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Editorial

Dear readers

This issue covers ophthalmic viscosurgical devices and their myriad uses in the current ophthalmology practice in detail in the perspective section. An update on how computer software can make a big impact on low vision care is covered. Continuing series on biostatistics takes a look at a commonly used statistical tool—regression analysis. Caution to be taken during anesthesia for infants undergoing Probing is discussed. A muscle puzzle to intrigue followed by Technology Update which takes a look at selective kaser trabeculoplasty concludes this issue.

Dr. S. Meenakshi
Editor
June 2010

AN APPEAL

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Perspective

Ophthalmic viscosurgical devices

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Ophthalmic viscosurgical devices (OVDs) have revolutionized anterior segment surgery. Initially, OVDs were substances that were in search of use. Sodium hyaluronate viscoelastic solutions were tried as vitreous substitutes as early as in the 1960s, with varying success rates.

The history of OVDs began in 1934, when Karl Meyer and John Palmer, at Columbia University, New York, isolated a new polysaccharide from the vitreous humour of cows.

Over the following decades, Endre Balazs, a Hungarian polymer chemist, perfected the techniques of extracting hyaluronic acid from rooster combs and purifying it to the point that it could be used in humans. He was also the first to suggest the use of hyaluronic acid in ophthalmic surgery.

Sodium hyaluronate viscoelastic solutions were tried as vitreous substitutes as early as in the 1960s, with varying success rates. The Swedish rheologists Ove Wik and Hege Bothner Wik at Pharmacia licensed Endre Balazs' new preparations of the polymer, producing Healon, the first OVD, in 1979. But their eventual niche in cataract and intraocular lens (IOL) surgery did not become apparent until 1979, when Balazs, Miller and Stegmann used it for that very purpose with considerable success.¹ Pharmacia eventually launched their product in 1980.

While generally speaking, all OVDs are used to create space, to balance pressure in the anterior and posterior segments of the eye, to stabilize tissue and to protect corneal endothelium;² however, over the years, different OVDs have evolved to have very tissue-specific roles, based on their physical characteristics. OVDs have been classified depending on their rheological properties. Rheology is defined as the study of the flow of matter: mainly liquids but also soft solids or solids under conditions in which they flow rather than deform elastically. We now know that the OVDs currently marketed differ not only in content and properties, but also in how those properties are altered by the surgical maneuvers required in specific operations.

Currently available OVDs are aqueous solutions of naturally occurring long-chain polymers (sodium hyaluronate, hydroxypropylmethylcellulose or chondroitin sulphate). Consisting mostly of water, those products are of nearly the same density about 1.0. Their functions of protection, cohesion, lubrication and retention are governed by their polymeric structure, molecular weight, electrical charge, purity and interchain molecular interactions. The physical properties commonly recognized as

differentiating the ophthalmic viscoelastics from each other include viscosity, elasticity, rigidity, pseudoplasticity and cohesion, all of which are clinically relevant in terms of protecting tissues, maintaining space and ease of injection and removal.¹

RHEOLOGICAL PROPERTIES OF OVDs

Viscosity

Viscosity is a measure of the resistance of a fluid which is being deformed by either shear stress or tensional stress. It describes a fluid's internal resistance to flow. It depends on molecular weight, concentration, temperature and solvent used. It can be increased by increasing the length of the molecule chain. Some fluids, such as air, water, and chondroitin sulphate, possess constant viscosity independent of shear rate (or force applied how fast it moves). Called Newtonian fluids, they contrast with non-Newtonian fluids, which exhibit varying viscosity at different shear rates.

Cohesion and dispersion

Cohesion is the tendency of a material's constituent molecules to adhere to one another rather than to disperse. The degree of cohesion (the physical opposite is dispersion) of OVDs plays an important role in OVD retention in the anterior chamber during phacoemulsification and removal at the end of surgery. It is a function of the rheologic molecule's chain length and the chemical properties of that polymer in solution. The degree of molecular entanglement increases with increasing chain length. This aggregation of polymeric molecules results in cohesion (e.g. like a blob suspended in water), whereas their spontaneous drifting apart results in dispersion (e.g. like salt in water). Zero-shear viscosity is defined as the viscosity a product will ultimately attain when at rest and undisturbed. Higher zero-shear viscosity is strongly correlated with higher cohesion in all OVDs.³ These properties are very important especially while understanding the removal of OVDs from the eye. Cohesive OVDs tend to stay together, clumped as a mass, thereby while aspirating, cohesive OVDs come out as a single blob. The intermolecular structure of dispersive OVDs, when aspirated under the

conditions of surgery, is not strong enough to resist breaking apart, even under low vacuum stress. This permits small pieces to be vacuumed from the aggregate mass and be dispersed, thus taking longer to remove from the eye.

