

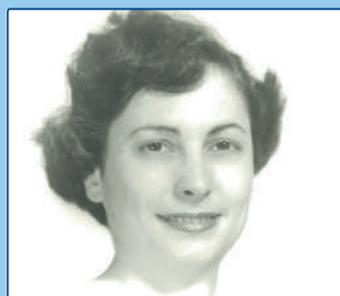
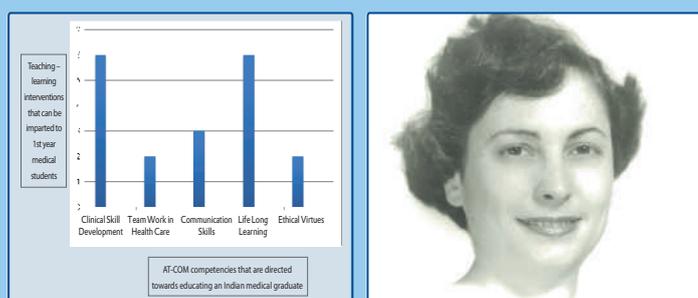


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MEDICAL JOURNAL

International Peer Reviewed Journal



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- Quo Vadis - Heart Valve Therapy
- The Significance of Teaching - Learning Methodology in Fulfilling the Goals of Competency Based Medical Education.
- Colour Vision Deficiency Amongst Medical Students – A Cross-Sectional Study
- Borderline Ovarian Tumors
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- Nina Braunwald - The Original Female Cardiothoracic Surgical Giant
- Interview with Professor - James Tatoulis

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MEDICAL JOURNAL

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Editorial

Greetings from the editorial board of Chettinad Health City Medical Journal

It gives us immense pleasure to bring out the final issue of volume 7. We take this opportunity to thank the authors and reviewers for their unceasing support. This issue has articles from various specialties, with three articles from cardiothoracic-vascular surgery. The perspective article on heart valve therapy explains about the evolution of valvular surgery in terms of advances in the procedure and the prosthetic valves used.

The efficiency of teachers for providing standard medical education plays a crucial role in moulding the future doctors. The first original article emphasises the importance of the teaching-learning methodologies in imparting competency based medical education. Medical postgraduates were evaluated on their knowledge of the Attitude and Communication (AT-COM) module which aims to strengthen the delivery of quality medical education.

The other original article is a cross sectional study to analyze the prevalence of colour vision deficiency amongst medical students. It was indeed a surprise to know that colour vision deficiency was seen in 3% of medical students involved in the study.

The review article on Borderline ovarian tumors (BOT) gives us an insight on the diagnosis, management and follow-up of BOT. The review article on Polypharmacy gives a detailed description on how polymedication can affect patient treatment and response. The article also provides suggestions on how to minimize the number of prescribed drugs.

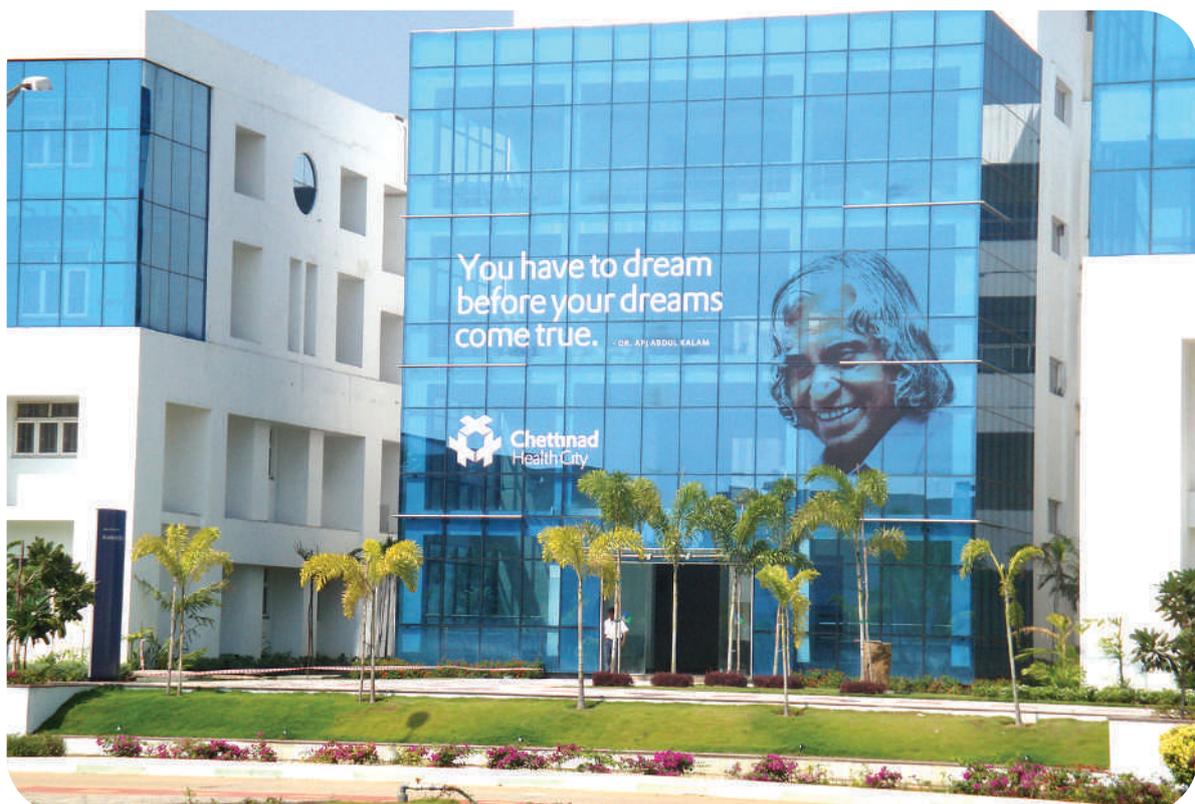
The Pages of History article is about Dr.Nina Braunwald the first female cardiac surgeon, and the difficulties she went through to 'break the glass ceiling' during the era when men ruled the surgical specialty.

To conclude with, we have the Interview with Prof. James Tatoulis, Professor of Cardiothoracic surgery, Australia who has been a mentor for many cardiac surgeons and is an active researcher.

Hope you will find this issue to would be informative and interesting. We look forward to your feedback.

Dr. Puvithra T

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Perspective Article

Quo vadis, Heart valve therapy? (Where are you heading?)

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Chettinad Health City Medical Journal 2018; 7(4): 125 - 126

It was over a hundred years ago that Sir Lauder Brunton, a visionary cardiologist first envisioned surgical intervention for valvular heart disease. The first procedure performed for the relief of heart valve disease was Closed Mitral Valvotomy, which was developed by bold mavericks like Souttar, Bailey and Brock. After several failures, success ensued. The indomitable pioneering spirit of these surgeons is best exemplified by Charles Bailey. His operating authority was revoked in all the hospitals but two, due to multiple failures. To overcome this minor obstacle, he posted simultaneous cases in the remaining two hospitals so that he could operate the patient in the second hospital if things went wrong in the first case. Before the hospital got the news that his first patient died, Bailey rushed to the second hospital and did a successful case, that later became the cornerstone for development of Mitral valve surgery.¹

The next big development in the surgical management of valvular heart disease was artificial valves. The development of cardiopulmonary bypass gave a fillip to artificial valve replacement in the latter half of the last century. Myriad valves were developed and refined. However, the requirement for oral anti-coagulation with its associated morbidities proved to be an insurmountable problem.²

The great French surgeon Alain Carpentier was responsible for developing tissue valves and valve repair techniques that would avoid the complications related to oral anti coagulation. He devised a reproducible model based on pathophysiology of the mitral disease, which is being used by every surgeon till date. Other pioneering surgeons such as Yacoub, David and El Khoury developed techniques of aortic valve repair, that were both durable and reproducible. By the turn of the century, surgical therapy and interventional therapy in the form of balloon valvotomy had been perfected with excellent results.³

From closed valvotomies to valve replacements with mechanical as well as bioprosthetic valves and then to valve repairs, minimal access approaches were the subsequent development in the treatment of valve diseases. Conventional sternal splitting approaches to valve surgery offer excellent exposure for valve replacement techniques with good patient recovery. However, sternotomies have their own set of complications. Rare cases of sternal wound infections could be extremely morbid with multiple surgical procedures and a resultant unseemly scar. Return to normal activities was also slow and cosmesis was not great, particularly important for younger patients. Sternal sparing minimally invasive approaches through minithoracotomies and partial sternotomies have slowly developed to be the choice in many centers, these minimal access approaches have been shown to be safe and can be used in the vast majority of patients.⁴

The trans arterial aortic valve replacement has taken the world by storm and is poised to replace surgical aortic valve replacement as the gold standard. TAVI (trans catheter aortic valve implantation) was developed as a palliative alternative to surgical aortic valve replacement in patients with prohibitive risk. With refinement of technique and catheters and improved collective experience, these procedures can be undertaken in nearly all patients requiring aortic valve replacement. The only prohibitive factor for these procedures is the cost, which can run up to five times the cost of traditional aortic valve replacements.³

In the foreseeable future bio-prosthetic tissue valve implanted either surgically or in the cath labs are going to remain the gold standard. The Achilles heel of bio-prosthetic tissue valves is Structural Valve Degeneration and it is being studied and addressed. Improvement in valve design, storage and implantation has improved the durability of these valves. Results from the last 20 years have been extremely satisfying, especially in the aortic position. These tissue valves will continue to be used in the older age group. However, patients below the age of 60 will also be increasingly considered for tissue valves as the feasibility of the valve in valve implantation by TAVI has been shown to be safe and feasible in degenerated valves.⁵

Finally, development of novel therapeutic targets to prevent or regress valve disease are being worked on. Defining the gene expression and various cellular and extracellular factors responsible for initiation and progress of valve disease will lead to developing gene based and drug-based therapy of at-risk patients. This will either halt or prevent disease in these high-risk groups. There have been a growing number of researchers involved in studying the actual disease process at the tissue and cellular level. Improved understanding of the genetic expression and response to hemodynamic stress is possible now with the advent of laboratory bioreactors. New insights have provided greater understanding of the complex cell-matrix interactions responsible for initiation and progression of valve disease.⁶

Recognition of the micro structure of the native valves and their ability to repair and regenerate over a 3 billion cycle lifestyle will allow critical modification in the design of degeneration-resistant tissue valves in the future. Tissue engineering has also progressed to the animal experimentation stage, this maybe the answer to the 'Holy grail', the perfect valve. The perfect valve has been described to be non-obstructive, non-thrombogenic, which will grow with the patient and last a lifetime.⁴ Better understanding of the mechanobiology of the valves, cell-cell and cell-extra cellular matrix interaction, as well as their role in initiation and progression of valve calcification will result in development of novel therapeutic targets to prevent or even

regress valve disease. This new understanding will also improve existing tissue valves and provide insights on methods to prevent structural valve degeneration. In the foreseeable future we will have the 'perfect' tissue engineered heart valve.^{5,6}

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Original Article

Colour Vision Deficiency Amongst Medical Students - A Prospective cross-sectional study

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Abstract

Introduction: This study was conducted to analyze the prevalence of color vision deficiency among a group of medical students.

