INTRODUCTION

Anaesthesia has branched out to various sub-specialities that are different in the knowledge of pathophysiology, pharmacotherapy, preoperative assessment and optimisation, intraoperative and postoperative management. Additionally, transplant anaesthesia involves ethical and medicolegal issues. The scope of this article is to discuss regarding career options in transplant anaesthesia and bariatric anaesthesia.

ANAESTHESIA FOR ORGAN TRANSPLANTATION

Solid organ transplantation (SOT) has seen a rapid evolution in the past few decades from an experimental approach in the 20th century to a definitive treatment option for end organ dysfunction with severely compromised quality of life, in the 21st century. SOT now has expanded its options to a variety of solid organs i.e., liver, kidney, pancreas, heart and lung into the donor pool. The Indian Parliament passed transplantation of human organ act (THOA) in 1994, which legalised brain stem death in India and the subsequent amendments in 2011 and 2014 form the legislative foundation for brain death declaration and organ donation.

National organ and tissue transplant organisation (NOTTO) is the national body that regulates, facilitates and records the country’s organ transplantation. Presently 250 hospitals are registered to handle solid organ transplants in India. NOTTO maintains various national registry related to organ transplant. SOT activity in India 2018 data is shown in Figure 1.
Among the SOT, kidney transplantation was the first to take place. Jaboulay performed the first kidney transplant in two patients using animal donors in 1906, but both the xenografts failed and both patients died subsequently.[3] Then in 1954, Merrill JP and co-workers performed a successful kidney transplant with long-term survival between two identical twins.[4] Dr. Mohan Rao, Dr. K.V. Johny and team at CMC Vellore performed first successful transplant in India in 1971.[5] Now it has become a routine procedure as the treatment of choice for the patients with end-stage renal disease (ESRD) to improve survival and quality of life. Kidney is the most frequently transplanted organ because of the easy availability of live donors, crucial backup of dialysis and the development of immune-suppressive drugs.

Liver transplantation is probably one of the most challenging surgeries as no artificial replacement support is available. With the first successful transplant in USA by Dr. Thomas Starzl in 1967 and by Dr. Roy Calne in Europe in the following year, liver transplant has seen a tremendous improvement in patient selection, perioperative management and postoperative immunosuppression over the next few decades.[6] In India, after few unsuccessful attempts, the first successful deceased donor liver transplant (DDLT) was done in 1998 and shortly thereafter by the first successful living donor liver transplant (LDLT) in November 1998, both performed by Dr. Rajashekar.[7] A multidisciplinary team approach has made liver transplant a successful treatment option for end stage liver disease. One-year survival rate of LDLT was claimed to be 85-90% as presented in a meeting in 2016.[8] With more than 30 liver transplant centres, India has emerged as the regional transplant centre for South East Asia.

The world has seen first successful pancreas transplantation in the late 1960s[9] that provides beta cell function to a diabetic recipient. Currently, four types of surgical options of pancreatic transplantation are in practice such as pancreas-alone transplant (PAT) for diabetic patients with adequate renal function, simultaneous pancreas-kidney (SPK) transplant for patients with uraemia, pancreas-after-kidney transplant (PAK) if a living donor kidney transplant is available, this is a better option to reduce the time on dialysis while waiting on the deceased donor list for a pancreas transplant and simultaneous transplantation of a deceased donor pancreas and living donor kidney (SPLK), which is a modified version of PAK. Another recent option is islet cell transplantation, which involves retrieval of islet cells from a deceased donor pancreas by enzymatic digestion and then injected through the portal or mesenteric vein, so that they embolize through the portal venous system to seed the liver.[1] The number of pancreas transplants are quite low (<100) in India because of low availability of the deceased donor organs and lack of trained surgeons.[10]

