery (Figure 1)

Most surgeons make some estimation of blood loss from the appearance of the operative field and the number of swabs used. This method is easiest and widely practiced. However, there is a wide discrepancy between the type and site of the surgery and size of the swab used. Thornton has stated that it is difficult for most observers to distinguish between a blood loss of 500 ml. and one of 1500 ml. Bonica and Lyter, in summarizing the work of 17 other investigators concluded that the

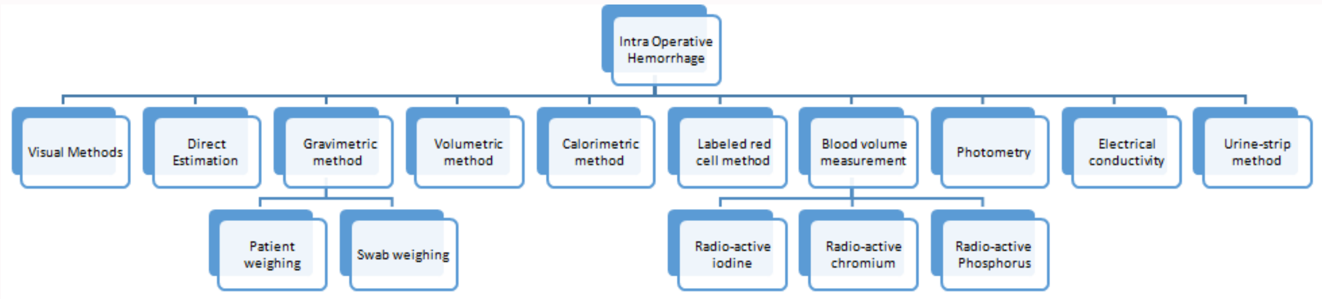

Figure 1:

surgeon's estimate is always less than the actual loss [6,7]. Following are the various methods used for measurements of Intra Operative blood loss:

Visual estimation

Most frequently practiced method. Most reports are during childbirth and the incidence of hemorrhage was underestimated in the visual estimation by 89% (Prasertcharoensuk *et al.*,) [8].

Direct measurement

Direct measurement is one of the oldest methods of accurately determining blood loss. Different reports enumerated used different tools to collect blood for direct measurement, in an attempt to quantify normal blood loss.

Gravimetric

A) Patient weighing: A special accurate weighing table is used to amount the pre- and post-operative weight of the patient. 1 gram is almost equal to 1 ml of blood. The method is elementary, inexpensive, and hardly requires any time or technology. Intra-operative discrepancies like drinking glucose (in case of giddiness), or urination have to be acknowledged. Johar and Smith in 1993 assessed the accuracy of gravimetric estimation of intraoperative blood loss using the calorimetric method. Using the patient's preoperative hemoglobin measurement, the amount of blood present in the sponges was determined [9].

B) Swab weighing: Weighing of unused swabs before surgery and re-weighed immediately after surgery before discarding them from the operative field. From their variance in weight between the two, blood loss is calculated. This method is also facile, quick, does not require any elaborative technique and is inexpensive. Sources of miscue includes other fluids assimilated in the swab, e.g. saliva, pus, inflammatory exudates etc. Also, blood aspirated by suction, blood swallowed by the patient and blood lost on instruments, gloves, drapes, scrubs, and by evaporation are other causes that may account for errors in calculation [10-12].

Volumetric

In volumetric method the content of any fluid to be introduced into the operative field is accounted pre-operatively and any surfeit fluid present in the aspirator jar after the surgery is surmised to be blood. Easy, inexpensive and technique free. In this case, sources of error are fluids other than blood and any bulk of material, which includes cotton pellet, tooth substance, cement, amalgam or even dressing materials, if any are aspirated [11,12].

Colorimetric

First described by Pilcher and Scheard. This includes washing of bloodstained swabs, instruments, drapes, scrubs, gloves etc., two or three times and then collecting the fluid left after the washing along with the contents present in the aspirator jar. This fluid is amassed in a container holding an agent, which alters hemoglobin to a more permanent pigment such as methemoglobin or cyanomethemaglobin. In cases where an immediate result is not required, the items and instruments may be soaked for 24 hours as a substitute to washing. By computing the hemoglobin concentration of the fluid in the container on a colorimeter, and its total volume, its hemoglobin content is calculated. If the patient's pre-operative hemoglobin is already listed, the amount of patient's blood in the container can be measured. This whole process can also be automated to give consecutive readings of blood that has been lost during the surgery. Devices that can perform this procedure are now available commercially (Photo Colorimeter, Digital photoelectric colorimeter SMART3). It is a certain method, which gives accurate reading. However, few sources of error includes variations in the patient's hemoglobin during operation, failure to collect all blood lost from the operative field and instability of hemoglobin that undergoes quick degradation, thus resulting an under estimation of the blood lost.

