

Artículo de revisión

La cirugía coronaria en Asia – La perspectiva desde la India

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La revascularización miocárdica es la intervención más común de cirugía cardíaca en India. Se ha desarrollado con extraordinaria rapidez en los últimos años, y en especial la cirugía sin circulación extracorpórea, entre otras razones por temas económicos. La anatomía de la cardiopatía isquémica en los pacientes indios, con un patrón de enfermedad difusa, obliga la realización de reconstrucciones con parche y endarterectomías. Se realiza una breve revisión de los factores patogénicos, fisiopatológicos y las estrategias quirúrgicas relacionadas con la cirugía coronaria en India con el fin de ofrecer al lector una visión general de la situación actual en el país.

Palabras clave: Cirugía coronaria. India. Cirugía sin circulación extracorpórea.

Coronary artery surgery in Asia – The Indian perspective

Coronary artery bypass graft surgery (CABG) is the most commonly performed operation in cardiac surgery in India. It has grown fast in recent years with the booming of off-pump revascularization due, among others, to financial reasons. The anatomy of coronary artery disease in Indians, with a generalized pattern of diffuse disease, makes mandatory the association of extensive patch reconstruction and endarterectomies of the coronary arteries. A brief review of the pathogenesis, epidemiology and surgical strategies related to CABG in India is performed in an attempt to offer the reader with an overview of the current situation in the country.

Key words: Coronary artery surgery. India. Off-pump coronary surgery.

INTRODUCTION

Ever since Dr. KM Cherian, from Chennai, performed the first coronary artery bypass grafting (CABG) in India, the scenario of coronary artery disease (CAD) and its therapy has undergone a sea change. Technologic advances in the field of cardiac surgery have changed the spectrum of patients with CAD referred for CABG. The improvements in percutaneous intervention, better understanding of cardiac physiology and evolution of the off-pump technology have all played a part in the progress of coronary artery sur-

gery in the country. Most importantly, indigenisation of products and techniques has helped the surgeons in the subcontinent to reach out to the millions in a cost-effective way¹. Nearly 60,000 open heart operations are performed in India in a year of which 50,000 are CABG's. The number of CABG's has gone up dramatically in two decades. The proportion of CABG's has gone up from 30% of total cardiac surgeries in the 1980's to 90% in the new millennium.

The etiopathogenesis of coronary artery disease and its management is significantly different in our subcontinent as compared to that of the west. More and more data have been published recently highlighting the differences in etiology, pathology, management strategies and operative technique of CAD from that in the west. This article attempts to give an overview of all these

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aspects as well as to highlight the authors experience in this field.

EPIDEMIOLOGY

Coronary artery disease is an epidemic in India at present². There has been a steady increase in the incidence and prevalence of coronary artery disease in the country. While many countries in the west have shown a decline in the incidence, such a trend has not yet been identified in this country.

The risk of CAD in Indians is 3-4 times higher than white Americans, 6 times higher than Chinese and 20 times higher than Japanese. Indians are prone to CAD at a much younger age. CAD affects Indians at least 5-10 years earlier than other communities³. The urban population is at a particularly high risk than rural population (9.5 vs. 4%)⁴.

Various factors are implicated in the etiopathogenesis of CAD in Indians. Conventional risk factors like diabetes, smoking, dyslipidemia, hypertension are more common in Indians predisposing them to CAD⁵. India is presently labeled as the "Diabetic capital of the world" with a diabetic population of 40.9 millions expected to rise to 69.9 million by 2025. The Indian diabetics have higher insulin resistance, greater abdominal adiposity, lower adiponectin and higher high-sensitive C-reactive protein levels, resulting in poor glycaemic control⁶. Higher glycosylated haemoglobin is correlated directly with CAD in Asian Indians⁷.

Smoking and tobacco use in various forms is more prevalent in Indians. This has resulted in young Indians being predisposed to CAD compared to the rest of the world. A decline in smoking in young is noted recently, and will prove a major factor for reduction of CAD in India⁸.

Indians undergoing CABG have been documented to have higher incidence of dyslipidemia. The cholesterol/HDL ratio, which is a better predictor of CAD than absolute values of lipids, is also found to be higher in the Indian population requiring coronary interventions or surgery⁹.

Non-conventional risk factors have also been investigated extensively. Most important of these factors include lipoprotein A, homocysteine, infectious agents, hyperinsulinemia, hyperfibrinogenemia and insulin resistance syndrome.

