

Kobayashi technique for myocardial revascularization – early experience

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Abstract

Background: Total arterial revascularization is a trend in the treatment of ischaemic heart disease these days. The aim of this study was to determine the short-term results of Kobayashi arterial revascularization technique.

Material and methods: Between May and August 2007 a total of 10 patients underwent coronary revascularization using Kobayashi technique. The quality of sutured bypasses was assessed using transit-time flow meter and postoperative coronary angiography.

Results: All bypasses had sufficient blood flow measured with a Doppler probe during the operation and showed 100% patency on postoperative angiograms. Two cases of blood flow competition occurred in the right coronary artery (RCA) territory. Both were due to insignificant stenosis of the RCA.

Conclusions: Kobayashi revascularization technique, although technically demanding, is safe and provides good short-term results.

Key words: CABG, of-pump, aorta no-touch.

Introduction

Our main goal in coronary surgery is to provide a long lasting reconstruction of coronary vasculature, minimize surgical trauma and reduce the number of postoperative complications.

It seems that this could be achieved by performing off-pump, aorta no-touch surgery using composite arterial conduits [1, 2]. Kobayashi described a technique which uses in situ internal thoracic arteries (ITA) and a radial artery (RA) for total arterial heart revascularization [3].

In order to introduce and verify this approach a pilot study has been undertaken, at our department. We analyzed the quality of sutured bypasses using a transit-time flow meter and postoperative coronary angiography.

Streszczenie

Wstęp: Całkowita rewaskularyzacja tętnicza wyznacza kierunek w obecnym leczeniu choroby niedokrwiennej serca. Celem pracy było ustalenie krótkoterminowych wyników rewaskularyzacji przeprowadzonej techniką Kobayashi.

Materiał i metody: W okresie między majem a sierpniem 2007 roku w grupie 10 chorych przeprowadzono operację chirurgicznej rewaskularyzacji techniką Kobayashi. Jakość pomostów oceniono śródoperacyjnie przepływomierzem ultradźwiękowym oraz angiograficznie po wykonanym zabiegu.

Wyniki: Podczas zabiegu przy użyciu techniki dopplerowskiej stwierdzono wystarczający przepływ krwi w wykonanych zespoleniach. Przeprowadzone po zabiegu badanie angiograficzne wykazało 100-procentową drożność pomostów. W prawej tętnicy wieńcowej zaobserwowano 2 przypadki kompetencyjnego przepływu, które wynikały z nieistotnej stenozы.

Wnioski: Rewaskularyzacja techniką Kobayashi, pomimo skomplikowanej technicznie natury zabiegu, jest bezpieczną metodą i gwarantuje dobre wczesne wyniki.

Słowa kluczowe: CABG, of-pump, aorta no-touch.

Patients and Methods

Between May and August 2007 a total of 10 patients underwent coronary revascularization using Kobayashi technique, at our department. The study cohort included 9 (90%) men and 1 (10%) woman who gave their consent to repeat coronary angiography. The preoperative clinical data of the patients are listed in Table I. All operations were performed by the same surgeon.

Kobayashi technique

Kobayashi technique consists of using two in situ ITAs and one RA. The RA is connected to the right ITA, in order to elongate it, creating an “I” composite graft. To decrease the

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risk of kinking in the ITA-RA anastomosis the connection is made in a side-to-side fashion. Left ITA is used to bypass the left anterior descending artery (LAD) or LAD and diagonal branch (Diag). "I" composite is used to sequentially supply the rest of the coronary vasculature.

In order to minimize the possibility of blood flow competition, the direction of the "I" graft (clockwise or counterclockwise) depends on the degree of the stenosis in the right coronary system (RCA). If the stenosis of the RCA is $\geq 80\%$ the "I" graft crosses over in front of the aorta, connects to the vessels on the lateral wall of the left ventricle (LV) and ends in the RCA territory. In case of RCA stenosis $\leq 80\%$, the "I" graft goes along the right heart border, connects to the RCA first, and ends on the lateral wall of the LV (Fig. 1A, B). The operation is performed on the beating heart.

All operations were performed using standard off-pump technique as described previously [4]. At the end of the procedure after protamine administration, the blood flow was measured through both ITA conduits using a Medi-Stim transit-time flowmeter. In cases when "I" composite was crossing over the aorta the conduit was positioned along the anomalous vein. It was covered by a flap made of retro-sternal fat tissue (thymus remnants), to decrease the risk of conduit injury if repeat sternotomy would be required in the future.

On postoperative day 6-7, control angiography was performed. The patient was dismissed from the hospital on the following morning.