In contrast to the previous methods, this method is expensive, time consuming, technique sensitive and requires trained personnel to carry through the whole procedure accurately [11,13-15].

Labelled red cells

In this method, a sample of patient's blood is incubated with Cr51, after which the red cells are washed, measured for gamma radiation on a scintillation counter, and are returned to the cardiovascular system.

Pre-operatively the amount of Cr51 present in the peripheral blood is tallied; and at the end of the operation all blood stained swabs, instruments, drapes, scrubs, gloves etc., are measured for gamma radiation and the volume of the blood lost is taken into account.

It is a reliable and accurate method. However, it is very expensive, time consuming, technique sensitive and needs trained personnel, and requires bulky instruments.

In addition, radiation hazards that the handling personnel comes across during the procedure restrains the usage of this method to research [16].

Blood volume measurement

This is a methodology, which follows the principle of measuring the difference between pre- and post-operative blood volumes, which may further inform the amount.

A known quantity of dye or radioactive tracer is injected into a vein. After a delay of a few minutes, which permits the dye to be evenly distributed throughout the cardiovascular compartment, a sample of blood is withdrawn.

From the dilution of the injected substance in the blood sample, post surgery, the blood volume is calculated.

A) Radioactive iodine (I): The first method is this includes intra venous injection of human albumin labeled with I131 or I132 which gets distributed throughout the cardiovascular system within 15 minutes. After this time has elapsed, a sample of venous blood is withdrawn and the plasma volume is calculated.

The blood volume is measured from the hematocrit reading of a sample of venous blood post-surgery. The difference between the two reveals the volume of intra-operative hemorrhage.

I131 has a shorter half-life than I132 and that is the reason why it is more suitable to estimate repeated blood volume in a spur of time, but the problem lies in the utilization of expensive procedures and apparatus [13].

An instrument with a built-in computer called Volumetron is now available. This device enables simple and quick measurement of blood volumes using I131 labeled albumin.

Sources of errors in this case are the different hematocrit readings obtained on samples of blood drawn from different parts of the cardiovascular system, and leakage of albumin from the cardiovascular fluid compartment [17].

B) Radio-active chromium: Second in line is this method in which a sample of patient's blood is labeled with Cr51, as described above, and flowed back to the cardiovascular system. After a few minutes, a sample of venous blood is withdrawn and the patient's total red cell volume is calculated pre and post surgically, from the hematocrit reading. This method is precised for measuring blood volume loss, but again it is elaborative and requires expensive equipment [18,19].

C) Radioactive phosphorus: Labeling of red cells with P32 as previously described for Cr51. They are then measured for beta radiation and are injected into the cardiovascular system. Blood volume is calculated from red cell volume.

Owing to the short biological half-life of P32, repeated estimations of blood volume are possible without having to increase the dose of P32.

As a technique for measuring operative blood loss, the advantages and disadvantages are the same as described for Cr51 [18,20].

D) Photometry: Photometers are used to measure the intensity of the light produced by an unknown source in terms of a standard source. The general technique is to locate the two sources so that they give the same illumination to two adjacent surfaces.

The photometer was invented by Charles Wheatstone (1802-1875). It originally had a glass bead stuck to the piece of putty in the upper right-hand corner. When the ivory handle on the crank was turned, the internal and external gearing made the bead travel in the rosette-pattern shown on the left, with each of the lights leaving a trail behind due to the persistence of vision.

Many modifications have been made to it and Jansen H in 1978 introduced the photometric method to measure free Hb in the haemolysed irrigant fluid.

The research using this method has been limited because it has to use some sophisticated apparatus such as portable photometer for hemoglobin detection, HemoCue photometer.

The test is simple to perform and gives highly reliable results within a few minutes [21-23].

E) Electrolytic conductivity: Leveen and Rubricus in 1958 introduced an automatic blood loss meter, which worked on electrolyte conductivity. It was based on the fact, that the specific conductivity of blood depends upon the electrolyte concentration, and has a constant value.

The mechanism consisted of a water-filled tub, containing an agitator, which extracts the electrolytes from the blood sponges and clothes. A suction pump transfers blood from the operating table directly into the tub. A conductivity bridge measures changes in conductants.

Automatic temperature compensation is accompanied by the introduction of a thermistor into one arm of the conductivity bridge.