Elasticity

Another rheological factor affecting intraoperative behavior of OVDs is elasticity, which is the tendency of a substance to resume its original form after having been stretched, compressed or deformed. Whether an OVD is predominantly viscous or elastic at the time of measurement depends not only on the molecular chain length and concentration, but also on the speed or frequency of impact as force is applied. Under low frequency impact, viscoelastics behave in a primarily viscous manner and become ever more relatively elastic as the frequency of the applied force increases.

Rigidity

Also referred to as complex viscosity, rigidity is the sensation of resistance, felt by the surgeon, to movement of an object through a viscoelastic substance. It is defined as the Pythagorean sum of viscosity and elasticity, i.e. $R = \sqrt{V + E}$.

Mathematically, rigidity is equal to the square root of the sum of the squares of the dynamic viscosity and the elasticity.¹

Viscoadaptibility

The introduction of Healon5 has revolutionized the classification of OVDs. The relatively old distinction between cohesive and dispersive substances does not fit the new generation of products, which display some features of dispersive substances while being highly viscous and cohesive in other conditions. At low shear rates, they appear to be extremely viscous and cohesive, but at mid-range flow rates they fracture, thus manifesting pseudo-dispersive behavior similar to substances of low molecular weight.

Their ability to change from a super-viscous-cohesive profile at low shear rate to fracturable at higher shear rates, displaying pseudo-dispersive behavior, is termed viscoadaptivity.⁴

CLASSIFICATION OF OVDs

Super-viscous cohesives

The super-viscous cohesive OVDs are a subclass of the higher-viscosity cohesive OVDs and show extremely high zero-shear viscosity greater than 1 million mPa S (milliPascal seconds). They are suited for use in topical and intracameral anesthesia and phacoemulsification techniques that entail confining the surgery to maneuvers 'within the capsular bag'. For instance, when capsulorhexis is to be performed in a shallow-chambered hyperope under topical anesthesia, a super-viscous cohesive OVD is especially helpful in achieving intraocular stability and creating and maintaining adequate operative space.

Viscous cohesives

The viscous cohesive OVDs (zero-shear viscosity between 100,000 and 1,000,000 mPa S) consist of the original Healon and all of its copies. They have the same utility and drawbacks as super-viscous cohesive OVDs, but generally are not quite as effective.

Lower-viscosity dispersives

When injected as a bolus into the eye, the lower-viscosity dispersive OVDs are (by definition) more likely than viscous and cohesive products to disperse into fragments in the anterior chamber.

Commonly available OVDs and their constituents:

Viscoelastic	Content	Mol. Wt.	Zero-shear velocity (mPa S)
Healon 5	2.3% Na Ha	4 million D	7000000
Healon GV	1.4% Na Ha	5 million D	4800000
Healon	1.0% Na Ha	4 million D	230000
Viscoat	3.0% Na Ha,	500000 D	50000
	4.0% CDS	23000 D	
Viscomet	2.0% HPMC	86000 D	4000
Ocucoat	2.0% HPMC	86000 D	4000

Viscoadaptive OVDs provide a new challenge in understanding removal. Their extremely high rigidity creates a substance with a consistency, under zero-shear conditions, close to that of a gel. Once grasped by the I/A or phaco tip, viscoadaptive OVDs are aspirated in a manner similar to that of viscous cohesive OVDs, following Poiseuille's law but slower than that of Healon or Healon GV because of increased viscosity. However, this is not the whole answer. High rigidity cause viscoadaptive OVDs to fracture before deforming sufficiently to permit scrolling around obstacles, or even into the I/A port. Viscoadaptive OVDs only fracture when sufficient shear stress is achieved by increasing the flow rate to increase anterior chamber turbulence or by applying high-vacuum stress to the OVD mass with the aspiration port. Only when the anterior chamber 'cast' is fractured are rigid viscoadaptive pieces in the anterior chamber sufficiently free to move in the balanced salt solution. As a consequence, with low aspiration flow rates and consequent low turbulence, viscoadaptive OVDs can be 'trapped' in the concavity of the cornea while phacoemulsification is performed in the capsular bag, enhancing endothelial protection.⁵ Thus by having superior space maintenance and also offering corneal protection, this has changed the way in which two or more OVDs were used for a single surgery.

CHEMICAL CONSTITUENTS OF OVDs

Hyaluronic acid

Hyaluronic acid is a mucopolysaccharide that is a polymer of *N*-acetylglucosamine and glucuronic acid. A salt of hyaluronic acid, sodium hyaluronate (NaHa), is found extensively as a gel in the inter-cellular matrices of vertebrate

soft connective tissues, especially the skin but also in the synovial fluid and the vitreous humour of the eye. As mentioned before, the pioneers of OVDs – Mayer and Palmer – isolated this substance from the vitreous of cows and named it 'hyaluronic acid' because they extracted it from the hyaloid and it contains uronic acid. Its ophthalmic concentrations are greatest in the vitreous humour and the trabecular angle and are least in the aqueous humour and on the endothelium.