Lipoprotein A is probably the most investigated non-conventional risk factor for CAD. It is ten times more atherogenic than LDL-cholesterol and is a stronger independent risk factor than diabetes mellitus¹⁰. The proposed mechanism of action of Lp(a) include preferential

uptake of Lp(a) into macrophages in atherosclerotic plaques by binding with fibrin and plasminogen receptors.

Elevated homocysteine level is also hypothesized as an independent risk factor of CAD in India. Though a high level of homocysteine was documented in South Asia, it did not translate into an independent risk factor of CAD¹. An association between infective agents and CAD has also been investigated. The most important agents include *P. Pneumoniae* and *M. Pneumoniae*. No concrete evidence has surfaced as yet and postulates remain postulates¹¹.

Growing urbanization and migration of population to the cities has resulted in majority of Indians adopting a western lifestyle. Moreover, the growth of information technology and business process outsourcing industries has caused a major shift in the lifestyle and food habits. Added to this is the work pressure and stress, which the employees are exposed to. All this has resulted in a steep increase in the conventional risk factors. The impact of these factors are already being felt in the health sector with increased referrals for heart disease related problems, metabolic disorders including diabetes, hypertension and obesity and psychiatric disorders¹².

PATHOLOGY

Indians have been documented to have smaller coronary artery dimensions (indexed to body surface area) than the western population. This factor, associated with earlier onset of CAD, higher incidence of triple vessel CAD and associated comorbidities like diabetes have resulted in a higher perioperative morbidity and mortality in the subcontinent. An improvement in infrastructure and better intensive care facilities has helped surgeons produce results comparable to the West^{12,13}.

Over the last decade, the spectrum of surgical patients has undergone a major change. More and more patients with single and double vessel disease now undergo percutaneous interventions. The introduction of drug eluting stents (DES) in the market has resulted in a major portion of these patients being managed with angioplasty and stenting. India has not remained far behind in the indiscriminate use of DES in triple vessel disease (TVD), like in the west, until recently. Though the evidence base is lacking, the socio-economic conditions and anxiety on part of patients to undergo a major cardiac surgery has resulted in many a patients with TVD being subjected to PCI with stenting. There is at present a lot of debate going on in this area. All these factors have resulted in only the worst coronary artery disease being referred for surgery.

Hence, diffuse CAD is on rise in the surgical spectrum in the country. A rough estimate is that about 25% of cases are either severe triple vessel disease or diffuse coronary artery disease requiring coronary reconstruction, with or without endarterectomy for revascularisation.

Calcium deposits in atherosclerotic plaques are a difficult problem, which surgeons encounter during CABG. Many of these patients require coronary endarterectomy. Coronary calcium scores are higher in older patients indicating severe disease. The younger population, which constitute a significant position of the CABG patients, have predominantly fibro-intima-medial thickening and sclerotic plaques with very less or no calcium deposits¹⁴.

In the west, the younger patients (< 40-50 years age) have predominantly single or double vessel disease, mostly discrete lesions and less calcium in their plaques. These patients tend to have higher prevalence of conventional risk factors and higher incidence of CAD in family. Attempts are on to predict the chances of developing CAD in asymptomatic population based on these risk factors¹⁵.

A major difference in the pattern of “CAD in Young” in India, which is also the author’s experience, is the higher prevalence of diffuse CAD, higher incidence of major cardiovascular events in past and higher proportion of LV dysfunction in patients undergoing CABG less than 40 years age. This is particularly common in the state of Kerala in South India. Here, the coronaries are sclerosed, diffusely diseased and not calcified. It is in this subset of patients that the author has performed maximum number of patch reconstruction of left anterior descending coronary artery without endarterectomy (refer controversies section), as these patients were otherwise termed inoperable.

STRATEGIES FOR REVASCULARISATION

Conventional CABG is routinely performed in India with approximately 50,000 patients having gone through this procedure a year. The major advancement in coronary surgery over the last decade has been the establishment of many single surgeon centers all around the country with capability of performing routine cardiac surgeries. Hence coronary surgeries have gone out to the public in a much appealing way. Indigenization of products and easier availability of trained personnel have gone a long way in popularizing CABG among the public¹⁶.