Materials and Method: In this prospective cross-sectional study, 300 undergraduate medical students in the age group of 19-22 years were screened for Color Vision Deficiency (CVD) using Ishihara's Pseudo-isochromatic chart. Students with defective color vision were identified.

Results: After careful screening it was noted that, out of the 300 students, color vision deficiency was seen in 9 students (3%) including 8 males and 1 female.

Conclusion: Our study shows a male preponderance for color vision deficiency which is similar to the previous studies done. CVD commonly remains undetected and hence medical students and doctors must be screened for color vision deficiency and made aware of their defect, so that they can take special care in future clinical practice.

Key Words: Color blindness, Ishihara plates, Medical students.

Introduction

Color plays an important role in being a sign in medical practice. Right from Biochemistry and Histology to Internal Medicine and Surgery, we unconsciously rely on our color vision to help us. However there has not been a lot of work done on studying the effects of Color Vision Deficiency (CVD) amongst doctors and medical students.

Awareness of the implications of CVD is usually restricted to those who suffer from it. Some doctors have given accounts in published articles about the difficulties it causes in medicine, and a couple of research articles have been published on this subject. Conclusions drawn from personal accounts inevitably are subjective, but recent studies have provided better evidence on the types of difficulty encountered and the effects on performance.

Screening for this deficiency pre-vocationally is only done for a few professions where color vision is considered important and not as a routine, even in the field of Medicine.

Normal vision is trichromatic, three types of cones detect the three primary hues which contain photosensitive pigments which overlap and peak in the green, violet and yellow-green parts of the spectrum. By comparing the rates of absorption of photons, the visual system can discriminate colours.¹

Ganglion cells mediate color which add or subtract input from one type to cone to the input from another type.²

There are three different types of cones, which contain a photo pigment maximally sensitive to one of the three primary colors- Red, Green and Blue.

CVD is basically a disturbance in the perception of color which could be due to a decrease in the amount of visual pigment per cone or a reduction in the number of cones.³

Color vision deficiency can be congenital (CCVD) or Acquired (ACVD).⁴

CCVD accounts for 8% prevalence in males and 0.4% in females in the general population.⁴

The congenital form of CVD is usually X-Linked recessive except for Tritan deficiencies which are caused by a mutation in gene coding for blue receptor or chromosome 7 and is autosomal dominant.⁵

Acquired forms could be due to drugs,⁶ diabetic maculopathy, hypertension, macular degeneration and yellowing of the lens⁷ due to ageing.

The four types of CVD are Protan ('Red' or long wave), Deutan ('Green' or middle wave), Tritan ('Blue' or short wave) and very rarely Achromatopsia (Total absence of color vision).⁸

Widespread interest in CVD followed John Dalton's⁹ description (1798) of his deutan (middle-wave) deficiency¹⁰ but, for the preceding centuries, the deficiency has been described as 'an immensely well-kept secret'.¹¹

Materials and Methods

A prospective cross-sectional study was conducted in Goa Medical College and Hospital from April 2017-May 2017. Informed consent was obtained from all participating medical students and approval was obtained from the Ethics Committee, Goa Medical College.

A total of 300 undergraduate Medical Students aged between 19-22 years were screened using 24 of Ishihara's Pseudo-Isochromatic plates. The plates were held at 75 cm distance and tilted at right angles to the line of vision.

All the screening was conducted under daylight conditions in the Ophthalmology OPD with no use of artificial lighting. Binocular testing was done. It was ensured that the test was conducted with due correction for refractive errors both for distance and near vision.

Plate 1- Introduction Plate; Plate 2-15- transformation plates used for screening red-green deficiencies and Plate 16 and 17 are used for protan and deutan defects. If 13 or more plates were red normally, color vision was regarded as normal. If less than 9 plates were red normally, the color vision is considered defective.

Color deficit individuals were immediately re-tested for confirmation and subjected to refraction and correction, Slit lamp biomicroscopy, and fundus examination ensure that no other ocular abnormality was present.

Results

A total of 300 students were enrolled for the study with ages ranging from 19-22 years.

107 were Males and 193 were Females. So a significantly larger number of females were studied.

A total of 9 students were found to be Color Vision deficient accounting for 3% of the 9 students, 8 were males and 1 was female.

All the 9 students identified the first plate correctly but were unable to identify the transformation plates which other students had no difficulty with.

Four out of the nine color blind individuals were aware of their defect.

Discussion

We thus see that color vision deficiency is not rare amongst medical students. Studies have shown that it does cause significant difficulty in medical profession.

Personal accounts of Color vision deficiency have been published by four doctors.

Ahlensteil,¹² a physician; Logan,¹³ a physician; Spalding,¹⁴ a GP; and Currier, a neurologist. They reported a wide range of difficulties and many were common to all. Blushing, pallor, faint rashes, cyanosis, erythema, blood in body products, ophthalmoscopy, otoscopy, and microscopy could all cause difficulties in observation. Logan¹³ and Spalding¹⁴ recommended the screening of medical students. Logan commented that difficulties could be overcome by awareness, self-training, and effort.

A questionnaire study conducted by Spalding¹⁴ to identify problems faced by 40 Color vision deficient doctors showed that the most common problems faced were:

- Widespread body color changes of pallor, cyanosis, jaundice, and cherry red (25 doctors);
- Rashes and erythema of skin (25 doctors);
- Charts, slides, prints, and codes (24 doctors);
- Test-strips for blood and urine (22 doctors);
- Ophthalmoscopy (18 doctors);
- Blood or bile in urine, faeces, sputum, or vomit (18 doctors);
- Otoscopy (14 doctors).

Dargahi et al (2010) reported 2.40% of medical laboratory sciences students and hospitals' clinical laboratories' employees of 'Tehran University of Medical Sciences' as color-deficient.¹⁵

Pramanik T, Khatiwada B and Pandit R¹⁶ conducted a study to determine the color vision deficiency among the 215 students of Nepal medical college.

Sardighan reported 2.13% and 0.57% CVD in Iranian male and female medical students respectively.¹⁷

CVD becomes very important in cases where there is so called pivotal observation¹⁸ a single sign that is essential to observe for the correct course of action. If a doctor misses certain symptoms or clues because of CVD, the patient's medical issue may be undetected and become worse when it could easily have been prevented for example: An Ophthalmologist with CVD might miss a single dot hemorrhage on a pregnant patient's fundus which would cause him to not screen her aggressively and therein worsen her retinopathy.

Color vision deficiency is still untreatable though gene therapy is being tried on adult primates with red-green deficiency. Colour correction systems are being tried which claim to be able to change the wave lengths of each color going into one or both eyes using eyeglasses or soft contact lenses.

Conclusion

The importance of screening for color vision deficiency in medical students and doctors cannot be stressed enough to guide them in making correct choices in their specialization.

They should be counselled and because of the availability of a wide range of specialties, the need to be deemed unfit for the medical profession need not arise.

Branches like Ophthalmology, Pathology, Dermatology and Gastroenterology should be best avoided.

Screening helps doctors to identify their limitations and think of ways to overcome these challenges, thus increasing their confidence.

Ultimately, it protects the patient from harm and the doctor from litigation.

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Original Article

The Significance of Teaching - Learning Methodology in Fulfilling the Goals of Competency Based Medical Education

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Chettinad Health City Medical Journal 2018; 7(4): 127 - 130

This study was presented to the medical education unit of Christian Medical College - Vellore as a pre-requisite for the completion of the advanced course in medical education by the first author of the study.

Abstract

Title of the study: The significance of teaching-learning methodology in fulfilling the goals of competency based medical education.

Type of study: Descriptive study.

Background: This study was proposed and carried out in view of the country's ruling medical council proposing the implementation of competency based medical education, as dictated by the Attitude and Communication (AT - COM) module, in medical colleges across the country. The AT-COM module facilitates the implementation of 5 competencies to the Indian Medical Graduate (IMG) that would in turn play a role in his/her efficient health care delivery to society. Medical Postgraduates were selected to participate in the study, as they would be the significant medical educators in the time to follow.

Objectives: 1. To assess teaching-learning methodology and its role in strengthening the AT-COM competencies in medical students.
2. To assess and implement principles of competency based medical education to medical postgraduates.

Materials and Methods: Following an ethical clearance by the institutional ethical committee, this study was carried out in the Department of Physiology, CHRI. 5 postgraduates of Physiology were subjected to a questionnaire based assessment on their knowledge of the AT-COM module following which principles of AT-COM competencies were imparted to them over a period of four months on a bi-weekly basis. Following this, the most appropriate teaching method specific to the teaching of first MBBS students was matched with the AT-COM competencies.

Results: From this short-term study, it was inferred that most of the teaching during the first MBBS was directed towards facilitating two of the five competencies spelt out by the AT-COM module.

Conclusion: Since the first MBBS teacher facilitates only two of the AT-COM competencies viz. educating the IMG towards being a competent clinician and being a life long learner, it was concluded that the medical teachers of the successive years must facilitate the learning of the remaining three competencies i.e. educating the IMG in the principles of communication, professionalism and team work. Medical teachers can efficiently impart the competency of professionalism if the teaching-learning of medical ethics was scheduled at appropriate phases during the entire period of study of the IMG. Another observation brought out in this study was that medical postgraduates were not aware of the current guidelines in medical education that would facilitate their duties as a medical teacher. This could be addressed by imparting such guidelines to postgraduates during their period of study.