Although lung transplantation was first attempted by Hardy and co-workers in 1963,[11] Joel Cooper in Toronto performed first successful long-term single lung transplant in 1983.[12] In India, heart and lung transplantation developed almost together. One month after THOA was passed, the first heart transplant in India was performed by Dr P. Venugopal at All India Institute of Medical Sciences, New Delhi on 3rd August 1994.[13] Next year, Dr K. M. Cherian at Madras Medical Mission hospital in Chennai performed first successful heart–lung transplant.[14] The first isolated single lung transplant was performed in 2011 by Dr. Paul Ramesh, Dr. Madhan Kumar and Dr. T. Sunder at Apollo Hospitals, Chennai.[15] India’s heart transplantation programme is the leading programme in South Asia with an average heart transplantation rate of 0.2 per million population (pmp) as opposed to the global average of 1.06 pmp (2016-2018).[16] But the programme was a slow starter and only 30 transplants were done across the country till the year 2012.[17]

Despite many challenges, the rate of the organ transplantation in India increased significantly in the last few decades, making this stream an attractive career option with a bright future for postgraduates. At present there is a huge demand versus supply in
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this stream, as the anaesthesiologist plays a crucial role at every level from the organ retrieval process to postoperative management in the intensive care unit. The technological boom in the field of transplant anaesthesia provides ample opportunities for a cutting-edge career path. Several multi-speciality hospitals have come up with international accreditations in order to cater to patients from abroad leading to ‘reverse brain drain’. Many Indian doctors trained abroad are now interested to return to their home country where the opportunity is now available to practise and provide quality care.\[8\] Transplantation, as a speciality, requires full-time professionals, who need to work with a multi-disciplinary team approach. Equipped with the right skills, anaesthesiology postgraduates can bag high quality jobs that will help them to mature and excel in the field. Being an organ transplant anaesthesiologist is rewarding in terms of financial gain, academic satisfaction, stimulating and challenging nature of the job.

Drawbacks of the speciality are the stresses posed by the long working hours of these complicated operations, night calls and demanding interpersonal relations between the team members.

Organ Transplant anaesthesia needs special training, which is offered by many dedicated centres both in India [Table 1] and abroad. Heart-lung transplantation anaesthesia is mainly conducted by anaesthesiologists trained in cardiothoracic-vascular (CTVS) anaesthesia. Presently, there are 250 hospitals that are registered to handle solid organ transplants in the country and among those, 108 undertake heart transplants.\[16\] These numbers are continuously growing, but the number of trained anaesthesiologists is always on deficit. A reputed group of hospitals utilises the service of a handful of trained people throughout India, which may compromise patient care and increase total cost. Interested candidates can be trained there under the guidance of experienced CTVS anaesthesiologists.

Ethical issues are very important in case of organ transplantation. Doctors are concerned with the possible emotional/financial exploitation of donors by recipients, their families and from transplant hospitals. They are worried that with the increasing demand of organs, the rights of the poor donor may be abused. Transplant hospitals have now become more vigilant with a proper screening system in place and an Authorization Committee of Hospital/District/State scrutinises all the applications. Today, living unrelated donations have become more transparent and streamlined.\[18\]

Transplant doctors also need to be aware of the medico-legal issues involved in it. Any medical treatment needed for the patients suffering from unusual reasons (accident, suicide, assault, poisoning or fall) needs to be notified to the police. These are usually called medico-legal cases. The police will then conduct an inquest about the incident and take charge of the case. A forensic doctor will examine the patient and will decide about organ retrieval.\[18\]

