Observational Study

Medicine®

OPEN

Impact of right coronary dominance on triple-vessel coronary artery disease

A cross-sectional study

Liyuan Peng, MD, PhD[a], Xincheng Guo, MD[b], Ya Gao, MD[c], Qi Guo, MD[d], Jingjing Zhang, MD[c], Bangjiang Fang, MD, PhD[e], Bin Yan, MD[a,*]

Abstract

This study was conducted to investigate the relationship between right coronary dominance and coronary angiographic characteristics in patients with or without significant coronary artery disease (CAD).

A total of 2225 patients undergoing coronary angiography (CAG) between January 2011 and November 2014 were recruited in our study. Based on the CAG results, patients were divided into the left dominance (LD) group, right dominance (RD) group, and co-dominance (CD) group. Multinomial logistic regression was applied to analyze the relationships between coronary dominance and triple-vessel CAD.

We found that patients with RD had a higher prevalence of triple-vessel CAD (36.6% vs 27.3%, $P = .008$) and significant stenosis in the right coronary artery (40.5% vs 29.2%, $P = .001$). In addition, results of multinomial logistic regression analysis showed that RD was significantly associated with the triple-vessel disease (odds ratio 1.768, 95% confidence interval 1.057–2.956, $P = .030$).

In conclusion, RD positively correlated with triple-vessel CAD rather than LD or CD in patients. This result suggested that RD may serve as a risk factor for triple-vessel CAD and more effective measures should be taken in RD patients to prevent fatal cardiovascular events.

Abbreviations: 95% CI = 95% confidence interval, CAD = coronary artery disease, CAG = coronary angiography, CD = co-dominance, DBP = diastolic blood pressure, DVD = double-vessel disease, IVS = inter ventricular septum, LD = left dominance, OR = odds ratio, RCA = right coronary artery, RD = right dominance, SBP = systolic blood pressure, sCAD = Significant CAD, SVD = single-vessel disease, TVD = triple-vessel disease.

Keywords: coronary angiography, fatal cardiovascular events, right coronary dominance

1. Introduction

The phenotype of coronary artery dominance includes left dominance (LD), right dominance (RD), and co-dominance (CD) based on the vascular supply of the posterior interventricular septum (IVS).[1,2] In the general population, LD and RD have reported prevalence of approximately 5% to 12% and 82% to 89% respectively, whereas CD is found in 3% to 7% of individuals.[3–5] Several studies have shown that LD is associated with increased long-term mortality in patients with significant coronary artery disease (CAD) and acute coronary syndrome.[6,7] A literature review indicated evidence demonstrating that LD has been found to be an independent predictor for the prognosis of patients with coronary emergencies.[8,9]

Significant CAD (sCAD) is defined as ≥50% luminal narrowing in at least one of the epicardial coronary arteries. Triple-vessel disease (TVD) is a severe type of sCAD since it involves significant stenosis in any 3 of the major epicardial coronary arteries (i.e., the right coronary artery, left anterior descending artery, and left circumflex artery).[10] Additionally, TVD is associated with higher rates of major adverse cardiac events and mortality than single-vessel disease (SVD) and double-vessel disease (DVD).[10,11] Currently, little is known about the relationship between coronary artery dominance and multivessel disease. Therefore, we conducted this study to investigate whether patients with right coronary dominance have a higher prevalence of TVD.

2. Methods

2.1. Study population

Between January 2011 and November 2014, 2225 in-hospital patients were recruited from the Second Affiliated Hospital, Xi'an Jiaotong University. Patients who underwent coronary angiography (CAG) during their hospital stay were included in our

Editor: Zhonghua Sun.

This study was supported by the Scientific Fund for the Young Talent of Shaanxi Province (Grant No. 2015KJXX-06).

The authors have no conflicts of interest to disclose.

[a] Department of Clinical Research Center, The First Affiliated Hospital, Xi'an Jiaotong University, Xi'an, [b] Intensive Care Unit, Hanzhong Central Hospital, Hanzhong, [c] Department of Emergency Medicine, [d] Department of Cardiology, The Second Affiliated Hospital, Xi'an Jiaotong University, Xi'an, [e] Department of Emergency Medicine, Longhua Hospital of Shanghai University of Traditional Chinese Medicine, Shanghai, China.

[*] Correspondence: Bin Yan, Department of Clinical Research Center, The First Affiliated Hospital, Xi'an Jiaotong University, 277 Yanta Road, Xi'an, 710061, China (e-mail: yanbin.1987@hotmail.com).

Medicine (2018) 97:32(e11685)

Received: 18 December 2017 / Accepted: 30 June 2018

http://dx.doi.org/10.1097/MD.0000000000011685

study. Exclusion criteria were patients who had undergone previous coronary artery bypass graft operation, those with a history of chronic and systemic disease, those with incomplete CAG reports and medical records, and pregnant women. All patients were referred because they had standard clinical indications for CAG. All patients signed the informed consent, and their records were anonymized and de-identified before analysis. The study protocol was approved by the Ethics Committee of the Second Affiliated Hospital, Xi'an Jiaotong University, and was conducted in accordance with the Declaration of Helsinki.