A servomechanism continuously brings the bridge into null balance, in order to have a direct reading instrument.

This method has the advantage of giving reading but disadvantage is that it is dependent on the constancy of the electrolyte content of the blood during the period of estimation [23].

F) Urine strip method: A urine test strip is a basic diagnostic instrument used to determine pathological changes in the urine in standard urinalysis.

In 2007, Ungjaroenwathana *et al*., used this method to estimate total blood in irrigating fluid in patients with transurethral resection of prostate surgery. Blood was collected prior to the operation, immediately post-operation and 24-hour post-operation. Total Hb and number of Red Blood Cells (RBCs) were measured. Volume of irrigating fluid used during the surgery was recorded. The treated irrigating fluid was diluted into various concentrations and filled in the plate and tested by the urine strip.

Blood loss was calculated by two methods, spectrophotography and urine strip method. The results showed that urine strip method for blood loss detection is a reliable and accurate though the technique is not best for detection but is practical and useful in immediate post-operative evaluation of blood loss [24-28].

Other Techniques

A. Other techniques for assessing operative blood loss are dependent upon serum specific gravity [10]. However, this technique is not commonly used. Plasma volume may be measured by labeling albumin with dyes such as Vital Red or Evans Blue instead of radioactive Iodine, but these methods have little application to the measurement of operative blood loss. Red cells can be tagged with Fe55 or Fe59, to measure blood volume, but their usage is restricted as they involve a relatively high dose of radiation (as said by Murray & Ports in 1960) [10]. Measuring the contents present in the suction bottle can also be done for measuring intra operative hemorrhage (with adjustments made for the amount of saline irrigation used).

B. A procedure in 1997 was developed in which a mathematical model of blood loss for a surgical hospitalization based on mathematical principles for blood loss and hemodilution. The model was designed so that the calculation of blood loss would be based on easily measured factors such as the patient's blood volume, the number and type of red cell units transfused the initial hematocrit, the discharge hematocrit, the transfusion trigger, the volume of intraoperatively salvaged blood transfused, and the amount of hemodilution performed. In this study, the blood loss measured was compared with the intraoperative blood loss actually estimated by the anaesthesiologist in 250 consecutive patients. The result showed that calculated blood loss was on average 2.1 times the intraoperative blood loss estimated by the anaesthesiologist. It was concluded that the use of such mathematical modelling to rapidly estimate a patient's blood loss has the potential to allow ready, objective comparisons between sites and even surgeons. It also allows for a more judicial and informed decision in the situation that any blood be available or the blood-conservation techniques that can be employed for a specific patient [25].

Zigdon *et al.*, (2012) conducted a study to measure the intraoperative bleeding during periodontal flap surgery. 26 patients scheduled for periodontal surgery were recruited for this study. Data regarding smoking habits, general health, and medications were collected. The amount of the local anesthetic that was injected was then recorded, as well as the number of teeth in the operative field and the duration of the procedure. During surgery, the liquids from the oral cavity were suctioned and collected into a sterile empty vial. To calculate the net amount of blood volume in the liquids, colorimetric assay using capillary blood fructosamine as a reference molecule was used. Patients taking aspirin (acetylsalicylic acid) have shown less blood loss. Local anesthetic amount, surgical field size, and the operation duration did not relate to blood-loss volume. The mean blood loss among current smokers was significantly higher compared to former or never smokers. The results of the current study confirmed that blood loss during periodontal surgery is minimal [26].

Regarding the effect of ibuprofen on intra-operative bleeding during periodontal surgery, in which temporary discontinuation of ibuprofen prior to surgery to decrease the risk of increased bleeding during periodontal surgery was recommended [27].

Conclusion

There are number of studies addressing the causes for intraoperative bleeding and their management, however, there is scarcity of literature on methods determining the quantity of intra-operative blood loss. The intent of this article is mainly to make the practitioners aware of different methods of estimating intraoperative hemorrhage and thereby addressing the need for immediate replacement of lost blood, especially in medically compromised patients, with pre-existing bleeding disorders. In addition, this review helps in determining the anticipated quantity of blood loss following specific surgical procedures, for accurate pre-operative preparations, to avoid any untoward consequences of excessive blood loss. Various methods for estimation of intraoperative blood loss have been enumerated and explained. However, no method is considered the gold standard. Each method has its own advantages and disadvantages. Considering a specific method is dependent on operators' choice, feasibility and cost efficiency. Based on the available research it is observed that there is insufficient literature to consider one specific method as ideal over the other. Hence, further studies and innovations in techniques for estimating blood loss are required.

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