| Table 1: List of Institutions offering specialty training in organ transplant anaesthesia |
|-----------|-----------------|-----------------|-----------------|
| Institution | City | Course | Admission Process |
| Institute of Liver and Biliary Sciences (ILBS) | New Delhi | DM (organ transplant An.), PDCC (liver transplant An.) | NEET |
| Sanjay Gandhi Post Graduate Institute | Lucknow | PDCC (organ transplant anaesthesia) one year programme started 2009-2018, now changed to PDF (postdoctoral fellowship) of two years started in 2019 | entrance test by SGPGI, at all India level in July every year |
| Postgraduate Institute of Medical Education and Research (PGIMER) | Chandigarh | Fellowship in organ transplant anaesthesia | online entrance test by their own |
| Medanta Medicity | New Delhi | Fellowship in liver transplant anaesthesia | personal interview by their own |
| Amrita Institute | Kochi | do | do |
| Sir Ganga Ram Hospital | New Delhi | do | do |
| Apollo Hospitals Education and Research Foundation (AHERF) | Various locations | do | do |
| Krishna Institute of Medical Sciences (KIMS) | Hyderabad | do | do |
| MGM Hospital | Chennai | do | do |
| Institute of Kidney Diseases & Research Centre (IKDRC) | Ahmedabad | do | do |
| Axon Anaesthesia Associates in association with its partner Global hospitals | Hyderabad | do | do |
| Dr. Rela Institute & Medical Centre | Chennai | do | do |
The ongoing coronavirus disease (COVID)-19 pandemic presents unprecedented challenges to the programme. While the kidney failure patients can continue dialysis, although at higher risk of contracting COVID-19, there is no such option for patients with a failing liver, heart or lung. Social distancing, nation-wide lockdown, scarcity of public transport, suboptimal counselling of the deceased patient’s family for donation, less blood donation, less availability of ICU beds and diverting the available resources to COVID patient care resulted into worsening of the already critically low pool of organs. Additionally, there is a risk of infection with progression to severe disease in both transplant recipients as well as those in waiting list due to frequent healthcare contacts, underlying health problems along with immunosuppression.\textsuperscript{[19]}

Another issue with COVID is that the presentation of myocarditis with the raised troponin levels, recent left ventricular dysfunction and electrocardiogram (ECG) changes may mimic signs of rejection. Two heart transplant recipients with COVID-19 infection have been reported in China. Both patients survived.\textsuperscript{[20]}

On the other hand, lung transplant is emerging as a definite treatment option for end-stage COVID-19 patients.

Surgeons in Austria on May 26, 2020 performed the world’s first known lung transplant to save the life of a Covid-19 survivor,\textsuperscript{[21]} followed by another lung transplant for coronavirus patient in the US by surgeons led by an Indian-origin doctor, Dr. Ankit Bharat, Chief of Thoracic Surgery in Northwestern Medicine.\textsuperscript{[22]}

Asia’s ‘first known lung transplant’ on a COVID-19 positive patient was performed in MGM Healthcare hospital in Chennai on 27 August by Dr. K R Balakrishnan and his team.\textsuperscript{[23]} Dr Sandeep Attawar in Krishna Institute of Medical Sciences (KIMS) Hyderabad performed the double lung transplant on a the man recovered from COVID.\textsuperscript{[24]}

**BARIATRIC ANAESTHESIA**

As in other countries in the 21\textsuperscript{st} century, obesity has reached epidemic proportions in India too, with morbid obesity affecting 5% of the country’s population.\textsuperscript{[25]} Bariatric surgery began in the 1950s with the jejuno-ileal bypass, which formed the basis for the development of this surgical speciality. Subsequently, weight loss procedures evolved along two main surgical principles, of restriction and malabsorption. Bariatric surgery is fast becoming the current standard of care for managing severe obesity, which includes a variety of procedures such as Roux-en-Y Bypass, Sleeve Gastrectomy and Biliopancreatic Diversion with Duodenal Switch.

With morbid obesity present in a high percentage of the general population, it is not unusual to have such patients admitted for non-bariatric surgeries or procedural sedation, and anaesthesiologists are very likely to encounter such a patient in their regular practice.\textsuperscript{[26,27]} This raises challenges for the anaesthesiologist for ensuring a safe and successful outcome.

The challenges are:

