Experience of Emergency Coronary Artery Bypass Grafting Surgery and Operative Transluminal Coronary Angioplasty

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Our experience of performing emergency coronary artery bypass surgery in 9 patients with acute myocardial infarction (AMI) and of intraoperative transluminal coronary angioplasty (OTCA) during bypass surgery in another 28 patients was reviewed. Data were evaluated in conjunction with the recent application of intracoronary thrombolytic therapy and percutaneous transluminal coronary angioplasty. In 4 of the 9 cases where the emergency coronary artery bypass grafting (CABG) was performed within 2 hours after the onset of AMI, no new Q waves appeared in electrocardiograms (3 cases), and remarkable improvement of left ventriculographic findings was noted when pre- and postoperative ventriculograms were compared in 2 of these 4 cases. Intraoperative transluminal coronary angioplasty was successful in only 51.6% of the cases when evaluated at the post bypass period and this was less successful than our experience with PTCA. The low success rate was considered to be due to the greater amount of intimal fibrosis in the more distal portion, where the OTCA is performed, than is found in the proximal portion of the coronary arteries.

RECENT advances in interventional therapies for acute coronary artery diseases have influenced the thoughts of specialists on the treatment and care of patients.

Emergency coronary artery bypass grafting (CABG) surgery,¹ percutaneous transluminal coronary angioplasty (PTCA),² operative transluminal coronary angioplasty (OTCA)³ and percutaneous transluminal coronary recanalization (PTCR)⁴ or intracoronary thrombolysis have been incorporated as the current treatments of choice⁵

Emergency coronary artery bypass grafting surgery on acute myocardial infarction (AMI) was initiated by Mundth et al¹ in 1973.

Indications for this operation are as follows

Key Words:

Emergency coronary artery bypass graft surgery
Operative transluminal coronary angioplasty

1) patients with accompanying shock, 2) those whose heart failure which cannot be improved by intensive medical therapy, 3) patients who are refractory to all treatments such as intraaortic balloon pumping and in whom surgical therapy such as CABG is a lifesaving measure and 4) those in whom the vital myocardium largely remains upon admission 2–3 hours after the onset of AMI, but where massive myocardial infarction could occur if the condition is left untreated.

We initially performed percutaneous transluminal coronary recanalization in 1975^{6,7} We made a trial using an intracoronary guide wire to recanalize occluded coronary arteries in 3 cases with acute inferior myocardial infarction at 48, 36 and 4.5 hours after the onset of the AMI. This procedure was followed by an intracoronary injection of urokinase. In one of the cases (the

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TABLE I

Diag	ACBG			OTCA		
	Age	Sex	Location		Location	% stenosis
OMI	52	M	LAD, RCA	I	4PD	80 → 60
OMI	52	M	LAD, RCA	I	4PD	80 → 60
OMI	59	M	LAD, RCA	I	4PD	45 → 30
OMI	63	M	LAD,	I	LAD (Seg 7)	40 → 40
OMI	46	M	LAD, RCA	I	LAD (Seg 7)	50 → 50
OMI	49	M	LAD, RCA	I, I	LAD (Seg 7), RCA (Seg 3)	40 → 40, 90 → 70
ANG	64	M	LAD, RCA	I	RCA (Seg 3)	70 → 20
OMI	55	M	LAD, RCX	I	LAD (Seg 8)	30 → 90
OMI	43	M	LAD, RCA	I	RCA (Seg 3)	99 → 20
OMI	45	M	LAD, LCX	I	LAD (Seg 8)	50 → 25
OMI	54	M	LAD, RCA	I	4PD	75 → 75
OMI	52	M	LAD, DB, RCA	I	4AV	75 → 50
ANG	53	M	DB, OM, RCA	I	4PD	50 →
OMI	64	M	LAD, RCA	I	4AV	99 → 100
ANG	66	M	LAD, RCA	I, II	4PD, PL	90 → 90, 75 → 75
OMI	53	M	LAD, LCX	II	4PD	80 → 60
OMI	54	F	LAD	II, II	RCA (Seg 3), 4AV	75 → 50, 90 → 90
OMI	63	M	LAD, LCX	II, II	RCA (Seg 3), 4PD	75 → 50, 95 → 75
ANG	56	M	LAD	II	4AV	50 → 0
OMI	62	M	LAD, LCX	II	RCA (Seg 3)	90 → 25
ANG	64	M	LAD	II	4AV	50 → 50
MCLS	7	M	Endarterectomy	II	LMT	99 →
Aortitis syndrome	19	F	Endarterectomy	III	LMT	99 → 0
OMI	62	M	LAD	IV	LMT	99 → 90
OMI	41	M	LAD, DB	IV	LAD (Seg 8)	60 → 60
OMI	66	F	LAD, LCX	IV	PL	40 → 20
OMI	54	M	LAD	IV	LAD (Seg 7)	50 → 50
OMI	46	M	LAD, PL, OM	II, IV	RCA (Seg 3), PL	99 → 99, 75 → 30

last case, where the procedure was performed early after the onset of the AMI), some effect was observed. We called this method "intracoronary guide wire recanalization (Endo's method)" and the details are described elsewhere^{6,7} Four years later, in 1979, Rentrop⁴ and Kanmatsuse⁵ reported recanalization after infusing streptokinase or fibrinolytic into the coronary artery.

In this presentation, the results of our clinical experience in performing emergency CABG surgery and OTCA in order to clarify the usefulness of the two methods compared to that of intracoronary thrombolysis and/or PTCA are

described and discussed.

PATIENTS AND METHODS

One group of patients underwent emergency CABG surgery and another group operative transluminal coronary angioplasty (OTCA). Emergency CABG surgery was performed in 8 cases of AMI during 1974–76, and in another case in 1984. The breakdown of the 9 cases is shown in Fig. 1. In 28 patients the OTCA was performed while CABG was under way (Table I).