Key Words: AT-COM competencies, Teaching-Learning Methodology, Indian Medical Graduate.

Introduction

Medical education in India is currently facilitated towards providing health care to the evolving needs of the nation and the world. In order to achieve this, the country's ruling medical council has proposed implementing the practice of competency based medical education.

The thrust in this form of medical education is continuous evolution of thought towards medical education making it more learner-centric, patient-centric, gender-sensitive, outcome-oriented and environment appropriate. This is in turn dictated by the AT-COM competencies, that if used appropriately, will strengthen the attitude and communication skills of an Indian

medical graduate (IMG), which is mandatory to the fulfillment of the goals dictated towards the inception of competency based medical education.¹

This short-term study, conducted in the Department of Physiology at Chettinad Hospital & Research Institute, was undertaken to educate medical postgraduates on the AT-COM competencies and, in the process, decide the appropriate teaching-learning intervention in developing an IMG with the requisite knowledge, skills, attitudes, values and responsiveness so that he / she may function appropriately and effectively as a physician of first contact within the community.

Methods

Type of study = Descriptive study.

The study was carried out in concordance with standards dictated by the ethical committee of the institute.

The postgraduates of physiology, 5 in number, were subjected to a bi-weekly teaching-learning interaction on the AT-COM competencies. This was carried out over a period of 3 months with the learners taking a

pre-test as well as a post-test on the topic under discussion. The AT-COM competencies that could be imparted in the teaching-learning cycle while instructing principles of physiology, were selected from the AT-COM module, following which the appropriate teaching methodology that imparts the required competency to the IMG were spelt out.

The 5 competencies dictated by the AT COM module¹ include:

1. Clinician - who understands and provides preventive, promotive, curative, palliative and holistic care with compassion.
2. Leader and member - of the health care team and system.
3. Communicator - with patients, families, colleagues and the community.
4. Lifelong learner - committed to continuous improvement of skills and knowledge.
5. Professional - who is committed to excellence, is ethical, responsive and accountable to the patients, the community, and the profession.

Sl. No.	Competency Addressed	Teaching Intervention / Strategy followed to strengthen the Competency
1.	Demonstrate knowledge of normal human structure, function and development from a molecular, cellular, biologic, clinical, behavioral and social perspective.	<ul style="list-style-type: none"> • Didactic lectures. • Small Group discussions. • Video based teaching. • Smart board teaching. • Student seminar.
2.	Demonstrate knowledge of abnormal human structure, function and development from a molecular, cellular, biological, clinical, behavioral and social perspective.	<ul style="list-style-type: none"> • Applied physiology in didactic lectures. • Problem Based Learning. • Student Seminar.
3.	Demonstrate ability to perform physical examination that is complete and relevant to disease identification, disease prevention and health promotion.	<ul style="list-style-type: none"> • Hands-On Demonstration. • Objective Structured Practical Examination. • Chart discussion • Flash Card discussion.
4.	Work effectively and appropriately with colleagues in an inter-disciplinary professional health care team respecting diversity of roles, responsibilities and competencies of other professionals.	<ul style="list-style-type: none"> • Stressing the importance of integrated work conduct in the practical laboratory.
5.	Be able to communicate adequately, sensitively, effectively and respectfully with patients in a language that the patient understands and in a manner that will improve patient satisfaction and health care outcomes.	<ul style="list-style-type: none"> • Training of communication skills on this competency during mentorship interactions and student seminars.
6.	Be able to perform an objective self-assessment of knowledge and skills and continue learning and refine existing skills and acquire new skills.	<ul style="list-style-type: none"> • Encouragement of learners on reflective learning and putting forth the importance of self-assessment in the medical curriculum.
7.	Be able to develop a research question and be familiar with basic, clinical and translational research as it applies the care of the patient.	<ul style="list-style-type: none"> • Encouraging students to participate in medical research methodology that may be introduced as an elective.
8.	Be able to recognize and manage ethical and professional conflicts.	<ul style="list-style-type: none"> • Imparting principles of medical ethics in large group discussions facilitated by continuing medical education programs.

Table-1: Teaching – Learning methodologies directed towards strengthening the AT-COM competencies of competency based medical education

The objectives that fulfill the AT-COM competencies while training 1st MBBS students relevant to the subject of physiology include:

✓ **To bring out the student's role as a clinician:**

Demonstrate knowledge of normal human structure, function and development from a molecular, cellular, biologic, clinical, behavioral and social perspective.

✓ **To bring out the student's role as a member of a care team & system:**

Work effectively and appropriately with colleagues in an inter-disciplinary professional health care team respecting diversity of roles, responsibilities and competencies of the other professionals.

✓ **To bring out the student's role as a communicator with the patient's family, colleagues & community:**

Be able to communicate adequately, sensitively, effectively and respectfully with patients in a language that the patient understands and in a manner that will improve patient satisfaction and health care outcomes.

✓ **To bring out the student's role as a lifelong learner committed to continuous improvement of skills and knowledge:**

Be able to perform an objective self-assessment of one's own knowledge and skills and continue learning and refine existing skills as well as acquire new skills.

✓ **To bring out the student's role as a professional who is committed to excellence, is ethical, responsive and accountable to patients, community, and profession:**

Be able to recognize and manage ethical as well as professional conflicts.

Having charted out the relevant AT-COM competencies applicable to training medical students in the first year of their studies, the teaching - learning methodologies directed to strengthen the corresponding competencies were discussed in small group discussions during which time the teaching faculty of the department of study also contributed their point of view. This is presented in Table - 1.

Results

Figure-1 depicts the number of teaching-learning interventions that were used, in the institute of the study, by first year medical teachers so as to effectively address the competencies and objectives of the AT-COM module.

From this figure, it can be deduced that the preponderant teaching-learning intervention used during the first year of medical training is directed towards clinical skill development and training students to be life long learners.

Discussion

This short-term study opens one's eyes to the impact of teaching and learning methodology on developing the competencies that must be mandatorily implemented in competency based medical education.² The study

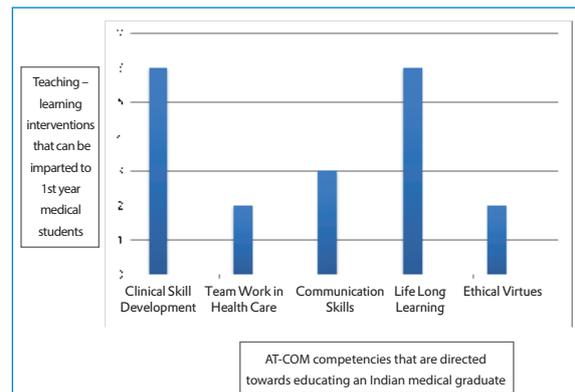


Figure-1: The AT-COM competencies and the number of teaching-learning interventions used to strengthen them, in first year medical students of the institute.

commenced with medical post graduates being made aware of essential principles of competency based medical education following which, the necessary teaching-learning interventions required to educate medical students on the same, were brought out.

It was noted that that during the first year of medical education, students were imparted six teaching-learning interventions to strengthen the domains of clinical skill competence as well as facilitation of students to be life long learners. The other domains mandatory to the development of the Indian medical graduate i.e. team work in healthcare, communication skills and ethical values were evidenced to have lesser teaching-learning interventions addressing them.

The primary inference of this short-term study is that it is mandatory for facilitators of medical education to address the domains of team work in healthcare, communication skills and ethical values to learners during the period following the first year of medical education. Of course, this must be done in addition to continuing medical education that facilitates medical students to strengthen their clinical skills as well as encourages them to be life long learners.

This study also brought out the fact that medical postgraduates, who will contribute to medical education in the days to follow, must be imparted the principles pertaining to competency based medical education.^{3,4} The postgraduates who participated in this study were made to answer a pre-study questionnaire on principles of medical education. They showed a significant improvement in the post-test questionnaire that they answered following the three months of the study.

It must be emphasized that this study paves the path for three outcomes in medical education that can be implemented in medical colleges with the advent of competency based medical education.⁵ This, in turn will allow the practice of competency based medical education to uplift the quality of healthcare within the society. These outcomes are highlighted in Table -2. It must also be remembered that the above-mentioned outcomes will facilitate the effective implementation of competency based medical education only if the chair and teaching faculty of each teaching department in a medical college specifically structure the teaching - learning exercise appropriately with regard to their subject of expertise.⁶

Short-term outcome	To develop a postgraduate who is aware of the importance of the AT-COM principles so the same can be implemented to the under graduate students during the teaching – learning process.
Intermediate outcome	To produce under graduates who will exhibit better professional conduct during the clinical years of training.
Long-term outcome	To implement a similar protocol in all the departments of a medical college.

Table-2: Outcomes of this study

In conclusion, this study shows that a competent teaching-learning methodology in medical education can allow a medical student to strengthen the three domains of Bloom’s taxonomy i.e. the cognitive, affective and psychomotor domains and also facilitate the student to ascend to the higher levels of the Miller’s pyramid.⁷

Acknowledgement - This study was carried out as a pre-requisite to completion of the Advanced Course in Medical Education and the authors of this article would like to sincerely thank the Medical Education Unit of the institute’s nodal center i.e. The Christian Medical College – Vellore for their guidance in facilitating the structure of the study.

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Review Article

Borderline Ovarian Tumors

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Abstract

About 15 to 20% of ovarian epithelial tumors are "borderline". Majority of them are serous or mucinous. They pose significant problems in diagnosis as there are no specific clinical features or investigations to ascertain the "borderline" nature. For a frozen section diagnosis an expert pathologist is needed. Surgical staging with radical surgery ensures near 100% survival in stage I. Even in advanced stage without invasive implants survival is excellent. A third of Borderline Ovarian Tumors (BOT) occur in women under 40 years. Fertility sparing surgery in early stage carries good prognosis. Laparoscopic surgery can also be undertaken without adverse effects. There is no role for adjuvant chemo/radiotherapy except probably when there are invasive implants. Prognostic factors include advanced stage at surgery, suboptimal debulking, invasive implants and micropapillary architecture. Long follow up has been recommended as recurrences are reported even after decades.