The sodium hyaluronate in currently available OVDs is extracted from rooster combs or streptococcal bacterial cultures.

Chondroitin sulphate

Chondroitin sulphate is a sulphated glycosaminoglycan (GAG) composed of a chain of alternating sugars (*N*-acetylgalactosamine and glucuronic acid). It is usually found attached to proteins as part of a proteoglycan. Unlike other currently available ophthalmic viscoelastics, chondroitin sulphate is a Newtonian fluid. Chondroitin sulphate has been proved to protect the corneal endothelium effectively, since it adheres to the cells, thanks to specific receptors. Other dispersive materials also appear to form a protective layer on the endothelium during surgery, whereas cohesive materials tend to wash out.⁴

Hydroxypropyl methyl cellulose

Hydroxypropyl methyl cellulose (HPMC) is a cellulose ether in which about one-third of the hydrogen of hydroxyl groups in methyl cellulose is replaced by methoxy and hydroxypropyl groups in a ratio of roughly 4:1. Unlike other OVDs, HPMC and modified HPMC products can undergo autoclave sterilization and be stored for as long as 2 years at room temperature without resulting depolymerization or alteration in rheologic properties.

BEST USES AND DISADVANTAGES OF OVDs

Higher-viscosity cohesives

Best uses

1. Create and preserve spaces
2. Displace and stabilize tissues
3. Pressurize the AC
4. Clear view of posterior capsule during phaco.

Disadvantages

1. Leave AC too quickly during I/A or phaco-suboptimal endothelial protection
2. Unable to partition spaces
3. More difficult to remove at the end of the procedure.

Lower-viscosity dispersives

Best uses

1. Remain adjacent to corneal endothelium throughout phaco

2. Selectively move and isolate
3. Partition spaces.

Disadvantages

Do not maintain spaces or stabilize as well
Irregular fracture boundaries obscure view of posterior capsule.

REMOVAL OF OVDs

To remove the OVD from an irregular space after it has been 'form fit' in place, the OVD must be supple enough to readily deform upon aspiration and follow well, must be able to be fractured into small pieces that do not have to deform to be removed or both. The rock 'n roll technique relies on the OVD being supple enough to deform but cohesive enough to follow well, allowing it to be scrolled out of corners into the I/A tip. Rock 'n roll therefore works best with viscous cohesive OVDs. The two-compartment and bimanual I/A techniques go directly after the OVD pieces, wherever they are, and do not rely on scrolling or cohesion.⁵

OTHER USES OF OVDs

Corneal surgeries

The use of air and an OVD has been reported to expose Descemet's membrane in deep anterior lamellar keratoplasty. Another application is the use of OVD as a cushion to protect endothelial cells from femtosecond laser dissection.⁶

Glaucoma surgery

The intracameral use of Healon 5 in cases after glaucoma surgery has been effective in early-onset hypotony.⁷ OVDs are also useful during trabeculectomy (23 from OVD1). A prospective randomized trial was performed using an injection of balanced saline solution (BSS) or Healon 5 subconjunctivally to modulate bleb formation. There was no difference in the success rates; however, Healon 5 has been associated with more diffuse blebs.

OVD is also used in macular hole repair and other vitreoretinal surgeries.

VISCOANESTHESIA

The effect of the intracameral lidocaine subsides fairly fast because it washes away easily during phacoemulsification, forcing the surgeon to accelerate his or her surgery or to renew the topical or intracameral anesthesia. Recently, a new OVD (Visthesia, Novartis) combining a viscoelastic substance and lidocaine was developed. Theoretically, this should provide the anesthetic effect of the intracameral injection of lidocaine and help to maintain the effect for a longer period of time, due to the extended exposure of ocular tissues to the anesthetic.⁴

Ophthalmologists must be aware of all the different rheological properties of different OVDs. The field of OVDs is constantly evolving, and keeping abreast of all changes is in the benefit of both the patient and the

ophthalmologist. The choice of the OVD should be decided depending on the properties of a particular OVD and the circumstances each individual case might present with. choosing an OVD by price alone or a single OVD for all situations can have disastrous consequences. Extensive knowledge of the behavior of different OVDs only will ensure a rational choice.

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Role of computer software in low vision/visual impairment

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Computers have become an integral part of human life today. They can also be used to enhance the ability and productivity of life of a visually impaired person in many ways. From simple changes that can be made to any computer, to sophisticated software specially designed for the visually impaired; there are various methods available with which a visually impaired person can comfortably use the computer.

For example, if a person has mild visual impairment (between N6 and N12), simple changes can be made on the everyday computer/laptop to make it more accessible.

Some simple modifications would be:

1. to use lower the screen resolution;
2. to set the computer to extra large fonts;
3. to use high-contrast desktop settings/themes;
4. to change accessibility options to enlarge cursor size/icon size/scrollbar size/use high-contrast settings; and
5. every Windows software has an inbuilt magnifier that splits the screen into two. One portion of the screen has letters in normal size, whereas the other portion is magnified (maximum magnification available up to 9 times).

