

Assessing coronary perforation during PCI

¹First Department of Internal Medicine, Nippon Medical School, ²Coronary Care Unit, Nippon Medical School Shirakabe Akihiro¹, Takano Hitoshi¹, Nakamura Syunichi¹, Kikuchi Arihumi¹, Sasaki Asako¹, Yamamoto Eisei¹, Kawashima Shuji¹, Takagi Gen¹, Fujita Nobuhiko¹, Aoki Satoshi¹, Asai Kuniya¹, Yoshikawa Masatomo², Kato Koji², Yamamoto Takeshi², Takayama Morimasa¹

[Background] During percutaneous coronary intervention (PCI), coronary perforation is one of the most undesirable complications which sometimes threaten their lives.

[Purpose and Methods] We reviewed the cases of overt coronary perforation in our institute and examined the mechanism of perforation, management of the complication and clinical outcome.

[Results] Between 1991 and 2005, we experienced 7 cases of coronary perforation out of 3128 PCI cases. The 7 cases consisted of 4 patients with acute coronary syndrome and 3 patients with stable angina. The perforation occurred during the use of debulking devices in 2 cases, immediately after stenting in two, immediately after post dilatation of stent in two, and during wiring in one. Intermediate or extensive calcification was observed by intravascular ultrasound in 4 patients. The restoration was attempted with long inflation of a balloon in 5 cases, with implantation of a covered stentgraft in one, and by emergent surgical repair in one. Subsequent cardiac tamponade occurred in 3 patients requiring pericardiocentesis and one patient died due to congestive heart failure. One patient underwent elective bypass surgery later. Administration of protamine was effective to stop bleeding in 4 patients, whereas continuation of heparin resulted in poor outcome (death and surgery). Although 7 patients continued to receive antiplatelet, no overt re-bleeding occurred.

[Conclusion] Coronary perforation during PCI is a rare complication, but is associated with significant morbidity and mortality. Intravenous administration of protamine is effective in conjunction with the use of non-surgical devices. Continuation of antiplatelet does not seem to induce adverse effect.

The Japanese Perforation and IVUS Registry in Stenting

¹Department of Cardiology, Heart Center, Rinku General Medical Center, Izumisano, Osaka, Japan
Nojima Yuhei¹, Sumitsuji Satoru¹, Nakatsuji Hideaki¹, Ihara Madoka¹, Nakaoka Hajime¹, Sato Makoto¹,
Yamazaki Keita¹, Haruta Hiroaki¹, Okutsu Masaaki¹, Kishida Ken¹, Nagai Yosiyuki¹

<Purpose>In our experience of intravascular ultrasound (IVUS) in PCI, we found out coronary perforation high risk signs. The purpose of this registry study is to evaluate high risk sign of coronary perforation in IVUS. <Methods>For this registry study, IVUS available 28 coronary stent and perforation cases were registered from 10 hospitals around Japan. For control group, 1036 stented cases in Rinku General Medical Center were used. Age, gender, stent/artery ratio and IVUS findings (calcium, eccentric plaque, negative remodeling, weak segment) are analyzed. Further detail pattern analysis of IVUS images were performed. <Results>In the 28 perforated cases, two were died, two had Q wave myocardial infarction but remaining 24 cases didn't have severe Sequelae. Age, gender, and stent/artery ratio are significant predictors for coronary stent perforation in this study. In IVUS analysis, only weak segment was observed in more than 80% of cases. Furthermore, three high risk IVUS patterns were defined, (1) severe eccentric calcified plaque with weak segment in opposite side; 9/28 cases (2) severe eccentric fibrous plaque with weak segment in opposite side; 8/28 cases (3) severe superficial calcium with weak segment in opposite side; 4/28 cases. <Conclusion>IVUS can show the new high risk sign of coronary stent perforation. Proper IVUS reading has potential of 75% reduction of coronary stent perforation risk.