Off-pump coronary (OPCAB) was first performed in India in the late 1980’s. The ability to perform coronary revascularisation without cardiopulmonary bypass was

a surgical challenge, which most surgeons took up early. There was a boom in OPCAB’s very soon with most centers taking up OPCAB for revascularisation in preference to on pump CABG. However, the initial enthusiasm dampened soon and only a handful of centers that were able to do full justice to the patients in terms of results are now performing nearly 98% OPCABs. In India, OPCAB is a more financially viable option without compromising the surgical results when compared to on-pump CABG. However, the technical challenge to perform OPCAB as a routine for all patients with CAD is taken up by a few centers only. Hence, today in India, CABG is at present polarized between surgeons who perform all coronary revascularisation on pump and those who employ OPCAB as a routine for coronary revascularisation. The latter group, to which the author belongs, hardly employs the pump for revascularisation¹⁷.

SPECIAL CONTROVERSIES

Arterial vs. venous grafts

The country is divided between proponents of total arterial revascularisation and practitioners of the left internal mammary artery bypass (LITA) and venous grafts, quite like their western counterparts. As it is practiced in the west, only one conduit has stood the test of time and is universally used – it is the LITA. More than 98% of patients undergoing CABG in our country receive a LITA graft, mostly to the left anterior descending coronary artery (LAD). There is difference of opinion between surgeons about using LITA as a dedicated graft to LAD or using it as a conduit for inflow into all the left sided coronaries. The author believes that LITA is the most valuable conduit for LAD and should not be shared with other territories^{18,19}.

Coronary endarterectomy

Endarterectomy is the conventional mode of revascularisation of diffuse CAD. It has been a boon for most surgeons attempting to operate on severely diseased coronaries. Results of coronary endarterectomy have always been inferior to conventional CABG with the added disadvantage of anticoagulants in the post-operative period.

Hence patch reconstruction of diffusely diseased coronary arteries without endarterectomy has gained popularity in the country. The coronary reconstruction by this technique involves reconstructing the new coronary lumen with the posterior 1/3rd being formed by the native coronary and anterior 2/3rd by the conduit. This

is usually done as an on-pump procedure, but the author has been performing these procedures as OPCAB with over 120 cases till date, being accepted for publication in Asian Annals after two year follow-up (unpublished data)²⁰.

CABG in acute coronary syndromes

Acute coronary syndromes include unstable angina (UA), non-ST elevation myocardial infarction (NSTEMI) and ST elevation myocardial infarction (STEMI). The optimal treatment for STEMI is percutaneous intervention or thrombolysis. The best treatment for UA and NSTEMI remain a matter of debate. Both PCI and surgeries are improving fast with excellent results being claimed with both options. Surgery is associated with a higher immediate mortality but long-term benefits are more with surgery when compared to PCI with popularization of OPCAB, the mortality, morbidity, ICU stay, renal dysfunction, neurological dysfunction of surgical patients is significantly reduced. Total arterial revascularisation further improves the results of CABG. Many surgeons in this country have taken up OPCAB for revascularisation in an ACS setting¹⁷.

Robotic cardiac surgery

Robotic cardiac surgery made its debut in India in the year 2002. Only two major institutes are doing robot assisted cardiac surgery till date, predominantly due to financial reasons. Even then, there has been a growth in the number of cardiac surgeries done robotically in these institutes, and chances of new institutes venturing into robotic cardiac surgery field are not dim²¹.

In summary, coronary artery surgery in India has developed at a very fast pace in the past fifteen years. OPCAB is a much appreciated surgical tool with financial reasons being an important factor in its development. Currently, a significant proportion of the cases of myocardial revascularization are performed in this way. Additionally, and in the opposite terms to the Western world, the anatomy of CAD in Indian patients makes Coronary reconstruction using mammary patch without endarterectomy a useful surgical option.

INTRODUCCIÓN

Desde la introducción de la cirugía coronaria (CC) por Cherian, de Chennai, en India, ésta ha experimentado cambios muy importantes. Los avances tecnológicos han modificado el espectro de los pacientes. La mejora de la terapia percutánea, la mejor comprensión de la fisiología cardíaca y la evolución de la tecnología sin circulación extracorpórea (CEC) han influido en el pro-

greso de la CC en India. Y muy importante, la indigenización de productos y técnicas ha ayudado a los cirujanos del subcontinente en la relación coste-efectividad¹. Se realizan unas 60.000 intervenciones en India al año, de las que unas 50.000 son de CC. La proporción de CC se ha elevado del 30% en los 80 hasta casi un 90%.