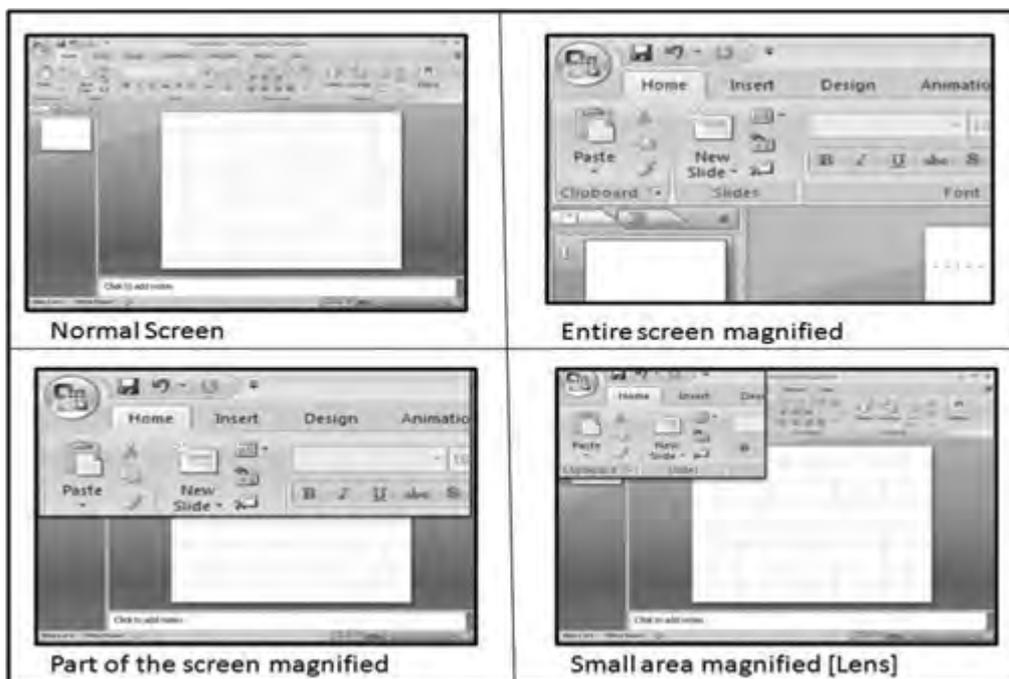
There are also modifications to customize the font color, background and font size for every component of the Window such as the Menu bar or even the caption buttons!

SCREEN MAGNIFIER SOFTWARE

For people with moderate visual impairment, a variety of screen-magnifying software are available in the market. This software interacts with the Graphic User Interface of the computer to enlarge the entire computer screen. These magnifiers have options such as enlarging the entire screen, to split the screen into parts or to use a magnifying 'lens' feature that magnifies only the area where the cursor is (see figure). They combine other options such as color inversion, color customization, cursor enhancements, etc., so that the screen can be modified to suit the user's needs. Some commonly used software are MAGic, Zoomtext, Virtual Magnifier.

OTHER FEATURES

1. The software can also be loaded directly onto a USB device. By just plugging in the device to a computer, the screen magnifier would automatically loaded onto the computer. Therefore, any computer could be made easily accessible with just the use of a USB device.
2. They come in combination with screen-reading facility so that highlighted magnified text is read-out aloud. The user can then combine the benefits of a magnifier with audio output to verify the text that is being read.



SCREEN-READER SOFTWARE

The screen-magnifying software also combines features of screen-reader software. At times, people with visual field loss or severe visual impairment prefer using screen-reader software to screen-magnifying software as it is too cumbersome for them to read magnified text.

Standalone screen-reader software are also available. Screen-reader software gives an audio output every time a key is pressed. Screen readers read out the text on a screen wherever the cursor is moved so that even a totally blind person can use the computer comfortably. (For example, there is an output saying 'F12' if the F12 function key is pressed, or an output saying 'Caps Lock switched on' if the Caps lock button is pressed.)

A person who is totally blind is first trained to use the keyboard with tactile sense. There is software called 'Talking typing teacher' which helps them to learn typing with audio cues from the computer. The second stage of training includes mastering all keyboard shortcuts to use the computer. Following this, training is given in handling a computer comfortably just as any person is trained in the use of Windows or any other operating system. The only limitation of a totally blind person when it comes to using computers even with the use of such software is that they cannot work with software requiring visual input for designs such as AutoCad or Photoshop.

OCR READERS

OCR stands for optical character recognition. This software converts any text that is scanned to a computer to a pdf version. It then reads out the text aloud. This

feature is especially useful to students who are partially sighted or visually impaired. For example, a student who is visually impaired and does not have access to textbooks in Braille can use this feature to read textbooks or any material. Commonly used software are OpenBook, Text OutLoud and Kurzweil.