Fenestration with cutting balloon and stenting for treating intramural hematoma

¹The Department of Cardiology, Kasugai Municipal Hospital, Kasugai, Aichi Japan

Terasawa Akihiro¹, Morimoto Ryouta¹, Shinoda Norihiro¹, Matsushita Etsushi¹, Sugino Shigeo¹, Uchida Issei¹, Kondo Keita¹

Intramural hematoma is an important complication of percutaneous coronary intervention leading to abrupt closure and myocardial infarction. We report three cases of intramural hematoma successfully treated with cutting balloon and stent. Case 1: 51 year-old male with unstable angina underwent cutting balloon angioplasty of 90% stenosis of the proximal left descending coronary artery at the origin of large diagonal branch. After cutting balloon angioplasty, abrupt closure of the diagonal branch was observed. IVUS showed obstructive intramural hematoma expanding from the origin to the mid portion of the diagonal branch. For fenestration of intramural hematoma, cutting balloon was inflated at the distal end of the intramural hematoma. After resolving the hematoma, stents were successfully implanted from the fenestration to the origin of the diagonal branch. Case 2: 52 year-old male underwent coronary angiography because of chest pain 7 days after stent implantation of the proximal right coronary artery (#1-2). Angiography showed occlusion distal to the stent. IVUS revealed obstructive intramural hematoma. Fenestration with cutting balloon and additional stenting distal to the previous stent restored distal flow successfully. Case 3: 68 year-old male underwent coronary angioplasty for chronic total occlusion of the proximal right coronary artery. After dilatation of the proximal right coronary artery, angiography showed dissection and high grade stenosis in the mid right coronary artery (#2,3). Fenestration of intramural hematoma was created with cutting balloon, and stenting achieved an excellent result. Conclusion; Fenestration with cutting balloon and stenting is useful for treating intramural hematoma.

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the Rinku experience of acute and sub-acute thrombosis with Cypher

¹Rinku General Medical Center, Izumisano city, Japan

Yamasaki Keita¹, Sumitsuji Satoru¹, Nojima Yuhei¹, Kishida Ken¹, Nagai yosiyuki¹

Background and aim: Stent thrombosis (acute and subacute; AT/SAT) is one of the fatal complication of stent procedures. We has been using Cypher stent for almost all PCI. The aim of this study was to clarify the AT/SAT of Cypher stenting in real world. Patient and Method: From Sep 2004 to Jun 2005, 504 PCI were performed including 383 elective and 111 emergent cases. Cypher use ratio were 99.2% (383/386) in elective case and 94.1% (111/118) in emergent case, respectively. AT/SAT was defined as stent occlusion within 30days after implantation, and with symptom, ECG change, or abnormal blood data. Result: We experienced totally 6 AT/SAT cases (1.3%). Elective Cypher stenting showed 0.5% (2/383) and emergent Cypher stenting showed 3.6% (4/111) of AT/SAT. Two cases of AT/SAT case in emergent procedure had particular patient factor, (1) thrombus high risk (DVT, BMS late thrombotic occlusion), and (2) massive intestinal bleeding. In the remaining cases, some technical errors such as remained stenosis or dissection, smaller MSA was observed. Conclusions: AT/SAT ratio of Cypher is acceptable low in elective cases. Carefull check of patient factor before Cypher use and of technical pitfalls after Cypher use will decrease AT/SAT of Cypher stenting.

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New method for detecting sub-clinical distal embolism during PCI

¹Department of Cardiovascular Medicine, Hokkaido University Graduate School of Medicine, Sapporo, Japan
Urasawa Kazushi¹, Soma Takamitsu¹, Ishimori Naoki¹, Tsutsui Hiroyuki¹