Key Words: Ovarian tumors, Borderline tumors, Fertility sparing surgery

Introduction

Ovarian tumors are common neoplasms in the lives of women. They are usually classified as benign and malignant. In 1971 FIGO introduced one more variety called "low malignant potential tumors". Subsequently WHO in 1973 named them as "borderline ovarian tumors (BOT)".¹ They are unique in the sense that they fulfil the criteria neither for benign nor for malignant. They are neoplasms with higher proliferative activity when compared with benign neoplasms but do not show stromal invasion which is characteristic of invasive malignancy. Though they can occur in any histological type, they are mostly seen in epithelial cancers. Among ovarian cancers, up to 90% are of epithelial origin and 10 to 15 % of epithelial cancers are borderline.

Epidemiology

BOTs are seen in 2.5 / 100,000 women per year. Due to improvement in diagnosis there seems to be increasing number of BOTs. It is also possible that age at menarche, menopause, increased usage of OC pills and hormone therapy, weight gain and infertility may play a role in increasing the incidence.² They present 10-15 years before their malignant counterparts. One-third present before age forty.³ The risk factors include Asian & Caucasian race, nulliparity, obesity, oral contraceptive pill usage, assisted reproductive techniques and smoking. Increased parity and lactation

are protective. Tubal ligation is not protective against BOTs.⁴ It may be noted that OC pills and tubal ligation are protective against malignant epithelial tumors.

Pathology

Out of BOTs, serous tumours account for 55% and mucinous 40%. Other histological types are rare.

Serous BOTs: They are mostly unilateral but bilateral in 25%. Majority (90%) are unilocular with fine septae. About 70% are in stage I at the time of diagnosis. The serous tumors may be papillary cystic or surface papillary lesions, adenofibroma or cystadenofibroma. There may be peritoneal implants in about 25%. These implants can be noninvasive or invasive.

The presence of a micropapillary architecture in the primary ovarian tumor is a strong predictor of invasive implants.⁵

Mucinous tumors: They may be unilocular or multilocular with fine septations and intramural nodules. They may have peritoneal implants less commonly. They may also be associated with pseudomyxoma. The implants may be secondary to malignancy of appendix. They may have intestinal (90%) or endocervical (10%) type of epithelium. The intestinal type are seen in older women, likely unilateral, multicystic and carry better prognosis. The endocervical type are seen in younger women, mostly unilocular, more commonly bilateral with peritoneal implants and carry poorer prognosis.

Following are the features of BOTs as suggested by Dietel and Hauptman⁶:

- Multi-layered epithelium (more than 4 cell layers)
- 4 or less mitoses per 10 high-power fields (HPF)
- Nuclear atypia which is mild
- Nuclear/cytoplasmic ratio increased
- Slight to complex branching of epithelial papillae and pseudopapillae
- Epithelial budding and cell detachment into the lumen
- Most importantly “no stromal invasion”

Diagnosis

BOTs pose problems of diagnosis as neither the clinical findings nor radiological findings and tumour markers are of much help in the accurate diagnosis. BOTs like the malignant ovarian tumors, do not produce any specific symptoms. A quarter of them may be asymptomatic and the rest may present with abdominal distension, abdominal pain, abdominal mass, altered bowel habits and bloating.⁵ Transvaginal sonography may reveal a complex cystic mass with septations and mural nodule. Doppler may show similar features like malignant tumors (increased vascularity and low PI). CT/MRI can detect advanced disease. Tumour markers like CA-125 may be elevated in 50% cases whereas CEA and CA 19-9 may be elevated in mucinous BOTs. None of the clinical features and investigations mentioned above can reliably predict the borderline nature of these tumors. Even the frozen section reports may be erroneous. Only histopathology confirms the diagnosis.

Staging and surgery

The staging of BOT is same as that of FIGO staging for malignant ovarian tumors. Most of the BOTs are seen in early stage. Surgical staging is mandatory as it is of prognostic value. Diagnosis of BOT at frozen section may be missed unless the pathologist is experienced. It is better to perform a complete staging once histologically a benign disease is unlikely. Though there are controversies regarding the extent of staging, the guidelines include Peritoneal washings, TAH, BSO, omentectomy, excision of deposits, biopsies of peritoneum over bowel, paracolic gutters, diaphragm etc and removal of pelvic and paraaortic lymph nodes. However, it has been found that lymph node involvement is not a prognostic factor; hence their removal can be omitted.^{7,8} In mucinous BOTs appendectomy is performed as it may be a metastasis from appendix.⁹ Studies found that most of the BOTs are inadequately staged and the recurrences are seen mostly in this group of patients.

Fertility preservation

Since a third of patients are under 40 years, and the majority present in early stage, they may need fertility preservation. In patients with unilateral tumor, unilateral salpingo-ovariectomy can be performed. Though recurrences are two to four fold more common than

radical surgery, they occur in about 10% and may not affect the survival as these recurrences can be successfully treated.⁸ Ovarian cystectomy is associated with more recurrences than ovariectomy. The risk of recurrence in the form of invasive cancer is very low. There is no need to biopsy the normal looking contralateral ovary. In bilateral tumors, bilateral ovarian cystectomy or unilateral salpingo-ovariectomy and contralateral ovarian cystectomy can be performed. Currently, more gynecologists prefer laparoscopic surgery as the survival rates are similar with less morbidity.⁸ But the controversies include spillage due to rupture of the tumour and port site metastasis. Recurrences following laparoscopic surgery may be related to ovarian cystectomy instead of salpingo-ovariectomy. When laparoscopy is considered, tumor markers have to be normal and one has to ensure that there is no spill by bagging the tumors. Once the family is complete, the completion surgery should be undertaken to reduce the recurrences as they can occur even after decades. In patients attempting conception following fertility sparing surgery, about 50% conceive. There is controversy whether assisted reproductive techniques in these patients result in increased recurrences.

Adjuvant therapy

There is no definite role of adjuvant chemo, radio or hormone therapy in early stage disease. Chemotherapy is recommended when there are invasive implants. Platinum based agents as in ovarian cancers have been tried. Even in advanced disease the results are mixed - some studies showing better survival without adjuvant therapy.⁷ Such patients are treated after enrolling in clinical trials.

Prognosis

The overall survival of BOTs is good with survival of 100% in stage I. In advanced disease without invasive implants 5 year survival of 95% can be anticipated. When there are invasive implants, the survival drops by one-third (66%).⁵ Even with invasive implants, one-third of the patients survive for 10 years. The 10 year survival for advanced disease is 65%.¹⁰ Lymph node involvement and histological subtype (serous/mucinous) do not carry any prognostic significance.⁸ Advanced FIGO stage, suboptimal debulking, invasive implants and micropapillary architecture carry poor prognosis.^{5,8,10,12} Progression to low grade serous carcinoma has been reported after long follow up. Hence, long follow up is advocated.¹⁰

Conclusion

BOTs are relatively rare epithelial tumors which usually present in early stage and carry excellent long term survival. Though staging laparotomy and radical surgery is the rule, in younger women with early disease fertility sparing surgery can be undertaken without affecting the survival. Minimal invasive surgery also can be undertaken with all its advantages. Adjuvant therapy is usually not advised.

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Review Article

Polypharmacy

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This article focuses on the discussion of the term "Polypharmacy", the rationality of polymedication, its limitations, the understanding of the concept in other systems of medicine and suggestions to minimize polymedication.

The term "Pharmacy" is derived through French and Medieval Latin from Ancient Greek word, *phármakon*, which means "a drug", "charm" and "enchantment."¹

Pharmacy is the art, practice, or profession of preparing, preserving, compounding, and dispensing medical drugs.² However, today, the pharmacies perform only the function of storing and dispensing of drugs. In common usage, pharmacy refers to a shop or hospital dispensary where approved medicinal drugs are sold.

Pharmacy practice also includes clinical services, reviewing medications for safety and efficacy, and providing drug information.

The term 'Poly' in English refers to more than one. Hence, Polypharmacy means more than one pharmacy and it may mean, getting drugs from more than one pharmacy. The pharmacy can dispense modern drugs, drugs of traditional medical systems or other systems, in which case polypharmacy may mean getting drugs of different systems of medicine from more than one pharmacy.

The concept of "polypharmacy" is said to have originated more than a century ago,³ but it has gained importance only in the recent past due to the prevalence of multiple medical disorders in individual patients.

Currently polypharmacy does not refer to multiple pharmacies, but multiple medications. However, there is no consensus about the meaning and definition of the term.⁴

According to WHO, the definition of polypharmacy is "the administration of many drugs at the same time or the administration of an excessive number of drugs" (WHO, 2004). WHO has not specified the number of drugs. The use of five or more medications is considered polypharmacy by most of the authors.^{5,6}

In patients suffering from cardiovascular disorders, even using more than two cardiovascular drugs is considered polypharmacy.⁷

If number of drugs is the criterion to define polypharmacy, then, if a patient takes a single tablet of a fixed drug combination like antitubercular formulation containing four first line drugs along with Paracetamol and Ranitidine can it be considered polypharmacy? If one takes, along with less than five tablets, an herbal extract which contains many active ingredients, can it be considered polypharmacy? In both cases, the number of drugs taken is more than five though the number of tablets is less than 5. Therefore, both may be regarded as polypharmacy.

As the term polypharmacy is used to refer to multiple medications rather than multiple pharmacies, the term "polymedication" may be more apt than polypharmacy. Polymedication can be due to using:

1. Multiple medications of modern system of medicine
2. Combination of drugs of modern and other systems of medicine like Siddha or Ayurvedha

Let us first consider multiple medications of the modern system of medicine.