Tab. I. Clinical profile of patients

Variable	No. (%) of patients
Coronary disease	
• Left main	3 (30)
• Triple vessel	7 (70)
Hypertension	8 (80)
Hyperlipidaemia	5 (50)
Diabetes mellitus	5 (50)
Stroke	0
Obesity	1 (10)
Previous percutaneous coronary intervention	2 (20)

Left ventricular ejection fraction 52% (40-65%)

Results

A mean of 3.5 grafts per patient were completed in our 10 patients. Table II lists the types of bypasses used and their blood flows. None of the bypasses required revision owing to technical errors or inadequate blood flow. All ITAs were harvested in skeletonized fashion. In two patients endoscopy was used for RA harvesting. None of the patients presented with neurological deficit in the upper extremity owing to RA harvesting.

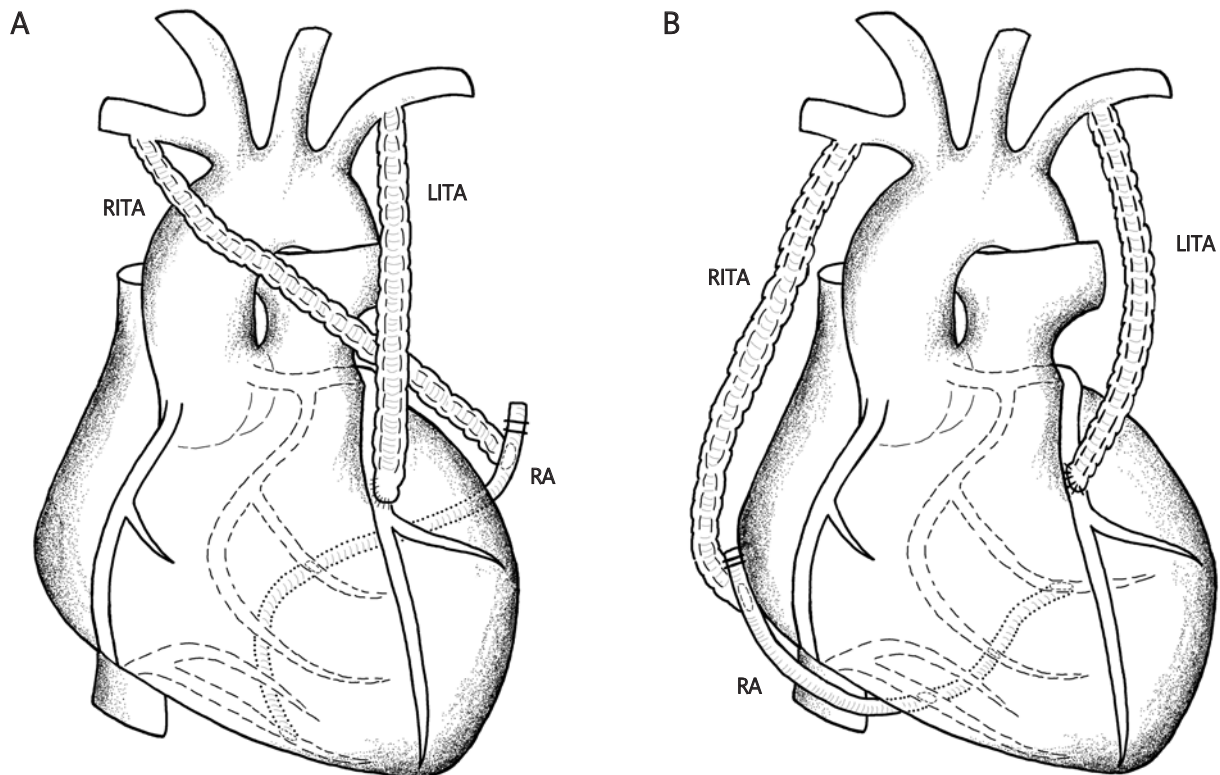


Fig. 1A-B. Kobayashi technique of heart revascularization – diagrams of composite bypass orientation. A) clockwise direction; B) counterclockwise direction

Tab. II. Types of used bypasses and perioperative blood flows

"I" composite – RITA + RA	Blood flow (ml)	LITA	Blood flow (ml)
OM+Circumflex	70	Diag + LAD	68
Diag + OM + PDA	40	LAD	27
PDA + OM	26	Diag + LAD	47
IM + OM1 + OM2 + PDA	36	LAD	21
RCA + OM	52	LAD	24
Diag1 + Diag2 + Circumflex	91	LAD	130
OM + Circumflex + PDA	60	LAD	66
OM + PDA	70	LAD	30
Diag + Circumflex	33	LAD	57
OM + Circumflex + RMD	72	LAD	63