No.	AGE	Time from attack	ECG		LV angiography		EF		LVEDP	
			Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	29	30M			?		?	60	?	14
2	51	40M (2 H)					34	70	24	11
3	20	1 H			?		?	62	?	12
4	55	2 H (3H30M)					56 (?)	64	24 (?)	15
5	49	3 H (5 H)					27	33	22	18
6	66	4H30M (6H10M)					42	57	25	14
7	44	6 H (8 H)					30	38	30	19
8	39	8 H (9H30M)					24	28	22	17
9	59	18H (19H50M)					38	44	18	14

Fig. 1.

RESULTS

I. Emergency coronary artery bypass grafting surgery

Coronary obstruction and subsequent ST elevation on the ECGs in cases 1 and 3 occurred during Bentall's operation on annulo-aortic ectasia. The coronary artery bypass grafting was performed 30 minutes and 1 hour after the onset

of the disease, respectively. In cases 2 and 4, AMI occurred during hospitalization. Operations on these 2 cases were performed 40 minutes and 2 hours after the onset of the AMI and obstructed coronary arteries were recanalized within 2 hours and 3.5 hours, respectively.

Operations commenced in cases 5-9 three to 18 hours, and the recanalization 5 to 19 hours after the onset of AMI. No lethal result occurred

OTCA

Fig. 2.

in any case and the graftings were patent in all cases. Electrocardiograms taken immediately before and after operation were also compared (Fig. 1).

New Q waves were not observed in cases 1–3. In case 4, R wave resulted in a decrease in amplitude. The QS pattern in case 7 underwent a transition from preoperative V_{1-4} to post-operative V_{1-5} . No changes were observed in cases 5, 6, 8 and 9.

Except for cases 1 and 3 in whom crisis occurred during surgery for aortic disease, left ventriculograms taken before and 1 month after operation were compared. Remarkable improvement was seen in cases 1 to 4 and slight improvement in cases 5 to 9.

II. Operative transluminal coronary angioplasty (OTCA)

The methods of OTCA were classified into 4 groups of procedures, as shown in Fig. 2.

- Group I Performed distally to the anastomosed site of the CABG (15 cases)
- Group II Performed directly from the proximal or distal site of coronary artery stenosis (9 cases)
- Group III Trans-aortic approach (1 case)
- Group IV Performed from the distal site of the coronary artery stenosis and proximal to the CABG site (5 cases)

The OTCA was performed on 33 arteries in 28 patients and the results are shown in Table I.

Thirty-one out of the 33 arteries underwent post-operative angiography. Improvement was observed in 16 (51.6%), and no changes in 14 arteries (45.1%). The improvement rate with OTCA was low compared with that obtained with PTCA.⁸

DISCUSSION

It can be stated that with emergency CABG surgery, greater improvement is obtained in those patients where the operations are performed within 2–3 hours after the onset of AMI.

Although CABG surgery may lead to complete recanalization of the coronary arteries, which is different from PTCA where the residual stenosis of the obstructed coronary arteries are present, at least 1–2 hrs is needed during the preparation before recanalization is possible. Therefore, recanalization should be performed at least within 3–4 hrs after the onset of AMI, and it is considered that even when PTCA is performed more than 3–4 hrs after the onset, it brings about very little improvement.

It should be stated that even in medically treated cases, i.e., those patients who do not undergo CABG, improvement of asynergy is often seen in the convalescent stage of myocardial infarction. Therefore, whether the slight improvement of the ventriculographic findings seen in cases 5 to 9 are attributed to the effect of CABG surgery or not remains unknown.

The reason for the low success rate of OTCA was thought to be due to the atherosclerotic lesion being more fibrotic at the distal portion; therefore the procedure was harder to perform than at the more proximal portion.

REFERENCES

1. MUNDTH ED, BUCKLEY MJ, LEINBACH RC, et al.: Surgical intervention for the complications of acute myocardial ischemia. *Ann Surg* 178: 379, 1973
2. GRUENT ZIG AR, SENNING A, SIEGENTHALER WO: Nonoperative dilatations of coronary-artery stenosis. Percutaneous transluminal coronary angioplasty. *N Engl J Med* 301: 61, 1979

3. MILLS NL, DOYLE D: Does operative transluminal angioplasty (OTA) extend the limits of coronary artery bypass procedure? *Circulation* 64 (Suppl IV): 292, 1981 (abstr)
4. RENTROP P, BLANKE H, KOESTERING K, et al.: Acute myocardial infarction: intracoronary application of nitroglycerin and streptokinase in combination with transluminal recanalization. *Clin Cardiol* 5: 353, 1979
5. KANMATSUSE K, LANDO U, MERCIER J, et al.: Rapid lysis of coronary thrombi by local application of fibrinolysin. *Circulation* 60 (Suppl II): 216, 1979 (abstr)
6. ENDO M: Dynamic coronary angiography. "Oga" Cardiology Conference, Akita, Japan, 1976
7. ENDO M, SEKIGUCHI M, SUZUKI S, MATSUMURA K, KOYANAGI H: Our experience of coronary intervention. Intracoronary guide wire recanalization and percutaneous transluminal coronary angioplasty. *Jpn Circul J* 1985 (submitted)
8. SUZUKI S, ENDO M, TAKABAYASHI W, HONDA T, MATSUMURA K, SEKIGUCHI M, HIROSAWA K, HIROE M, NISHIOKA T: Improved myocardial ischemia and left ventricular function during exercise after successful percutaneous transluminal coronary angioplasty. *Jpn Circul J* 1985 (submitted)