Polypharmacy is grouped under different types:

- a) Appropriate polypharmacy⁸
- b) Problematic polypharmacy⁸
- c) Simultaneous polypharmacy⁹
- d) Cumulative polypharmacy⁹
- e) Continuous polypharmacy^{9,11}

a) Appropriate polypharmacy refers to prescribing for a patient with multiple medical problems where the selection of drugs is optimized based on the best available evidences and prescribed for the utmost benefit of the recipient. E.g: prescribing medications for a patient with hypertension, diabetes and ischemic heart disease with antidiabetic, anti-hypertensive and cardioprotective drugs.

b) Problematic polypharmacy is prescribing multiple medications inappropriately where the given combination may cause risk/ harm to the patient. E.g. Prescribing drugs to counteract the potential side effects of other drugs, like giving antiulcer medication (PPIs especially, Pantoprazole) along with anti-microbial or antihypertensive drugs, which are not known to cause gastritis. Most of the patients suffering from cardiovascular and metabolic syndrome take PPIs continuously everyday

along with other drugs as they are not advised to stop PPI by the physician. Patients are also unable to stop PPI for fear of rebound acidity. The long-term toxicity of PPIs may result in malabsorption of calcium and magnesium which could lead to bone fractures or cardiac abnormalities. The 2013 ACG guidelines have given a warning about the risk of increased *C. difficile* infection and community-acquired pneumonia in patients taking long term PPIs.

Problematic polypharmacy can also be called as inappropriate polypharmacy as the medications which could eventually be cumulatively toxic are used indiscriminately.¹⁰

c) Simultaneous polypharmacy denotes the number of drugs simultaneously taken by a patient on a given day. For example, prescribing antimicrobial, antipyretic, antiemetic, antiulcer and antihistamine for a patient with fever may be considered simultaneous polypharmacy.

d) Cumulative polypharmacy is the sum of different medications administered generally over a given period of time like three months to twelve months.

e) Continuous polypharmacy indicates limited number of medications taken regularly for a prolonged period.¹¹ Life-long therapy for diabetes, hypertension and Ischemic heart disease are examples of continuous polypharmacy.

Factors influencing Polypharmacy

1) Coexisting morbidities

It is very common at present to see patients suffering from multiple medical problems. When a patient suffers from hypertension, diabetes, dyslipidemia and ischemic heart disease, it is inevitable that he/she has to be prescribed multiple drugs. In this situation polymedication is a necessity. However, the physician has to carefully select the drugs in order to avoid adverse effects due to drug interactions.

2) Geriatric age group

The life expectancy is increasing globally. In India it was 67.14 years in 2012, and in 2018, it has improved to 68.8 years.¹² The population living beyond 60 years is projected to increase significantly from 104 million in 2011, to 174 million in 2026.¹³

The older population is liable to suffer from multiple disorders – diabetes, hypertension, cardiovascular disease, parkinsonism, Alzheimer's, renal dysfunction and others. Hence, it is essential for them to be prescribed with multiple medications. As the renal and hepatic function decline with age, dose adjustment is necessary to prevent the occurrence of adverse effects in this vulnerable population.

3) Vulnerability of physicians

The physician's practice of prescribing more drugs than the necessary ones contributes to polymedication, which can be due to the pressure from the pharmaceutical agents to promote certain drugs.

4) Insurance

Coverage of expenditure of treatment by medical insurance can persuade both the physician and patient to adopt polypharmacy.

5) Symptomatic treatment

The patient is simply treated for the symptoms rather than the cause of the symptoms. Multiple symptoms could be due to one cause like diabetes or depression. For example, drugs are prescribed for each of the symptoms such as body pain, fatigue, headache, body weight changes and lack of sleep, all of which are associated with diabetes or depression. Such treatment of symptoms will not be treatment of the disease itself.

6) Non-availability of the information on the drugs prescribed previously

Most of the time it may not be possible to find out why a particular drug was prescribed earlier. The current examination of the patient may not indicate the necessity to administer such a drug. The treating physician may continue the same drug to avoid withdrawal effects.¹⁴ Consider, for example, continuing a patient on Insulin even when the blood sugar remains consistently controlled with oral antidiabetic drugs.

7) Consulting multiple Physicians

Each physician prescribes from the perspective of his/her own specialty without taking into consideration the drugs prescribed by the other physicians. An orthopedist prescribes an antiulcer medication along with an analgesic, and a general physician prescribes antimicrobial and antiulcer drugs for respiratory infection in a diabetic patient. Ultimately, the patient has two antiulcer medications even when he or she does not suffer from gastritis. It is common to see antiulcer medication being prescribed in most of the prescriptions.

8) Withholding information by patients

Patients take treatment from more than one physician without informing the details of medication prescribed by the other physicians. Sometimes the patients take drugs of modern medicine as well as those of other systems of medicine such as Siddha and Ayurvedha which may result in drug interactions. Certain herbal products like soya, garlic, Ginkgo biloba can interact with warfarin metabolism.¹⁵

In addition, the patients may be taking multivitamins on their own. Even as prescription of proton pump inhibitors with antidiabetic or antihypertensive drugs has become a routine, prescription of multivitamins with multiminerals has also become a common practice.

9) Self medication

Easily available information on the internet emboldens the patients to choose drugs for themselves. Moreover, patients consume many health medicines such as natural preparations thus increasing the number of drugs.

10) Over the counter drugs

Patients are also likely to take OTC drugs in addition to the drugs they take regularly. This can add to polymedication. OTC drug formulation like antacids can inhibit the absorption of other drugs.

11) Taking medication on the advice of the staff in the pharmacy

Drugs are issued to patients by the sales person in the pharmacy without a prescription. As the dispensing person in the medical shop will not be able to diagnose,

wrong drugs may be issued resulting in problematic polymedication.

12) Fixed drug combinations (FDCs)

Fixed drug combinations usually contain more than one drug. Some of the commonly available combinations include Amoxicillin and Clavulanic acid, Furosemide and spironolactone, Telmisartan and hydrochlorothiazide, Metformin and Glimepiride. If a patient takes all these four formulations, the number of drugs taken will not be four, but eight though the tablets are four. Though this will not count as polypharmacy (as the number of drug combinations is only four), it is still polymedication as the number of drugs exceeds five.

The above discussion shows that the causes for polymedication are multifactorial.

Rationality of polypharmacy:

1) Concurrent treatment of multiple medical problems: As discussed earlier, when patients suffer from multiple problems multiple medications become mandatory to give relief from suffering.

2) Prevention of ADRs: The side effect of one drug is counteracted by another drug (Hypokalemia that could be caused by digoxin can be prevented by coadministration of ACE inhibitors and both are indicated in congestive cardiac failure). Thiazide diuretic is administered with potassium sparing diuretic to avoid potassium deficiency that can be caused by thiazide diuretic.

3) Dose and toxicity reduction: The dose of individual drugs can be reduced in order to reduce toxicity. For example, in cases of autoimmune disorders like rheumatoid arthritis, along with low doses of corticosteroids, steroid sparing drugs like methotrexate could reduce toxicity and benefit the therapeutic outcome.

4) Prevention of drug resistance as in tuberculosis and anti-HIV therapy in which polymedication is approved.

5) Prevention of risk factors : Drugs are given prophylactically to prevent risk factors for a particular disease. "Polypill" was a concept introduced by Wald and Law in 2003, and the pill composed of a statin, thiazide, β -blocker, ACE inhibitor, folic acid, and aspirin. It was predicted that such a polypill could reduce the risk of Ischemic heart disease by 88% and stroke by 80% in the geriatric population.¹⁶

6) Reduction in the cost: Though polymedication can increase the cost of drug therapy, replacing costlier drugs with less costlier ones with equal efficacy will reduce the cost and improve the rationality of multiple drug use.

Limitations of polypharmacy:

1) ADRs due to drug interactions

In addition to adverse effects caused by individual drug therapy, inappropriate combinations can cause adverse effects due to drug interaction. The analysis of prescriptions of older patients carried out in Sweden revealed that those prescribed 5 to 7 drugs daily were 4 times more likely to experience a drug-drug interaction; those taking 8 to 10 medicines

8 times and those taking 14 to 16 medicines were 20 times more likely to experience adverse reactions due to drug interactions.^{17,18} In adults above the age of 55, daily consumption of five or more drugs is found to be associated with risk of impaired mobility and global cognition, independent of the comorbidities and of the pharmacological class.¹⁹

The prevalence of hepatic cytochrome enzyme-mediated, drug-drug interaction was 80% in a prospective cohort study conducted among adults taking five or more medications and the risk increased to 100% when the number of drugs was twenty or more.

The author knows of a patient prescribed with diltiazem and metoprolol for hypertension, was advised to have a cardiac pacemaker by a cardiologist, as the patient's heart rate (HR) was below forty. However, when diltiazem was replaced with Telmisartan (ARB), it resulted in improvement in HR the next day and in a few days HR became normal and the patient did not require pacemaker. Identification of such complications due to drug interaction is a mandatory skill required to prevent unnecessary treatment as well as anxiety to the patient.

2) Drug Burden

Drug Burden Index was the tool used by Hilmer et al. to quantify the medication load. They had carried out a cross-sectional study in the geriatric population taking anticholinergics and sedatives and concluded that the combination of these two drugs reduces the functional ability of the older people over a period of five years.²⁰ Polymedication carries a higher risk in the older population due to the presence of multiple medical problems.

3) Organ toxicity

The two organs that could commonly get affected adversely due to medication overload are the liver and kidneys.

In a study conducted in Germany based on the data gathered from nursing homes, the authors observed that polypharmacy (5-9 drugs) and excessive polypharmacy (≥ 10 drugs) could cause severe renal failure.²¹

The duration of polypharmacy seems to be associated with occurrence of acute renal failure in elderly patients with multiple chronic diseases.²²

Drug-induced hepatotoxicity is a well known adverse effect. The hepatotoxicity will be aggravated with polypharmacy and the severity of hepatic damage can be high in alcoholics.

4) Failure of therapy

The failure of therapy on certain occasions could be due to the combination of drugs used. A patient with diabetes and rheumatoid arthritis (RA) was prescribed prednisolone along with hydroxy chloroquine and leflunamide. This patient was on Metformin 500 mg twice a day. Her blood sugar was normal initially, but later it remained elevated. She was advised to take Insulin. The poor control of blood sugar could be due to the administration of prednisolone. In such patients substituting prednisolone with other DMARDs would be a better alternative. Hence, identifying the cause of failure of treatment is essential in order to avoid

substituting prednisolone with other DMARDs would be a better alternative. Hence, identifying the cause of failure of treatment is essential in order to avoid polymedication.