1. Obese patients have a multitude of comorbidities and conditions that make the perioperative period critical, necessitating dedicated, well-equipped hospitals/departments with ICU/HDU facilities and multidisciplinary backup.\textsuperscript{[28,29]}
2. The pre-anaesthetic check-up involves screening for obstructive sleep apnoea (OSA) in addition to other comorbidities, optimisation of the functional status and cardiopulmonary reserve. Recently, sleep-related disorders have drawn considerable attention of anaesthesiologists from the perspective of perioperative outcomes.
3. Airway management can be a challenge in case of an obese patient, more so with morbidly obese, that needs a well-strategised plan.\textsuperscript{[30,31]}
4. Recently, practices involving high-flow nasal oxygen up to 35-70 litre/minute have been described for enhancing preoxygenation and preventing atelectasis, especially when rapid-sequence intubations are planned without mask ventilation.\textsuperscript{[32]} High-flow nasal oxygen enhances the postoperative outcome in bariatric surgery and is likely to play a leading role in the future.
5. The morbidly obese patients should be observed for longer periods up to 4 hours in post anaesthesia care units (PACU) for meticulous monitoring of respiratory complications. A dedicated extubation room is preferable.\textsuperscript{[33]} As it is labour-intensive and deterioration can be rapid and catastrophic, postoperative monitoring necessitates the continued presence of an experienced and dedicated physician.
6. Enhanced recovery after surgery (ERAS) has been a focus of surgical practice in recent years, which should include the minimum
safe standards for day care admission, fitness for discharge to high-dependency wards and transfer-out plans that comply with international standards.\textsuperscript{34} Anaesthesiologists caring for the obese should plan the after discharge care too!

7. Anaesthesia for the morbidly obese parturient poses challenges with respect to pregnancy-related complications, surgical difficulties and postoperative concerns over and above that of a non-pregnant patient, especially with regard to maternal changes and effects on the foetus.

8. Children and adolescents are still developing, both physically and mentally and do not have competency to consent. Young patients may be considered for surgery after failure of conservative means and the risk/benefit profile favours surgery. Bariatric surgery in children and adolescents should be performed only in specialised, high volume centres.\textsuperscript{35,36}

9. Owing to the extra weight and size of the patients, both the staff and patients are vulnerable to skeletomuscular and nerve injuries,\textsuperscript{32-34} which should be prevented by all measures.

Dedicated high-volume centres in bariatric surgery have seamless workflows that enable all members in the team to understand the challenges of these patients, their limitations and the nature of their comorbidities. Importance of having a team of enthusiastic anaesthesiologists, who are keen to collaborate and work as a team to achieve safe outcomes for patients, cannot be overemphasised.

Obesity & Metabolic Surgery Society of India (OSSI) conducts a 1-year clinical fellowship programme in Metabolic & Bariatric Surgery (FMBS). The list of hospitals participating in FMBS programme is given in Figure 2.\textsuperscript{37} Out of these, Max Institute of Minimal Access, Metabolic and Bariatric Surgery (MAMBS), Max Saket in New Delhi, Asian Bariatric Institute in Ahmedabad (3 months duration) and Axon Anaesthesia Associates in association with its partner Global Hospital in Hyderabad (1-year duration) run fellowship course in bariatric anaesthesia. Interested candidates can also undertake informal training in other listed hospitals under guidance of experienced bariatric anaesthesiologists.

COVID-19 poses an extra challenge to the obese population, as there is the additional stress of potential concerns about disruption to insurance coverage because of job loss, worries about risk of exposure to COVID-19, isolation and lack of social support. All these increase the risk for compromised mental health over and above already pre-existing psychological concerns. COVID in obese patients increases risk for poor physical and mental health outcomes. Delaying surgery will exacerbate both these risks, necessitating monitoring by and involvement of both medical and mental health providers.\textsuperscript{38} International societies viz American Society of Metabolic and Bariatric Surgery (ASMBS) has strongly rejected classifying metabolic and bariatric surgery as ‘elective’ and prefers the use of the term ‘Medically Necessary Time-Sensitive Surgery’ or ‘Medically Necessary Non-Emergent Surgery’ to better define the effectiveness of the surgical intervention and the progressive nature of medical conditions it treats. They have called for safe resumption of bariatric and metabolic surgery before COVID-19 pandemic is declared over.\textsuperscript{39}

**CONCLUSION**

Postgraduation in anaesthesiology provides the eligibility for a job or freelance practice. But having a subspeciality training gives a high-paying superior quality of institutional attachment, which in turn provides academic excellence, greater recognition and job satisfaction. However, postgraduate (PG) trainees should develop interest while in their PG training, conduct a thorough research about both the pros and

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**Figure 2:** Participating hospitals in FMBS programme\textsuperscript{37}
cons of each specialty and then carefully choose their future area of work.

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REFERENCES