There are also standalone machines such as SARA that can independently read out text without the need for a computer.

Screen-magnifying or -reading software cost anywhere between US \$200–600. However, there are also trial versions that can be downloaded for free. However, these versions can be used for limited period only (say 60 days).

Computer software and technology has therefore created immense opportunity for enabling the visually impaired to function on par with their sighted peers. Training in the use of such software is a part of most rehabilitation centers for visually impaired and even certain eye hospitals in the country.

The Low Vision Care Clinic at Sankara Nethralaya has a demo version of screen-magnifying software (MAGic, Zoomtext, Supernova) and screen-reader software (JAWS) for demonstration to patients. Please feel free to visit the clinic for a demo or for any additional information.

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2010 SN-ARVO

'Diabetic Retinopathy: From Bench to Population'

Vision Research Foundation, the research wing of Sankara Nethralaya, will be hosting the 2010 SN-ARVO meeting entitled '**Diabetic Retinopathy: From Bench to Population**', from September 9-11 in Chennai, India. This three-day symposium, which aims to improve the understanding of Diabetic Retinopathy, will feature prominent national and international faculty. Basic scientists, general ophthalmologists, retinal specialists, diabetologists and epidemiologists will be participating at the event.

The conference will focus on Clinical and Basic sciences. Topics that will be deliberated upon include the current concepts in the management of Diabetic Retinopathy, the genetic mechanisms in Diabetic Retinopathy, the role of stem cells and nano particle mediated drug delivery in Diabetic Retinopathy.

The 2010 SN-ARVO conference will enable participants to:

- ▶ Explore the recent advances in epidemiology, molecular biology, genetics, imaging and management of Diabetic Retinopathy.
- ▶ Bridge the gap between basic and clinical sciences and enhance their understanding of the various aspects of Diabetic Retinopathy.
- ▶ Promote interdisciplinary research with a common platform for epidemiologists, molecular biologists, clinical scientists and clinicians.
- ▶ Provide a setting for effective networking and discussion among various stakeholders in research and care of Diabetic Retinopathy.

Registration and abstract submission have started
For details: <http://www.sankaranethralaya.org/drpd/drpd.html>

Muscle puzzle

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Q. A 13-year-old male presented with left face turn and squint noticed since childhood. On examination, the child had 6/18 vision in the right eye with 6/9 vision in the left eye. His CTC OD: +3.00 DS/−1.50 DC×180; OS: −0.50 DS/−1.00×180. Anterior and posterior segment findings were within normal limits.

By looking at the nine gazes below,

1. What is your diagnosis? and
2. Management of the case?



Ans:

Diagnosis:

Right type II duane's retraction syndrome with exotropia and downshoot.
Right strabismic and refractive amblyopia.

Treatment:

New glasses Rx. for the right eye were given and the patient was advised to do part time occlusion of the left eye 4 hours a day.
Option of surgery was given to treat the strabismus.

Introduction to Biostatistics-5

Regression analysis

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INTRODUCTION

If two variables are correlated, then it is possible to predict the value of one from that of the other by using regression techniques. Regression analysis is a statistical tool to study the nature and extent of functional relationship between two or more variables and to estimate (or predict) the unknown values of dependent variables from the known values of independent variables. A regression line is the 'best-fit' line through the data points on a graph. The regression coefficient gives the 'slope' of the graph, in that it gives the change in value of one outcome, per unit change in the other.

BASIC TERMS

Dependent (response) variable: The variable which is predicted on the basis of another variable is called a dependent variable. It is usually denoted by Y .

Independent (explanatory) variable: The variable which is used to predict another variable is called an independent variable. It is usually denoted by X .

For example, in a study, intraocular pressure and central corneal thickness were compared. Then the intraocular pressure is a dependent variable and the central corneal thickness is an independent variable.

Slope: It quantifies the steepness of the line. It equals the change in Y for each unit change in X . It is expressed in the units of the Y -axis divided by the units of the X -axis. If the slope is positive, Y increases as X increases. If the slope is negative, Y decreases as X increases. The Y intercept is the value of the line when X equals zero. It defines the elevation of the line.

TYPES OF REGRESSION

Simple regression

Simple linear regression is used to obtain linear relationship between one dependent variable (continuous) and one independent variable. The value of independent variable is used to predict the value of the dependent variable by means of a simple linear mathematical function, the regression equation, which quantifies the straight-line relationship between the variables. The simple linear regression equation is the same as the equation for any straight line:

$$\text{Expected value of } Y = a + bX$$

where a is a constant, known as the 'intercept constant', the point where the regression line cuts the Y -axis when $X=0$, b

is the slope of the regression line and is known as the regression coefficient, and X is the value of the independent variable.

Once the values of a and b have been established, the expected value of Y can be predicted for any given value of X .