La etiopatogenia de la cardiopatía isquémica y su manejo son diferentes en nuestro subcontinente en comparación con los países occidentales. Hay mucha información relativa a las diferencias en etiología, enfermedad, estrategias de manejo y técnica operatoria. Este artículo intenta revisar estos aspectos y la experiencia del autor en este campo.

EPIDEMIOLOGÍA

La cardiopatía isquémica (CI) es una epidemia en India², con un aumento constante de la prevalencia y la incidencia. El riesgo de CI en los indios es tres-cuatro veces superior a la de los norteamericanos, seis veces la de los chinos y 20 veces la de los japoneses. Los indios presentan CI a edad mucho más temprana, unos 5-10 años antes que en otras comunidades³. La población urbana tiene un riesgo muy superior a la rural (9,5 vs 4%)⁴.

Hay varios factores implicados. Los convencionales como diabetes, dislipemia e hipertensión son más comunes en la población india⁵. A India se le conoce en la actualidad como la «capital de la diabetes del mundo», con una población diabética de 40,9 millones, que se espera aumente a 69,9 millones en 2025. Los indios diabéticos tienen mayor resistencia a la insulina, mayor adiposidad abdominal, menor adiponectina y niveles más elevados de proteína C reactiva altamente sensible, lo que resulta en un control de la glicemia inferior⁶. Niveles más elevados de hemoglobina glucosilada se relacionan directamente con la CI en los indios⁷.

El tabaquismo en sus diversas formas es más prevalente en indios, lo que ha resultado en una predisposición superior de indios jóvenes a padecer CI que en el resto del mundo. Se ha notado una cierta reducción del consumo de tabaco en jóvenes, lo que podría ser un factor para el control de la CI en India⁸.

Los indios sometidos a CC tienen una incidencia superior de dislipemia. El índice colesterol/HDL más elevado en la población india que requiere intervenciones percutáneas o quirúrgicas⁹. También se han investigado factores no convencionales de los que los más importantes son la lipoproteína A, homocisteína, agentes infecciosos, hiperinsulinemia, hiperfibrinogenemia y el síndrome de resistencia a la insulina.

La lipoproteína A es 10 veces más aterogénica que HDL, y es un factor independiente más importante que la diabetes¹⁰. Su mecanismo de acción incluye una captación preferencial por los macrófagos de las placas de arteriosclerosis a través de receptores de fibrina y plasminógeno.

Los niveles elevados de homocisteína se consideran un factor de riesgo independiente de CI en India¹, y también se ha investigado la asociación de agentes infecciosos y CI, si bien no existe hasta el momento una evidencia concreta¹¹.

La creciente urbanización ha resultado en la adopción por parte de la población india de un estilo de vida occidental. El desarrollo de la tecnología de la información y la externalización de las empresas ha causado cambios profundos en el estilo de vida, incluyendo la alimentación, añadiéndose el aumento del estrés y la presión laboral. El impacto de estos factores se hace notar en la salud a través de problemas cardíacos, metabólicos, como la diabetes, la hipertensión, obesidad y trastornos psiquiátricos¹².

PATOLOGÍA

Se ha documentado que los indios tienen arterias coronarias más pequeñas (en relación con la superficie corporal) que los occidentales. Esto, asociado a la precocidad de la CI, una incidencia superior de enfermedad multivaso y la diabetes, resulta en una morbilidad peroperatoria superior. La mejoría en infraestructura y cuidados postoperatorios ha ayudado a mejorar los resultados^{12,13}.

En la última década se ha apreciado un cambio en el espectro del paciente quirúrgico, habiendo aumentado el número de pacientes con enfermedad de uno y dos vasos sometidos a terapia percutánea. La introducción de los *stents* farmacoactivos (DES) ha resultado en el incremento de este tipo de terapia. En India también se ha notado un uso indiscriminado de los DES en la enfermedad multivaso. Si bien no hay evidencia científica, las condiciones socioeconómicas y la ansiedad de los pacientes frente a una intervención mayor ha favorecido la terapia percutánea, si bien existe un importante debate en la actualidad. Todo ello ha resultado en que los peores pacientes acaban en cirugía.

De aquí que la CI difusa aumente en el espectro quirúrgico. Un 25% de los casos tienen enfermedad difusa que requiere reconstrucción coronaria con o sin endarterectomía. Los depósitos cálcicos en las placas ateromatosas representan un problema difícil. Muchos pacientes requieren endarterectomía. La población joven tiene predominancia fibrointimal, con escaso depósito cálcico¹⁴.