BACKGROUND: Distal embolism during PCI procedure is known to deteriorate long-term cardiac morbidity and affect cardiac mortality in some cases. Although massive distal embolism can be recognized as "slow flow" or "no flow" on coronary angiogram, sub-clinical distal embolism is generally impossible to detect on coronary angiogram mainly because the existence of the embolized coronary arterioles is concealed by the reactive dilatation of remaining coronary vascular bed. **PURPOSE:** In this study, we develop a new method to detect sub-clinical distal embolism. **METHODS:** FFR was measured before and after PCI by using a pressure wire (FFR1 and FFR2, respectively). The increase of coronary resistance due to sub-clinical distal embolism was named as Coronary resistance index (CRI), and defined to be $[FFR2*(1-FFR1)] / [FFR1*(1-FFR2)]$. **RESULTS AND DISCUSSION:** CRI was measured in the patients undergone elective PCI procedure in our institution. CRI was shown to have an enough sensitivity to detect sub-clinical distal embolism which was undetectable by standard coronary angiogram. In order to confirm the feasibility and clinical value of this new index, further investigation including long-term follow up might be necessary in large number of patients.

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Nicorandil reduces the incidence of minor cardiac-marker elevation after coronary stenting

¹Cardiovascular Center, Sakakibara Hospital, Okayama, Japan

Murakami Masaaki¹, iwasaki kouitirou¹, yamaji hirosuke¹, murakamimasaaki_1965@yahoo.co.jp takashi¹, yamamoto keizou¹

Background: Minor cardiac marker elevation after PCI has long-term prognostic significance. We examined whether nicorandil reduces the incidence of minor cardiac marker elevation after coronary stenting. Methods: Patients (n=192) undergoing coronary stenting were randomly assigned to receive nicorandil (nicorandil group, n=91) or vehicle (control group, n=101). Nicorandil (2 mg/kg/min, intravenously) was administered immediately after the patients were transferred into the catheterization laboratory and continued for 6 hours. We measured the serum concentrations of CK-MB before, immediately after, and 6, 12, and 24 hours after the procedure, and those of cardiac troponin T (cTnT) 24 hours after the procedure. Results: There was no significant difference in clinical background between the 2 groups. The nicorandil group showed a significantly lower incidence of CK-MB elevation (>1 x upper limit of control range, 20 IU/L) than the control group (8.2 vs 21.8%, p<0.05). The levels of serum CK-MB in the nicorandil group were significantly lower than those in the control group (13.4 ± 5.7 vs 16.5 ± 9.7 IU/L, p<0.01). Similarly, the nicorandil group showed a significantly lower incidence of cTnT elevation >1 x (0.1 ng/ml) or >2 x (0.2 ng/ml) upper limit of control range than the control group (14.3 vs 26.7%, p<0.05, or 7.7 vs 17.8%, p<0.05). Serum cTnT levels were also significantly lower in the nicorandil group than in the control group (0.05 ± 0.10 vs 0.15 ± 0.36 ng/ml, p<0.01). Conclusions: The results demonstrated that nicorandil reduces minor cardiac marker elevation after coronary stenting.

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Incidence and clinical outcomes of cholesterol embolization syndrome, a complication of cardiac catheterization

¹Internal Medicine, Kawakita General Hospital

Iwashita Tatsuo¹, Oshima Akio¹, Tonoike Norimasa¹, Kakihara Masako¹, Mizumura Taisuke¹, Fukuda Junko¹, Okai Takahiro¹, Sugimura Youichi¹, Tamamura Toshitake¹

Objective; To identify the incidence and the clinical outcomes of cholesterol embolization syndrome as a complication of cardiac catheterization. Methods; We retrospectively evaluated a total of 3000 consecutive patients, who underwent left-heart catheterization at our institution. The diagnosis of the cholesterol embolization syndrome was made when patients had peripheral cutaneous involvement (blue toe). Results; Five patients (0.17%) were diagnosed as having cholesterol embolization syndrome. Histopathological evidence of cholesterol embolization was achieved from two patients. Blue toe occurred 15 to 110 days (mean 42 days) after the cardiac catheterization. When blue toe occurred, all patients had elevated serum creatinin and eosinophil counts compare to base line. No death was seen after diagnosis of cholesterol embolization syndrome. Three patients were received steroid therapy. All patients with steroid therapy showed improved renal function and two had improved cutaneous symptoms. Despite steroid therapy, one patient received his left foot amputation. Two patients did not have steroid therapy. One of them needed continuous hemodialysis due to reduced renal function, and the other patient had his left 5th toe amputation. Conclusions; Cholesterol embolization syndrome is a rare but serious complication after cardiac catheterization. Steroid therapy may improve clinical outcomes and early recognition of cholesterol embolization syndrome may be important.