For example, we can predict the weight of children based on their age. Here age is known as the 'predictor' and also known as the independent variable, whereas weight is referred to as dependent variable. Hence the simple linear regression line can be written as

$$\text{Weight} = a + b(\text{age})$$

The three possible ways in which a slope can be found in a study are the following:

Multiple regression

Multiple linear regression is used to obtain linear relationship between one dependent variable (continuous) and more than one independent variable. More than one variable (Independent) is used to predict the value of dependent variable.

$$Y = a + bX_1 + cX_2 + dX_3 + \dots$$

For example, if a hypotensive agent is administered prior to surgery, recovery time for blood pressure to normal value will depend on the dose of the hypotensive agent given and the blood pressure level during surgery. Here the recovery time (dependent) depends on more than one factor, and hence multiple regression analysis should be used to predict its value as in the following mathematical function:

$$\text{Recovery times} = \text{Constant} + b(\text{drug dose}) + c(\text{blood pressure level}).$$

Logistics regression

It is used to describe the relationship between a categorical outcome variable and one or more categorical or continuous predictor variables.

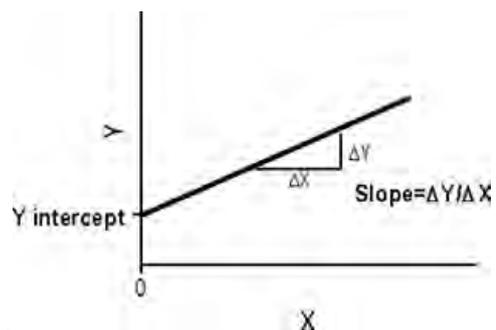


Figure 1.

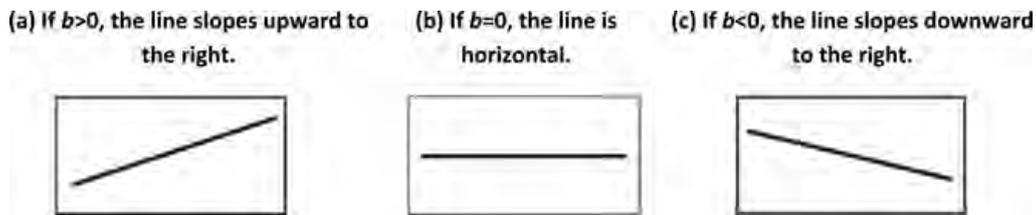


Figure 2. Three possible graphs of $Y = a + bX$.

Logistic regression is a variation of ordinary regression which is used when the dependent (response) variable is a dichotomous variable (i.e. it takes only two values, which usually represent the occurrence or non-occurrence of some outcome event, usually coded as 0 or 1) and the independent (input) variables are continuous, categorical, or both. For instance, in a medical study, the patient survives or dies.

Unlike ordinary linear regression, logistic regression does not assume that the relationship between the independent variable and the dependent variable is a linear one. Nor does it assume that the dependent variables are distributed normally.

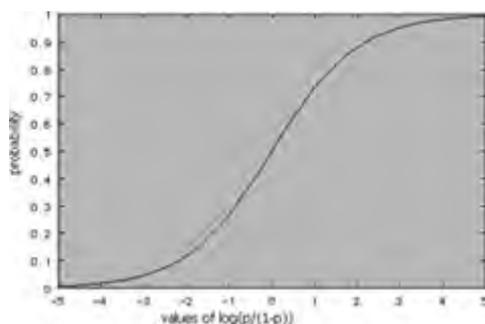
The form of the model is

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k$$

where p is the probability that $Y=1$ and X_1, X_2, \dots, X_k are the independent variables (predictors). $\beta_0, \beta_1, \beta_2, \dots, \beta_k$ are known as the regression coefficients, which have to be estimated from the data. Logistic regression estimates the probability of a certain event occurring.

Logistic regression thus forms a predictor variable ($\log(p/(1-p))$) which is a linear combination of the explanatory variables. The values of this predictor variable are then transformed into probabilities by a logistic function. Such a function has the shape of an S. On the horizontal axis, we have the values of the predictor variable, and on the vertical axis we have the probabilities.

Logistic regression also produces odds ratios (ORs) associated with each predictor value. The 'odds' of an event is defined as the probability of the outcome event occurring divided by the probability of the event not occurring. In general, the OR is one set of odds divided by another. The OR for a predictor is defined as the relative amount by which the odds of the outcome increase (OR greater than 1.0) or decrease (OR less than 1.0) when the value of the predictor variable is increased by



one unit. In other words, (odds for $PV+1$)/(odds for PV), where PV is the value of the predictor variable.

Basic assumptions for regression model are as follow:

- (i) Independence: all observations are independent of one another.
- (ii) Normality: data should follow normal distribution.
- (iii) Linearity: there should be a linear relationship between the cause and effect.
- (iv) Constant variance: the variation between the dependent and independent variable should be significant and constant.
- (v) Outliers: the presence of outliers should be checked before the regression modelling.
- (vi) Need for additional predictor variables: to get more accurate results, always look for an additional independent variables in a study.