Los pacientes occidentales jóvenes (< 50 años) tienen predominio de enfermedad de uno o dos vasos en forma de lesiones circunscritas. Estos pacientes tienen una prevalencia elevada de factores convencionales y CI familiar. Se intenta predecir los cambios en la CI en pacientes asintomáticos¹⁵. Una diferencia importante en la CI del «joven» en India, lo cual es también la experiencia del autor, es la gran prevalencia de enfermedad difusa, de accidentes cardiovasculares y de mayor proporción de disfunción ventricular izquierda en pacientes intervenidos de CC de menos de 40 años. Esto es particularmente común en el estado de Kerala, en el sudoeste de India. Las coronarias están esclerosadas, presentan lesiones difusas y no están calcificadas. Es en este grupo de pacientes donde el autor ha realizado el mayor número de reconstrucciones con parche sin endarterectomía.

ESTRATEGIAS QUIRÚRGICAS

La CC convencional es rutinaria en India, con unas 50.000 intervenciones/año. El mayor avance en CC en la última década ha sido el establecimiento de múltiples centros con un solo cirujano con la capacidad de realizar cirugía cardíaca, lo que ha favorecido el conocimiento público. La indigenización de los productos y disponibilidad de personal entrenado han influido en hacer popular la CC¹⁶.

Se practica CC sin CEC (OPCAB) en India desde finales de los 80. La posibilidad de realizar OPCAB fue un reto quirúrgico al que se enfrentaron muchos cirujanos, apareciendo la explosión de esta forma de cirugía, que muchos centros han preferido a la CC convencional. El entusiasmo inicial se disipó y sólo unos pocos centros realizan hasta el 98% de este tipo de cirugía en India. La opción OPCAB es económicamente viable en India sin un aparente compromiso de resultados. La CC está polarizada en India entre los cirujanos que abogan por la CC convencional y OPCAB. El autor pertenece a este último grupo¹⁷.

CONTROVERSIAS ESPECIALES

Injertos arteriales o venosos

El país está dividido entre los que proponen revascularización arterial completa y los que prefieren el uso de la arteria mamaria interna izquierda (AMII) e injertos venosos. Tal y como se conoce, sólo un conducto ha pasado la prueba del tiempo y se utiliza de forma universal. Mas del 98% de los pacientes en nuestro país

reciben un injerto de AMIi, la mayoría a la arteria descendente anterior (DA). Hay diferencias de opinión sobre si la AMIi debe utilizarse sólo para la DA o debe usarse como conducto secuencial. El autor opina que la AMIi es el conducto más valioso, y que no debe compartirse con otros territorios^{18,19}.

Endarterectomía coronaria

La endarterectomía es el modo convencional de revascularizar la CI difusa. Sus resultados han sido inferiores a la derivación convencional, con la desventaja adicional de necesitar anticoagulantes postoperatorios. De aquí que la reconstrucción con parche de arterias con enfermedad difusa y sin endarterectomía se haya popularizado en India. En general se realiza con CEC, pero el autor ha realizado este procedimiento como OPCAB en más de 120 casos²⁰.

La cirugía coronaria en los síndromes coronarios agudos

Los síndromes coronarios agudos incluyen la angina inestable, el infarto sin elevación del segmento ST (SCASEST) y el infarto con elevación del segmento ST (SCACEST). El tratamiento óptimo de este último es la intervención percutánea o la trombólisis. El mejor tratamiento para el ángor inestable y el SCASEST es materia de debate. La cirugía, no obstante, ofrece mejores resultados, y la asociación de OPCAB favorece la reducción de morbilidad. La revascularización arterial completa puede mejorar los resultados de la CC. Un importante número de cirujanos ha optado por OPCAB para la revascularización en los síndromes coronarios agudos¹⁷.

Cirugía cardíaca robótica

La cirugía cardíaca robótica se inició en India en 2002. Tan sólo dos instituciones mayores la han realizado hasta la fecha, fundamentalmente por razones económicas. A pesar de ello, en estos centros ha aumentado el número de intervenciones realizadas, y no hay que despreciar las posibilidades de nuevos centros que incorporen estas técnicas²¹.

En resumen, la CC en India se ha desarrollado de forma muy rápida en los últimos 15 años. La CC sin CEC es una opción muy apreciada, incluyendo los aspectos financieros. En la actualidad, una proporción significativa de intervenciones se realiza de esta forma. Además, la anatomía de las arterias coronarias en los pacientes de India obliga a reconstrucciones complejas con parche o endarterectomía.

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