RITA – right internal thoracic artery; LITA – left internal thoracic artery; RA – radial artery; OM – obtuse marginal artery; PDA – postero-descending artery; LAD – left antero-descending artery; Diag – diagonal artery; IM – intermediate artery; RMD – right marginal artery

The mean blood flow through left ITA was 53.3 ml/min and through right ITA 55 ml/min, with mean pulsatility indices (PI) of 2.3 and 1.7, respectively. There were no perioperative myocardial infarctions or hospital deaths in the studied cohort. One patient (10%) suffered from superficial wound infection in a distal pole of the sternotomy (4 cm in length), which was subsequently successfully treated by secondary suture.

The postoperative coronary angiography showed 100% patency of sutured anastomoses (Fig. 2). In two patients competitive blood flow was present in the RCA territory. In the first case it was caused by coronary vasospasm that

led to overestimation of the degree of RCA stenosis (up to $\geq 80\%$) on the preoperative angiogram. In the second case the competition occurred despite the "I" composite counterclockwise orientation (RCA stenosis being only 60%) and was probably also due to insignificant RCA stenosis.

In one patient a large lateral costal branch of ITA was present on the angiogram (despite ITA dissection up to the anonymous vein) with good contrast filling of the LAD. One patient suffered from brain transitory ischaemic attack during repeat angiography examination.

Discussion

Total arterial revascularization (TAR) is a trend in the treatment of ischaemic heart disease these days. Especially when combined with off-pump surgery and aorta no-touch technique it seems to provide the most benefit for the patient. One of the issues that concern many surgeons who perform TAR operations using composite grafts is the competitive blood flow. Kobayashi developed a technique of TAR based on two in-situ ITAs and RA. The proposed design of operation is based on the author's great experience in the field of blood competitive flow in bypasses [5]. TAR performed on the beating heart is technically very demanding surgical coronary intervention and that is why before wider introduction of this procedure at our department a pilot study was undertaken to analyze the early results.

In the cohort of 10 patients, all of them showed good perioperative blood flows in sutured bypasses. On the postoperative angiograms all the anastomoses remained patent. There were two cases of blood flow competition present. The first one was owing to misinterpretation of the preoperative angiogram. The second one was also caused by insignificant RCA stenosis (60%). This time, however competition appeared despite the counterclockwise (recommended) orientation of the composite graft. In both

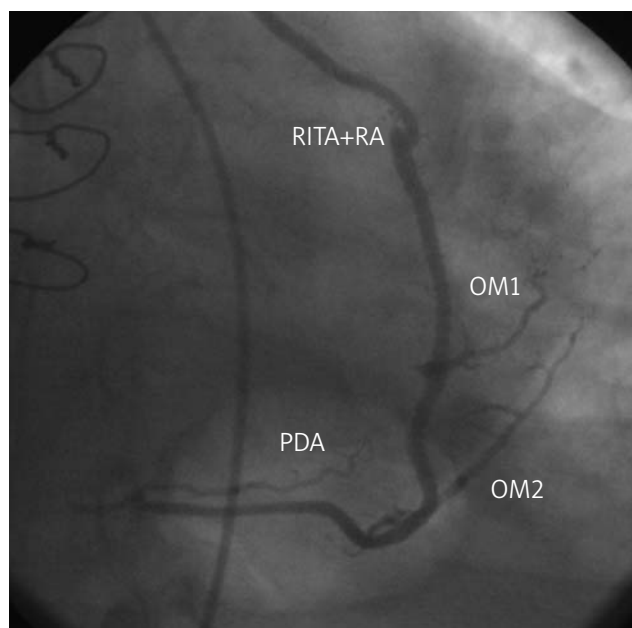


Fig. 2. Postoperative angiogram showing good patency of "I" composite bypass sutured to both OM1 and PDA

competition cases, perioperative blood flow through the "I" composite (RITA) was greater than the blood flow through the contra-lateral thoracic artery (LITA).

The postoperative course of all patients was without major events, except one patient suffering from superficial wound infection in a distal pole of the sternotomy. There was one incident of brain transitory ischaemic attack but this was related to the postoperative angiography examination and not to the procedure itself.

Conclusions

The outcomes of this study lead us to the conclusion that Kobayashi revascularization technique although technically demanding is safe and provides good short-term results. It is necessary for the patients undergoing this operation to have

significant disease of the RCA system, to avoid the blood flow competition phenomenon.

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