5) Drug resistance

If the optimum dose and duration of the therapy of an antimicrobial is not followed by the patient, there is a chance for developing multidrug resistant organisms. The emergence of MDR tuberculosis could be due to this reason.

Multi-drug resistant tuberculosis is due to inadequate or improper administration of anti TB drugs. When the patients recover from the acute phase, they tend to stop taking their medication due to the long duration of treatment. As the eradication of TB bacteria is incomplete, the organisms develop resistance to drugs. When the patients report with recurrence of symptoms, the organisms may not respond to first line drugs already given and in addition they become highly contagious and spread the disease.

6) Compliance to treatment

When multiple drugs are prescribed with complicated regimen (like before food, after food, along with food, before breakfast, at bedtime, once a day, once a week etc), it is difficult for the patients, especially for those elderly who may have memory disturbances, to adhere to the therapeutic regimen. Poor compliance with treatment is common among the elderly suffering from multiple disorders such as diabetes, dyslipidemia, hypertension, Ischemic heart diseases, stroke, parkinsonism and osteoarthritis as they may have to take several drugs on a single day. Both under medication and over medication are possible, hence the treating physician should choose only drugs which are absolutely essential. Even for the younger population, it would be difficult to follow the complex drug regimen.

Let us discuss the following prescription (Table 1) given to a patient above 60 years of age. The content of the prescription is reproduced exactly how it was written:

Sl.no	Name of the drug	Dose	Frequency	
1.	Metoprolol tab	50 mg	1 OD	After meal
2.	HCO tab	200 mg	1 BD	After meal
3.	Mecovit tab		1 OD	After meal
4.	Azathioprine	50 mg	1 BD	After meal
5.	Clopidogrel	75 mg	1 OD	After meal
6.	Montelukast chewable	5 mg	1 OD	After meal
7.	Citicoline tab	500 mg	1 BD	After meal
8.	Defacort tab	6 mg	½ OD	After meal
9.	Omeprazole cap	20 mg	1 BD	Before meal
10.	Aerocort inhaler 200	One puff	1 BD	After meal
11.	Ecosprin tab	75 mg	1 OD	After meal
12.	Amlodipine tab	5 mg	1 OD	After meal
13.	Losartan tab	50 mg	1 BD	After meal
14.	Iron, B12, folic		1 OD	After meal
15.	Metformin tab	500 mg	1 OD	After meal
16.	Atorvasatin tab	20 mg	1 hs	After dinner
17.	Vit. D3 sachet	60000 IU	Weekly	After meal
18.	Sulphasazine tab	500 mg	2 BD	After meal
19.	Telmisartan tab	40 mg	1 hs	After meal
20.	Pregabalin tab	75 mg	1 hs	After dinner

Table 1 : Sample prescription 1

In this prescription, the total number of drugs prescribed is twenty. After meal refers to which meal is not given. The formulation is provided after the drug name where as it has to be given before the drug name. This is clearly a case of polypharmacy. Multiple drugs are prescribed for rheumatoid arthritis, metabolic disorder and hypertension. While the four anti rheumatoid drugs may eventually increase the blood pressure, the glucocorticoids may increase both blood pressure and glucose level. Sulfasalazine and Deflazacort may aggravate peptic ulcer. The absorption of iron may be affected by Omeprazole. The lack of improvement in this patient could be due to these interactions.

The second prescription given below (Table 2) was given to a middle-aged woman who suffered from chronic pain in the neck and joints.

The content of the prescription is exactly reproduced from the original prescription.

Sl.No	Name of the drug	Dose	Frequency
1.	Levorid	1 mg	1/7 am
2.	Allegra	120 mg	1 /7 pm
3.	Bromhexine	8 mg	1 - 1 - 1
4.	R - Cinex	600/300	1/30 minutes before breakfast
5.	Ethambutol	600 mg	2/25 minutes before breakfast
6.	Liv- 52		2-0- 2 after food
7.	Shelcal	500 mg	1- 0- 0
8.	Rocathiol	0.25 mcg	0 - 0 - 1
9.	Thyrox	25 mcg	1/30 minutes breakfast
10.	Flunarin	5 mg	1/after breakfast
11.	Becozinc		1- 0- 0
12.	Roxid	150 mg (14)	1- 0 - 1
13.	Ciplox from 8 th day	500 mg (30)	1 - 0 - 1
14.	Canditrol from 8 th day	100 mg (180)	0 - 0 - 2
15.	Libotryp from 10 th day		1/8 pm daily non stop
16.	Shallaki from 1 st day itself	400 mg	1-1-1 after food

Table 2 : Sample prescription 2

It is a complicated prescription containing sixteen drugs (two antimicrobials, antifungal, antitubercular drugs, combination of amitriptyllin and chlordiazepoxide, two antihistamines, calcium, Liv 52, Shallaki and others) from more than one system of medicine. The formulation of the drugs is not provided. The patient has to remember which day and time she should take these drugs.

Libotryp is a combination of Chlordiazepoxide and Amitriptyllin. Chlordiazepoxide is a benzodiazepine which is given for insomnia to produce sleep. It has been advised to take this medication "non-stop" and duration of the therapy is not mentioned. Though the two antihistamines -Allegra (fexofenadine) and Levorid (levocetizine) are grouped under least sedative antihistamines, they also cause sleep. Most often patients complain of excessive sedation when Levocetizine is prescribed alone. Amitriptyllin is an antidepressant with sedative effects. When these four drugs are given together what would be the extent of sedation they would cause? In fact, this particular

patient stopped all the medications and she switched over to alternative system of medicine.

The reason for prescribing both Ciprofloxacin and Roxithromycin is not known. For this particular patient, antitubercular therapy involving multiple drugs is a necessary one. But the rationale for the prescription of the non-tubercular drugs is not evident. For such patients drugs should be selected in such a way that there are no untoward drug interactions.

7) Latrogenesis

Complications due to drug interaction and adverse drug reaction can be diagnosed as new disease and treated. Hyperglycemia induced by long-term administration of steroid or IV infusion of dextrose is diagnosed as diabetes for which anti-diabetic drugs are prescribed. Subsequently, patients develop hypoglycemia and get treated with IV infusion of dextrose. This is one of the common problems encountered when patients consult multiple physicians as well as when drug history is not considered properly.

8) Cost

It is obvious that more drugs means more expense. On an average, a lower income group patient who is prescribed Metformin, Glimepride, Voglibose, Telmisartan and Metoprolol has to spend at least Rs. 1300 / month. Patients with cardiac diseases will have to spend even more, especially when they are prescribed multivitamins, calcium, vitamin D and antiulcer medication.

9) Failure of analysis before issue of prescription by the physicians

It is mandatory that every physician should review his/her prescription for potential drug interaction and the necessity for choosing a particular drug. It is very common to see a prescription having the following drugs for a patient with hypertension, and diabetes with acute exacerbation of bronchial asthma along with lower respiratory infection:

- Tab. Metoprolol 25 mg bd
- Tab. Telmisartan 40 mg bd
- Tab. Metformin 500mg bd
- Tab. Glimepride 1mg bd
- Tab. Pantoprazole 40 mg once a day/ twice a day
- MDI with Salmeterol and Fluticasone
- Tab. Amoxicillin with Clavulanic acid (500+ 125 mg) 625 mg bd for 5 days
- Cough expectorant containing Salbutamol and Ambroxol for 5 days

It is possible to say whether the above mentioned prescription is right or wrong. Right from one perspective wrong from another.

Let us discuss the benefits and risks of these drugs one by one.

Metoprolol, a beta blocker is proved to be useful in hypertension. But can it be given for a patient with diabetes? The physician should inform the patient to check blood sugar level periodically whenever he/she feels fatigue and headache as the other features of hypoglycemia such as palpitation and tremors will be masked by metoprolol.

Pantoprazole is a drug which is likely to figure in almost all prescriptions. The approved indications for Pantoprazole are Erosive esophagitis, GERD and Zollinger Ellison syndrome. Instead of pantoprazole, patients may be advised to take antiulcer medication if they develop gastritis after consulting the physician.

Salbutamol present in the expectorant can increase the heart rate and BP which can reduce the action of metoprolol and telmisartan. In addition, salmeterol and fluticasone in the MDI can produce a similar effect. The failure to control BP and blood sugar could be due to such drug combinations.

Using multiple medications from other systems of medicine:

It is common for a patient to develop fever during the course of treatment for life style diseases for which he/she will already be on multiple medications. If it is dengue fever, the patient takes Nilavembu Kudineer (NK). NK is a combination of nine medicinal plants. Among them the important one is *Andrographis paniculata*.

As it is a polyherbal formulation, it can be considered polymedication. Several lehiyagkaL and ChooranagkaL are used in therapy in Siddha and Ayurvedic systems of medicine. As the ingredients in each of these preparations have their own individual actions complementing each other producing a synergistic effect. Each individual plant extract contains multiple phytochemicals. When a polyherbal formulation is consumed, the patient will be taking multiple ingredients. When such preparations are accepted, polypharmacy used in modern medicine can also be accepted as a rational therapy provided the combinations of drugs produces no harm to the patient.

Thus the problems that could occur with polymedication are adverse effects due to drug interactions including treatment failure in addition to high cost and poor compliance to treatment. The adverse effects can range from mild to severe ones like renal and hepatic and CNS toxicity.

How to reduce polymedication

1) Intelligent polypharmacy with rational combination:

We can intelligently combine drugs in such way that the benefits of the drugs prescribed would outweigh the risks associated with each medicine as well as with the combination of drugs.²³

E.g:

1. HAART for HIV infection
2. Anti TB regimens
3. Anticancer therapy

The above combination of drugs, though not risk free, is life saving to the patients. We have to carefully balance between risk and benefit of such polymedications.

2) Adapting the following criteria for drug selection:

In drug selection, the following factors may be taken into account: safety and efficacy of the drug with regard to age, gender, pregnancy, lactation and coexisting morbidities like renal or hepatic dysfunction.

The need of drug therapy: Before starting any new drug therapy the physician has to ascertain whether pharmacotherapy is needed for the patient. It is well known that mild hypertension and diabetes can be controlled with non-pharmacological management.

The economy of the drug: Less costlier drugs which are equally effective have to be chosen instead of more expensive ones.