Tests for goodness of regression model

Coefficient of determination (r^2) is the measure of goodness-of-fit of linear regression.

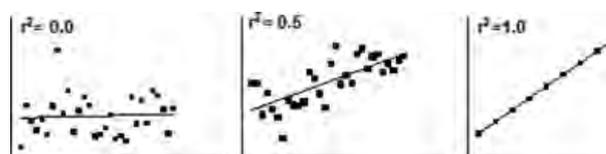
THE MEANING OF r^2

The value r^2 is a fraction between 0 and 1 and has no unit. An r^2 value of 0 means that knowing X does not help you predict Y . There is no linear relationship between X and Y , and the best-fit line is a horizontal line going through the mean of all Y values. When r^2 equals 1, all points lie exactly on a straight line with no scatter. Knowing X lets you predict Y perfectly.

CONCLUSION

To summarize, in a study, whenever a relationship between two or more variables has to be tested, first plot a scatter diagram between them and then determine the level of correlation. If the correlation value is >0.5 , then one can predict the value of the dependent variable from the independent variable using the regression model as explained above in the chapter.

In the next edition, we will discuss about inferential statistics.



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Probing and syringing the nasolacrimal duct in infants: guidelines for prevention of anaesthetic complications

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Congenital nasolacrimal duct obstruction is among the most commonly encountered congenital anomaly in paediatric age group, presenting in up to 30% of newborn infants.

Probing for congenital nasolacrimal duct obstruction is a simple ophthalmic outpatient procedure, but it carries anaesthetic risks. The irrigated fluid along with accumulated collected infected secretion in the obstructed nasolacrimal duct can get aspirated into the respiratory tract. It can also cause severe laryngospasm.

ANAESTHETIC MANAGEMENT

Anaesthetists must be able to manage severe laryngospasm accompanied with hypoxia or cyanosis. If in anxiety, if they forcibly try to ventilate with a mask in an unintubated child, the already collected fluid will be forced into the respiratory tract along with the air.

Hence, a safer anaesthetic technique should prevent the collection of irrigated fluid in the throat which should include the following procedures:

- (a) Positioning of the child in Rose position (position for tonsillectomy) and
- (b) Suctioning of the injected fluid as soon as it is injected and before it gets collected.

MODIFIED TECHNIQUE

Endotracheal intubation is done under intravenous anaesthesia followed by muscle relaxant and oxygenation, ventilation under monitoring.

The child is positioned in Rose position followed for tonsillectomy.



Rose position

In this position, both the head and neck are extended. This is done by keeping a sand bag under the patient's shoulder blade. In this position, there is virtually no aspiration of blood or secretions into the airway.

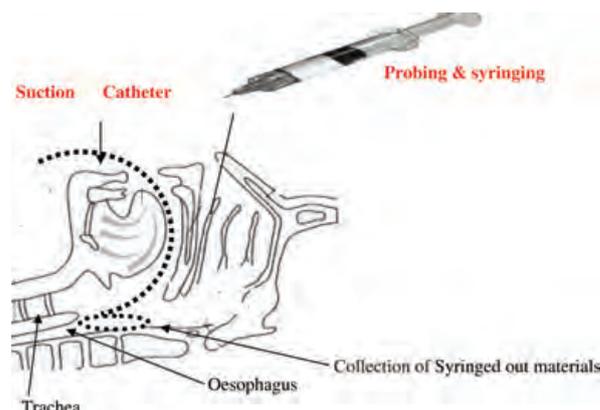
Paediatric size suction catheter is placed in the throat, and all secretions in the throat are sucked out before probing. After probing, saline coloured with sterile fluorescein strip is injected. Simultaneously, the suction apparatus is switched on to suck out the injected fluid.

Flow of saline in the throat is confirmed by passage of fluorescein-stained saline passing through the suction catheter. This also forms a confirmation test for the patency of the nasolacrimal duct after probing.

Before recovering the child and extubating and removing the sand bag under the shoulder, all secretion blood and syringed fluid should be sucked out completely.

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Technology Update

Selective laser trabeculoplasty

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INTRODUCTION

Laser trabeculoplasty using the argon laser was described in a classic paper by Wise and Witter in 1979. Anderson and Parrish then discovered in 1983 that selectively absorbed optical radiation could cause damage to pigmented structures. In theory, this made precise aiming unnecessary because inherent tissue properties provide target selectivity. Latina and Park applied this concept and demonstrated that selective targeting of pigmented trabecular meshwork (TM) cells was possible.