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Statins have diverse effects in coronary intervention.

¹Department of Cardiology, Kansai Rosai Hospital, Hyogo, Japan

Oshima Fusako¹, Kotani Jun-ichi¹, Nanto Shinsuke¹, Uematsu Masaaki¹, Morozumi Takakazu¹, Awata Masaki¹, Onishi Toshinari¹, Iida Osamu¹, Ito Noriaki¹, Minamiguchi Hitoshi¹, Nagata Seiki¹

Creatine kinase-MB (CK-MB) elevation after percutaneous coronary intervention (PCI) is related to poor outcomes. Statins may prevent CK-MB release by modifying plaque characterization. We investigated the influence of statins on CK-MB release after elective PCI. Methods: We studied 29 consecutive patients who had been on statins, either pravastatin 10mg/day (group P, n =13) or atorvastatin 10mg/day (group A, n =16), for at least 4 weeks prior to PCI, and underwent successful PCI. CK-MB was measured within 24 hours after PCI. Results: Patient, lesion, procedure characteristics, incidence of coronary dissection and flow-reduction were all similar between the groups. There were no significant differences in lesion length and post-procedural minimum lumen diameter (9.4 ± 4.4 v. s. 11.5 ± 10.6 mm, n. s., 2.0 ± 0.5 v. s. 2.4 ± 0.7 mm n. s.). CK-MB was significantly lower in group A than in group P (21.1 ± 13.7 v. s. 10.0 ± 5.7 IU/L, $p=0.006$) Conclusion: Atorvastatin attenuated PCI-related CK-MB release, whereas pravastatin did not.

	Total cholesterol (mg/dl)	LDL-cholesterol (mg/dl)	Frequency of abnormal CK-MB (%)
Atorvastatin (n=16)	193 ± 26	119 ± 28	6.3
Pravastatin (n=13)	193 ± 39	116 ± 38	46.2
P value	n.s.	n.s.	0.02

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Use of statins prior to PCI with drug-eluting stenting reduces myonecrosis and improves clinical outcomes

¹Division of Cardiology, Cheng-Hsin General Hospital, Taipei, Taiwan

Jen Hsu-Lung¹, Yin Wei-Hsian¹, Chiang Meng-Cheng¹, Wang Jiann-Jong¹, Pin Huang Wen¹, Feng An-Ning¹, Yang Yung-Nien¹, Young Mason Shing¹

[Purpose] Primary and secondary prevention with statins reduce major adverse cardiovascular events (MACE) in patients with coronary artery disease (CAD). However, the impact of statins on CAD patients undergoing percutaneous coronary intervention (PCI) with drug-eluting stent (DES) has not been well studied. The aim of this study was to determine whether pretreatment with statins can reduce peri-procedural myonecrosis and improve clinical outcomes in these patients.

[Methods] 182 consecutive patients underwent PCI with DES were studied prospectively. We compared the incidence of peri-procedural myonecrosis within 24 hours after PCI and the 6-month MACE (death, stroke, revascularization with PCI or CABG, unstable angina requiring hospitalization) rate among patients who received statins prior to PCI (N= 62) to those who did not (N=120).