Availability: The drugs prescribed should be available in the nearby pharmacy. Otherwise, the patient has to go from one pharmacy to another to get the prescribed drugs. In the process, the patient's treatment is likely to be delayed and the drugs may get substituted with the alternatives.

3) Following Beers criteria

Beers criteria are generally applicable to geriatric population. The American Geriatrics Society (AGS) has updated the Beers Criteria for rational use of drugs in older people. It gives a detailed list of drugs to be avoided in the older population.²⁴

4) Prevention of prescribing cascade^{25,26}

Prescribing cascade refers to prescribing additional drugs to treat the adverse effects of other drugs. According to Kalish et al, a "prescribing cascade occurs when a new medicine is prescribed to 'treat' an adverse reaction to another drug in the mistaken belief that a new medical condition requiring treatment has developed." Prescribing cascade is a major problem causing polypharmacy. The physicians should be able to differentiate between an adverse effect and the onset of a new disease.

5) '4 R' principle

The 'R' principle followed in animal research can be applied in the selection of drugs also. The principle of Refine, Reduce, Replace or Remove can be followed in the selection of drugs, especially when polypharmacy is necessary.

1. Refine the selection of drugs which are action-specific with least side effects.
2. Reduce the number of drugs to a minimum.
3. Replace with non-pharmacological management wherever possible, especially for lifestyle-related disorders.
4. Remove the patient from drug therapy as early as possible.

Conclusion:

The term polymedication is the appropriate alternative term for polypharmacy. Polymedication is more common among the elderly. It should be adopted only when it is absolutely essential and beneficial to the patient. Polymedication becomes inevitable for those suffering from multiple disorders. However, it carries a higher risk of causing adverse effects as well as inconvenience and extra cost. Proper diagnosis, drug history and rational combination of drugs would prevent unnecessary polymedication. The 4'R' principle of Refine, Reduce, Replace or Remove can be applied in the selection of drugs.

In itself, polymedication is neither a peril nor a boon. Its rationality or irrationality depends on the physician. In the hands of a good physician, it can prove to be a boon too!

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Pages of History

Nina Braunwald - The Original Female Cardiothoracic Surgical Giant

Breaking glass ceilings with grace and compassion

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On March 11, 1960, 32 year old Nina Braunwald made history when she became the first cardiac surgeon of either sex to replace the mitral valve.¹

Men have outnumbered women in modern medicine for several decades now. This is quite evident in surgical specialties and glaringly stark in cardiac surgery.² A line that encapsulates the real issue that all female cardiac surgeons face is:

'It isn't just a glass ceiling that needs to be cracked, it's a broken ladder that you'll have to climb to get to it'.

Nina Braunwald, the first female cardiac surgeon, made headlines during a time when almost all specialty surgeons were men. Individual talent and drive alone did not guarantee a woman entry into cardiothoracic surgery. This was an era in which Helen Taussig, a female pioneer in paediatric cardiology, had been barred from cardiac surgical training at both Harvard and Hopkins.³

Nina Braunwald (1928 – 1992) was no ordinary woman. She was the first woman to perform open-heart surgery and was the first surgeon of either sex to perform a mitral valve replacement. She was also the first woman to be elected to the American Association for Thoracic Surgery.⁴

Born in Brooklyn, New York in 1928, she discovered early on that she had the ability to paint and draw well. Influenced by her father to become a physician, combined with her interest in art, she directed herself towards surgery. She married Eugene Braunwald, a brilliant cardiologist, thus gaining insight into the field of cardiology. She completed her training in general surgery at Georgetown University Medical Centre, with a postdoctoral fellowship at Charles Hufnagel's surgical laboratory. Then with her mentor, Andrew Morrow, at the National Heart Institute, she began the work that would make her famous. Despite an overtly hostile environment toward women, it was her quiet

resilience that fueled her continued advancement in cardiothoracic surgery, as she established a cardiac surgery training program at the University of California San Diego.⁴

Nina Braunwald worked tirelessly towards the development of an artificial heart valve. She developed the Braunwald-Cutter valve that became commercially available in 1971 and was implanted in thousands of patients. Never one to rest on her laurels, Braunwald continued to work on mechanisms to improve tissue resistance to thrombotic disease and contributed to advances in pulmonary to systemic shunt development and surgery for pulmonary thromboembolic disease.⁵

Any professional woman, in this day and age, can easily imagine the lofty barriers of gender bias that Nina Braunwald would have had to overcome to get to where she was. She had carved for herself a distinguished niche in this co-called 'man's world' of cardiac surgery. She had to prove over and over that she was as good as a man, if not better. Although she did not proclaim herself to be a feminist, she was undoubtedly a spectacular surgeon and this was simply how she proved all her detractors wrong. That Nina Braunwald overcame these barriers was a testament, not only to her individual assets, but also to the contribution of forward-thinking and dedicated mentors.⁴

Emulating her mentors, she was a role model to her students, positively influencing their careers and freely giving credit to those she worked with, a rare trait in most cardiac surgeons even today. She was described to be a petite five-foot-tall woman who was 'all about business and would tell it as it is'. Her observations were accurate, often witty yet respectful and conveyed to her residents a kindness that was not easily forgotten.⁴

A determined goal-oriented woman and a mother of three daughters, she balanced family responsibilities with the hefty demands of cardiac surgery. Eugene Braunwald described her approach to both as 'doing only what she considered essential, doing it intensely, and not spending much time or energy on anything else'. It is little known that she was pregnant during her first successful mitral valve replacement and operated well into the 7th month in each of her three pregnancies. Eugene Braunwald fondly described his wife as a terrific mother with incredible dedication to

her family. "She always came home for dinner and never missed putting her children to bed even if that meant returning to the hospital later to finish her work."⁶

An early colleague described her to be 'pioneering and determined, yet a gentle and good person at heart'. Dr. Braunwald matched her innovative brilliance with compassion that touched both her patients and students. One of her surgical residents recounts;

"She was thoughtful, well organized, quick and always concerned for the patient. She spoke softly. Everyone listened. The mood in the operating room was formal, but each person was given respect that made them feel comfortable."⁶

Nina Braunwald died in 1992, at the age of 64 years. Eugene Braunwald established a foundation that continues to support women in cardiac surgery.

1. The Association of Women Surgeons annually confers the Nina Starr Braunwald Award to women who fulfil exceptional roles in academic cardiac surgery.
2. The Thoracic Surgery Foundation for Research and Education established the Nina Starr Braunwald Research Grant, which includes two years of research funding support and is given annually to a promising young female cardiac surgeon.⁶

Decades after Nina Braunwald's career flourished, women still labour under preconceptions that deter them from pursuing careers as cardiac surgeons and emerging successful. Why are women so underrepresented in cardiac surgery? Are women inadequately encouraged to join cardiac surgical specialties, or do they receive inadequate support after joining?

One solution to this dilemma seems to be that early involvement, determination, smartwork and support from mentors, both male and female, all contribute greatly to a woman's ability to become a successful cardiac surgeon. Nina Braunwald remains a role model for all women and men who aspire for a successful career in cardiac surgery, against all odds.

A pioneer, not simply because of her presence as the first woman in cardiothoracic surgery, but because of her brilliant mind and outstanding surgical skills, Nina Braunwald did so with grace and compassion, and hence will remain an inspiration for many generations to come.

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Interview with Professor James Tatoulis

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Career Highlights of Professor James Tatoulis



Masters in Surgery (research into mitral repair)

Doctorate in Medicine (research comparing on-pump and off-pump coronary surgery)

Director of Cardiothoracic Surgery at the Royal Melbourne Hospital 1988.

Professor of Cardiothoracic Surgery at the University of Melbourne 2007.

Multiple International invitations as a guest lecturer, and faculty member.

Visiting Professor to the Hadassah Hospital in Jerusalem, Israel, and University of Virginia, Charlottesville, USA.

Honorary fellowship to the Royal College of Surgeons Thailand.

Honorary membership to the Society of Cardiothoracic Surgeons of Great Britain and Ireland and of the Hellenic Association of Cardiothoracic Surgery.

Chief Medical Advisor, National Heart Foundation of Australia

Chairman, Board of Cardiothoracic Surgery, RACS

Excellence in Surgery Award – Royal Australasian College of Surgeons.

Order of Australia, for services to medicine – particularly in the field of Cardiothoracic Surgery.

1. What motivated you to take up medicine and cardiac surgery in particular?

As a young person, I was always interested in both history and science.

Towards the end of high school, I was keen to become a physicist or astronomer, but in the final year of high school, my best friend convinced me that we both should do medicine together.

This was also highly encouraged by my parents.

I had a great time at University and enjoyed the medical course - especially Anatomy, Pathology and Surgery.

Following graduation (1972), I enjoyed each of the term rotations in the different specialties, including medical specialties such as Cardiology.

At that time (1975) the Royal Melbourne Hospital was planning to expand its Cardiac Surgery program, and I was approached to train in Cardiothoracic Surgery, which seemed a great idea at the time, but not knowing what it really encompassed! Hence after 3 years of rotating house medical officer jobs (1972-1975), and a year of general and vascular surgery (PGY4 - 1976) I embarked on Cardiothoracic training, which involved a further 5 years, including stints in Portland Oregon with Dr Albert Starr, Cleveland and at Duke University in the USA. I returned as a Consultant Cardiothoracic Surgeon to the Royal Melbourne Hospital and Epworth Hospital in November 1981.

2. What were the challenges you faced as a young cardiac surgeon in a specialty that was in its infancy,

how do you think these challenges have changed in a modern scenario?

I do not think that challenges featured much in my thinking. As a young Cardiothoracic Surgeon I was always keen to operate and do my very best. Perhaps there was a degree of naivety but counteracted by genuine enthusiasm and commitment to the specialty.

I can only recall one really challenging situation early on in my career – operating on my first dissection as a young consultant recently returned from the USA. It was a dissected descending thoracic aortic aneurysm in a 17 year old boy with Marfan's, son of a Doctor (and had not been previously diagnosed).

I recall performing the surgery on a Sunday night feeling quite unsupported and a bit out of my depth.

Fortunately, all went well and the patient was still alive (though he had other surgeries) when last reviewed 34 years later.