Selective laser trabeculoplasty (SLT) utilizes this principle of selective photothermolysis which relies on selective absorption of a short laser pulse generated and spatially confined to the pigmented TM cells. A Q-switched, frequency-doubled 532-nm Nd:YAG laser is able to deliver a short pulse duration of 3 ns that limits the conversion of energy to heat, further minimizing the collateral tissue damage. The thermal relaxation time of a chromophore is the time required to convert absorbed electromagnetic energy to heat energy. A short pulse duration is critical to prevent collateral tissue damage. If the energy deposition time is short, as in the case with a Q-switched laser, minimal heat transfer takes place. The 1-ms thermal relaxation time of melanin and the 3-ns SLT pulse essentially prevents thermal dissipation to surrounding tissue.

MECHANISM OF ACTION

In SLT, disruption or death of pigmented TM cells alone appears to induce a response that results in intraocular pressure (IOP) reduction. Biological effects may be more important and include some immediate responses involving the release of chemotactic and vasoactive agents, such as the cytokines interleukin-1a, interleukin-1b, and tumor necrosis factor- α . These factors are involved in the release of gelatinases, in macrophage recruitment, and in other activities affecting aqueous outflow directly or indirectly. Cytokines act as growth factors for human TM cells, which repopulate the SLT-treated areas and these factors could act at the level of the Schlemm's canal to increase transendothelial fluid flow. Cytokines are also involved in the expression of certain metalloproteinases and stimulate the remodeling of the extracellular matrix of the TM and increase aqueous flow. Hence, SLT probably stimulates the intrinsic system to remodel the TM without causing observable mechanical or thermal

damage to the lasered area. The biological effect rather than a mechanical process in SLT could account for the IOP lowering effect in the eye contralateral to the treated eye. Localized laser treatment induces a general low-grade inflammatory process in other parts of the TM through the spread of free radicals in the aqueous humor. This may initiate anti-inflammatory cells to clean up the whole TM and facilitate aqueous outflow. The large spot size in SLT (400 μ m) versus 50 μ m in ALT is used to maintain a low fluence (energy/area), which is essential for the selectivity of the SLT. Because the spot size is large, the laser beam probably has an effect on the pigmented cells not only in the TM, but also potentially in the ciliary body.

PROCEDURE

SLT is performed on eyes pretreated with apraclonidine (Iopidine, Alcon), with 50 spots applied adjacent to each other over 180° of TM per session. A Goldman three-mirror gonioscopes is placed on the eye with methylcellulose. The aiming beam is then focused onto the pigmented TM. The 400- μ m spot size is large enough to irradiate the entire antero-posterior height of the TM. The visible end-points of typical conventional ALT, such as blanching of the TM or bubble formation within the TM, are not seen with SLT. To determine the optimum energy level for SLT for each eye, the Nd:YAG laser energy is initially set at 0.8 mJ, and then the energy level was increased by 0.1 mJ until the threshold energy for bubble formation is observed. After the threshold energy was identified or if bubble formation is already noted at the initial energy level, the laser energy level is decreased by increments of 0.1 mJ until no bubble formation is observed. This lower energy level is known as the 'treatment energy'.

Treatment is done in single-pulse mode placing 50 \pm 5 contiguous, but not overlapping, 400 μ m laser spots along 180°. Bubble formation is monitored with each pulse. In cases with significant variation in trabecular pigmentation, the pulse energy is decreased if bubble formation occurred as described above. Post-op medications consist of topical steroids administered for 3 to 4 days. The period of time required for IOP reduction to be observed after SLT has been found to be highly variable, but frequently, within 4–6 weeks the SLT effect may 'kick-in' to result in an IOP reduction, but in some patients the response may take even longer, up to some months.

INDICATIONS AND OUTCOME

The indications for treatment with SLT are similar to the indications for ALT. Patients with open-angle glaucoma, who are candidates for conventional ALT, can be considered for SLT. SLT may be especially effective in treating patients with failed ALT, in whom TM scarring precludes the repeated use of ALT. The lack of thermal collateral damage suggests that SLT is a repeatable procedure that can be used as a non-invasive, long-term management for uncontrolled open-angle glaucoma, whether as a primary treatment, or as an adjunct to medications or in eyes with prior ALT/LTP needing further IOP lowering. SLT has also been shown to work well with patients with pigmentary, pseudoexfoliation, and juvenile open-angle glaucomas. Furthermore, this treatment is also a reasonable alternative to patients who are poorly

compliant or have problems obtaining or are intolerant to their glaucoma medications.

SLT should not be used in patients with narrow-angle, congenital glaucoma, and cautiously with inflammatory glaucoma.

SLT seems to be an effective, repeatable, and safe alternative to ALT in the treatment of open-angle glaucoma. Any ophthalmologist who currently performs ALT can easily shift to SLT.

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I also take the opportunity to welcome you all to visit Elite School of Optometry and Sankara Nethralaya. The tour of our facilities can be arranged on request. We plan to recognize innovations in the field of eye/vision care through the Prof SRG-ESO Innovation Award. For ophthalmic companies, it will be a great opportunity to meet so many vision care practitioners from all over the country. So, block your dates to be part of the conference. I am sure it will be an experience you will cherish for a long time.

With regards,
R.K.K.
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