[Results] The baseline characteristics were similar in both groups. However, statin pretreated patients were more likely to have hyperlipidemia (79.6% vs 59.5 %; P<0.05) than those who did not receive statin therapy. Patients pretreated with statins had a significantly lower incidence of myonecrosis (8.2% vs 14.5 %; P<0.05) at 24 hour and lower MACE rate at 6 months (16.2 % vs 25.5 %; P<0.05). After adjusting for all baseline characteristics, use of statins before PCI was associated with a 51% decrease in risk of all MACE (OR=0.49; CI =0.18-0.96; P<0.05).

[Conclusion] Statin therapy prior to PCI with DES may reduce peri-procedural myonecrosis and improve clinical outcomes. These results need to be confirmed in large prospective randomized trials.

Usefulness of IVUS guided minimum contrast PCI using SES for patients with renal dysfunction

¹Cardiology of Heart Center, Izumisano City Hospital Rinku General Medical Center, Osaka, Japan
Okutsu Masaaki¹, Sumitsuji Satoru¹, Nakatsuji Tsuyoshi¹, Ihara Madoka¹, Nakaoka Hajime¹, Sato Makoto¹,
Yamasaki Keita¹, Nojima Yuhei¹, Kishida Ken¹, Nagai Yoshiyuki¹

Backgrounds: Saving residual renal function is important issue for the patients with renal dysfunction (RD) not receiving continuous hemodialysis (CHD). Further exposure of contrast medium has possibility of worsening of renal function. IVUS and Cypher has potential to reduce contrast exposure with minimum contrast use and dramatically low revascularization rate. Objectives: We investigated safety, feasibility and efficacy of PCI limiting contrast medium use within very low dose (minimum contrast PCI) for patients with RD but not receiving CHD. Patient and Method: 17 patients underwent minimum contrast PCI with IVUS guidance and using Cypher. To minimize contrast exposure, CAG and PCI was performed separately with more than several days interval. PCI was performed with CAG images and IVUS guidance. Actually in PCI, the contrast was used only for stent positioning and final angiographical check. General strategy of minimum contrast PCI was IVUS and Cypher stenting but some case required pre-dilation using small size balloon or rotablator. Results: All of 17 cases successfully underwent minimum contrast PCI without any complications. 6 cases underwent PCI for 2VD at once. Used contrast medium volume was only 12.5 ± 6.0 ml. Post PCI serum creatinine (S-Cr) didn't worsen compared with pre PCI (pre PCI: 2.1 ± 0.8 mg/dl and highest value within 10 days after PCI: 2.2 ± 0.9 mg/dl). Conclusions) Minimum contrast PCI using IVUS and Cypher was safe, feasible, and effective strategy for patients with renal dysfunction.

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Acetylcysteine vs. hemofiltration for preventing contrast agent nephrotoxicity after CAG and PCI

¹Department of Cardiology, Matsue Red Cross Hospital, Shimane, Japan

Mikami Shinsuke¹, Shiode Nobuo¹, Shirota Kinya¹, Yamada Tadakatsu¹, Ishii Hiroshige¹, Gotou Kenji¹, Suenari kazuyoshi¹, Sairaku Akinori¹

Background: It was reported that the antioxidant N-acetylcysteine (NAC) prevents acute contrast nephrotoxicity in patients with impaired renal function who undergo computed tomography scanning. However, its role in coronary angiography is unclear. We evaluated whether oral NAC prevents acute deterioration in renal function in patients with moderate renal insufficiency who undergo coronary angiography (CAG). Methods: Fourteen patients received oral NAC (1300 mg twice per day, NAC group) before CAG and physiological (0.9%) saline intravenously before and after CAG. These patients data were compared with the previous data of patients who had underwent hemodialysis (HD) after CAG (n=35, HD group) retrospectively. Serum creatinine levels at baseline, 24 hours and 6 months after CAG were compared. Results: There were no significant difference in the baseline serum creatinine levels (1.41 ± 0.52 mg/dl in NAC group vs 1.64 ± 0.41 mg/dl in HD group; $p=0.08$) and total contrast volume. Serum creatinine levels in both groups did not significantly increase after 24 hours and 6 months. The change of serum creatinine levels was similar in both groups. (-1.3 ± 4.4 mg/dl vs -0.2 ± 0.4 mg/dl, after 24 hours, 0.12 ± 0.26 mg/dl vs 0.09 ± 0.44 mg/dl, after 6 month, respectively). Conclusions: NAC may prevent patients with moderate chronic renal insufficiency from contrast induced deterioration in renal function after CAG similarly to HD.