The differences in the challenges from the early 1980s to now, are the expansion and sophistication of procedures. In the late 70's and early 80's there were fewer operations and these were fairly standard e.g. CABG with Saphenous Vein Grafts or with 1 Mammary plus SVG. Today even a "straight forward" CABG operation has many possible formats - 1, 2 or more arterial grafts, ITA x1 or 2, RA x1 or 2, on-pump, off-pump, sternotomy, left thoracotomy, MIDCAB, Hybrid, robot assisted - just to consider one procedure let alone the many approaches to the aortic and mitral valve, and the expansion of techniques in the surgery of the thoracic aorta.

I firmly believe that a young Cardiothoracic Surgeon should train in at least 3 different centres, to be exposed to the many variations of techniques and adopt those that they find comfortable and most effective for them.

3. Do you think a mentor is necessary for a young cardiac surgeon? Did you have a mentor who helped shape your career?

A mentor is important. I had two. Mr. George Westlake who was my Chief at the Royal Melbourne Hospital, and was responsible for most of my training. He was a gifted technical surgeon and I was able to learn how to operate well, and expeditiously.

My second mentor was Professor Brian Buxton who was a colleague 10 years my senior, also a superb technical surgeon. In addition, Prof Buxton impressed upon me the importance of strategic thinking, clinical research, data bases, collaboration and the importance of professional associations.

I think it is important for a young surgeon, irrespective of the specialty to have 1 or 2 seniors they can use as role models, ask for guidance, and discuss not only operative surgery, but all the other aspects that are important in a professional's life.

4. Do you think you need to have the typical "surgeons personality" to be successful, what do you think are the attributes that make a good cardiac surgeon?

Personality and accepted behaviour have changed dramatically over my professional lifetime. Gone are the days of the Authoritarian Surgeon. It is important that one functions as part of the team, albeit as its leader. In that role the surgeon needs to recognize and acknowledge the significant contributions of all. Successful cardiac surgery could not be performed without a good assistant, an excellent scrub nurse, a diligent cardiac anaesthetist and importantly the perfusionist, who has the great responsibility of keeping the patient alive whilst the cardiac surgery is being performed.

Although all this is self evident, it is also commonly taken for granted. Hence recognition of the roles of each of these members of the team, both at the end of a particular operation, and at Unit or Department events is absolutely essential. A little bit of acknowledgement goes a long way!

At the outset of your career you should "build" your own team with individuals that you like and respect and create a sense of loyalty towards each other.

5. You have an active training program, what motivates you to remain active in the teaching field?

I have worked in the public, university teaching hospital system continuously for 46 years – the first 10 years as a house medical officer / registrar, and subsequently as a consultant. I have always enjoyed teaching, both at a clinical and an operative/ technical level. I believe teaching, and interacting with enthusiastic, motivated and highly intelligent young doctors is stimulating. It is immensely rewarding to see young doctors develop their knowledge and technical skills.

From a personal point of view, it helps keep one young and in touch with the younger generation's thoughts and aspirations and gain an insight into their world.

6. You are an active researcher with numerous publications in major journals and books, why do you think research is important for a young cardiac surgeon?

I believe that curiosity is one of the most important human characteristics. It is essential for the advancement of knowledge, irrespective of the field. It also makes a person a much more interesting human.

I despair when I note intelligent people around me show no interest in things or events beyond their day to day commitments. There is just so much we do not know, even in our field, hence further exploration in this and other areas is just such an obvious thing to do.

7. Do you believe that there is gender bias in surgery in general and cardiac surgery in particular, how do you think this situation can be changed?

I do not believe that currently there is an intended gender bias in the selection of young doctors entering surgery in general and cardiac surgery in particular.

With respect to cardiac surgery it is certainly a demanding specialty in the training phase and during one's career.

The training is rigorous, lengthy and it is difficult to interrupt. A career as a consultant involves performing long and sometimes high-risk surgeries, being readily available for emergencies, to resolve unexpected complications at any hour, to travel to satellite referral centres, and spending time at overseas institutions and meetings. All these components of the career are truly demanding and feature significantly in the considerations for choosing a career, both for young men and women.

I have a daughter, who is a lawyer, and I am extremely conscious of ensuring equality of opportunity.

At one point in time I employed 50% of the female cardiac surgeons in Australia!!!

The reality is that even in today's modern (even western) society, social gender roles are still well defined. For a female cardiac surgeon to succeed, she needs totally reliable support, especially at home, so that she can concentrate on surgery, the patients, and postoperative matters without being compromised especially in the unpredictable availability to deal with unexpected demands.

8. Most young residents speak of quality of life and work life balance; do you think this is easily achieved in cardiac surgery? Were you able to achieve this balance? Were your family supportive of the time demands of the specialty?

Although being a Cardiac Surgeon, defines who we are for 30 or more years, it is important to have an interesting and fulfilling life outside of the hospital setting. I think it is definitely possible to achieve this, it is just a matter of wanting to and planning.

I always had my daughter's school events (school sports, swimming carnivals, Father's Day breakfast, speech days etc. placed in my diary months in advance, and my wife, secretary and I ensured that the times for these were "quarantined". These events can never be repeated – seeing your child win a race, or be given an award, or acknowledged in some way, especially in front of others and peers will only happen occasionally. If you are not there to witness it, it is a moment forever lost.

I planned vacations around the time of my daughter's school holidays. There is no reason why any surgeon cannot do this to ensure enough family time and enjoy moments which cannot otherwise be recaptured. The secret of the success is forethought and planning. It is much easier to do nothing than to actually do something! There is no doubt that being a cardiac surgeon is demanding in terms of time and especially in dealing with the often unexpected demands (acute dissections, postoperative bleeding). However, these can be offset by good planning for family time (as mentioned above) and having a great understanding and trust with your colleagues so that your patients are well looked after when you are absent.

9. What do you think should be the changes in training keeping in mind the rapid progress of percutaneous techniques?

Imaging techniques and ingenious technological advances will continue to occur. Most aortic valve surgery and a high proportion of mitral pathology will be addressed by percutaneous techniques. Hence, young cardiac surgeons must incorporate these techniques into their training and early practice. They must ensure access to hybrid operating rooms, and convince hospital administrators that more such rooms will be required in the future. Young surgeons will need to form collegial partnerships with cardiologists, and vascular surgeons, to train in and develop wire, catheter and endovascular skills, and to be able to work cooperatively together in the future.

A significant dilemma which will arise will be the nature of open cases in the future.

The open cases will be extremely complex high-risk cases which cannot be addressed by trans catheter techniques – infective endocarditis with Aortic root or Mitral annular abscess, extensive reoperations such as 1 or 2 valve replacements plus coronary artery bypass grafts, complex ascending thoracic and transverse arch pathology. Such surgery will be extremely challenging for young surgeons who do not get to perform a high volume of routine, simpler cardiac surgeries.

The role of coronary surgery must not be forgotten! Coronary surgery still forms the bulk of cardiac surgery, and will progressively form a greater proportion of traditional Cardiac surgical procedures. The constantly emerging evidence of the superiority of coronary surgery, particularly where multiple arterial grafts are used – over stenting (except for primary angioplasty for acute myocardial infarction) will progressively cement the place of coronary surgery.

However it is possible the nature of coronary surgery will change with the aging population.

I would predict that it will evolve in 2 ways – a greater use of multiple arterial grafts, and also hybrid procedures where a surgical LIMA/LAD is performed, supplemented by stents to significant right coronary circumflex lesions if required.

10. Where do you see cardiac surgery in 20 years?

Routine aortic and mitral procedures will be predominantly performed by percutaneous trans catheter techniques, as will simple congenital structural heart disease corrections. Traditional "open" cardiac surgery will be predominantly confined to the much more complex high-risk operations, and a will present a challenge to the surgeons of the era. They must foresee all this, and train and adjust their skills accordingly.

With respect to percutaneous trans catheter procedures – I do not think that the "label" of who does such procedures, whether they be interventional cardiologists, or cardiac surgeons is important. What is important is that the proceduralist is well trained and extremely competent and obtains the best possible results for the patients, irrespective of their "title".

11. When you retire from the field what would you like to be remembered for, your greatest achievement? Your legacy?

Hopefully I would like to be remembered for 4 main achievements.

1. For establishing and building one of the most successful and respected departments in Cardiothoracic Surgery in Australia. From 3 surgeons to 11, from 200 cases to over 1500 per year (1100 Cardiac, 400 Major Thoracic) and for constantly introducing our new concepts and innovations in Cardiothoracic Surgery, including Intraoperative Trans Esophageal Echo, Implantable Defibrillators, Arrhythmia surgery, Mitral repair, off-pump CABG, MIDCAB, Sutureless valves, smaller incision access, percutaneous techniques and robotic thoracic surgery.
2. In helping develop, and champion the role of multiple arterial grafting, especially bilateral internal thoracic artery, and radial artery grafting throughout the world. Melbourne, and in particular the Royal Melbourne Hospital (as well as the Cleveland Clinic) are recognized as pioneers in and advocating for multi arterial coronary grafting and in promoting the enhanced long term benefits these techniques can achieve for patients.
3. My Academic Involvement.

I was able to be a busy clinical surgeon (at times up to 15 open hearts per week) but simultaneously able to achieve a Masters degree, and a Doctorate in the University of Melbourne by research. I have published over 180 articles as author or co-author, and presented numerous abstracts, and been an invited faculty member at numerous national and international meetings. During this time my

interaction with senior medical and research students and young doctors has also been a highlight.

4. As a mentor in the training of over 60 Cardiothoracic Surgeons from Australia, New Zealand, Europe, North and South America, Japan, Thailand, and Indonesia.

Perhaps the most rewarding group of all to mentor, has been that from India- over 30, all of whom, almost without exception have gone on to become incredibly successful cardiac surgeons, and leaders in their field when they returned home.

Abbreviations

CABG – Coronary Artery Bypass Graft

SVG – Saphenous Vein Graft

ITA – Internal Thoracic Artery

RA – Radial Artery

MIDCAB - Minimally Invasive Direct Coronary Artery Bypass

LIMA - Left Internal Mammary Artery

LAD - Left Anterior Descending Artery

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