Effectiveness of preventing radiocontrast nephropathy (RCN) with N-acetylcysteine (NAC)

¹Department of Cardiology, Mitsubishi Kyoto Hospital, Kyoto, Japan, ²Department of Pharmacy, Mitsubishi Kyoto Hospital, Kyoto, Japan

Ohno Mikiko¹, Miki Shinji¹, Mizoguchi Tetsu¹, Kono Yutaka¹, Beppu Koki¹, Mizote Masako², Yoshida Akira¹

<Background>Radiocontrast nephropathy (RCN) is one of the major causes of drug-induced acute renal failure on CAG or PCI. Protection of renal tubular cells against oxidative stress is one of the significant approach to avoid RCN. Tepel et al. originally reported that an antioxidant, N-acetylcysteine(NAC), is highly effective in preventing RCN. Since then, a number of clinical trials have been performed to confirm the effectiveness of this compound, but the results are controversial. <Purpose>We examined the effectiveness of preventing RCN on CAG or PCI. <Methods>33 patients (male:23, mean age:57years old, mean serum Creatinine(Scr) :1.8) with pre-medication of NAC 24 hours before were examined CAG(21 patients)or PCI(11patients). They have received 8A(mg) NAC orally before CAG(PCI) and adequate hydration (mean hydration volume was 2053ml with 0.45 or 0.9 saline). Mean volume of contrast medium was 96.5ml in CAG and 155.8ml in PCI respectively. We compared the Scr and BUN before and 24 hours after CAG and PCI. <Results> The mean Scr before and after CAG were 1.94 and 1.56 (p=0.234), and the mean BUN before and after CAG were 31.9 and 22.8 (p<0.05) respectively. The mean δ Scr and δ BUN were -0.38 and -11.2. The mean Scr before and after PCI were 1.6 and 1.55(P=0.82), and the mean BUN before and after PCI were 25.4 and 22.7(p=0.63). The mean δ Scr and δ BUN were -0.05 and -4.5.

Aneurysm formation and pneumonitis after implantation of drug-eluting stents: 3 case reports suggesting a probably hypersensitivity

¹Department of Cardiology, Grant Medical Foundation, Ruby Hall Clinic, Pune, INDIA

Grant Purvez.K¹, M. S. Hiremath¹, J.S. Hiremath¹, R. S. Shinde¹, C. N. Makhle¹, R. S. Shetty¹, R. B. Sethi¹, M. A. Gadkari¹, M. Durairaj¹, A S Sathe¹, A. C. Mehta¹

Drug-eluting stents have reduced the frequency of in-stent restenosis. But long term safety data on DES is lacking. Here we present 3 probable cases of DES hypersensitivity reactions. 2 cases showed aneurysm formation post DES implantation and 2 had bilateral extensive interstitial pneumonitis. Case1: Elderly gentleman was implanted with sirolimus eluting stent in proximal RCA. 2 weeks later, he presented with unstable angina and high grade fever. Coronary angiography done showed an aneurysm formation at the proximal end of the stent with total occlusion. Subsequently, the patient was sent for CABG. Case 2: A 58 year old female was implanted with a sirolimus eluting stent. 3 weeks later she was admitted with fever, rash, breathlessness, pneumonitis, bilateral pleural effusion and a pericardial effusion. Repeat coronary angiography showed aneurysm formation in the LAD artery. Case 3 : 62 year old man was implanted with 2 sirolimus eluting stents in RCA following an inferior wall MI. 4 days later he presented with severe bilateral necrotizing predominantly interstitial pneumonitis