Dyslipidemia was defined as patients with a total cholesterol level ≥200 mg/dL, triglyceride level ≥150 mg/dL, low-density lipoprotein level ≥130 mg/dL, or high-density lipoprotein level ≤40 mg/dL.[12] A current smoker was defined as a person who had ever smoked 100 cigarettes and was currently smoking every day or some days.[13] Diabetes mellitus was diagnosed as patients with a fasting plasma glucose level ≥7.0 mmol/L (126 mg/dL) or 2-hour post-load plasma glucose level ≥11.0 mmol/L (200 mg/dL).[14] Hypertension was defined as patients with a systolic blood pressure (SBP)≥140 mm Hg and/or diastolic blood pressure (DBP) ≥90 mm Hg in office, daytime SBP≥135 mm Hg and/or DBP≥85 mm Hg, or night-time SBP≥120 mm Hg and/or DBP≥70 mm Hg in ambulatory blood pressure monitoring.[15] Myocardial infarction was confirmed by biomarker evidence of myocyte necrosis, electrocardiogram findings, and the presence of symptoms of ischemia.[16]

2.2. CAG results

All patients underwent CAG using the Judkins method, following puncture of the femoral artery or through the radial artery approach.[17] The CAG report was written and double-checked by 2 independent interventional cardiologists. Based on the CAG results, patients were divided into the LD group (the posterior descending artery was being supplied by the left circumflex artery), RD group (the posterior descending artery was being supplied by the right coronary artery), and CD group (the posterior descending artery was being supplied by both the left circumflex artery and right coronary artery).[18,19] Patients with LD or CD anatomies were placed into the left-CD group, because these patients had similar distribution of coronary stenosis. Those with RD anatomy were included in the RD group. Significant stenosis was defined as lesions with a diameter stenosis ≥50%.[20] SVD, DVD, and TVD had one, 2, and 3 vessels with significant stenosis, respectively. The control group included patients without significant stenosis.

The severity of CAD was evaluated with the Gensini score. In this scoring system, 1 represents 1% to 25% stenosis, 2 represents 26% to 50% stenosis, 4 represents 51% to 75% stenosis, 16 represents 76% to 99% stenosis, and 32 represents complete occlusion. Then the score is multiplied by different factors according to the functional significance of the coronary artery.[21]

2.3. Statistical analysis

Results are presented as a mean ± standard deviation for continuous variables and numbers (percentage) for binary variables. Analysis of variance and the chi-square test were used to compare variables between the subgroups of coronary artery dominance. Variables with statistical significance in univariate models were then included in multivariate analyses. Multinomial logistic regression analysis was used to test the association between coronary vessel disease and variables (i.e., age, sex,

Table 1

Baseline characteristics by coronary dominance.

Clinical variables	Total (n = 2225)	Right dominance (n = 2016)	Left dominance (n = 150)	Co-dominance (n = 59)	*P*-value
Age, years	58.5 ± 10.3	58.5 ± 10.4	59.5 ± 9.6	55.9 ± 9.7	.073
Male gender	1545 (69.4)	1393 (69.1)	102 (68.0)	50 (84.7)	.570
Baseline SBP, mm Hg	131.1 ± 28.8	131.5 ± 28.8	128.7 ± 26.2	126.1 ± 35.0	.207
Baseline DBP, mm Hg	76.6 ± 15.6	76.7 ± 15.5	76.3 ± 13.7	75.8 ± 21.1	.876
Heart rate, bpm	73.6 ± 17.6	73.5 ± 17.5	75.0 ± 18.4	73.0 ± 18.6	.574
CAD risk factors					
Diabetes	365 (16.4)	336 (16.7)	19 (12.7)	10 (16.9)	.545
Hypertension	1120 (50.3)	1023 (50.7)	68 (45.3)	29 (49.2)	.753
Current smoking	993 (44.6)	889 (44.1)	69 (46.0)	35 (59.3)	.382
Hyperlipidemia	249 (11.2)	224 (11.1)	19 (12.7)	6 (10.2)	.852
Dignosis					
AMI	767 (34.5)	708 (35.1)	41 (27.3)	18 (30.5)	.345
STEMI	670 (30.1)	621 (30.8)	34 (22.7)	15 (25.4)	.242
NSTEMI	97 (4.3)	87 (4.3)	7 (4.7)	3 (5.1)	.950
Unstable angina	395 (17.8)	362 (18.0)	24 (16.0)	9 (15.3)	.801
History					
Prior MI	144 (6.5)	136 (6.7)	6 (4)	2 (3.4)	.251
Prior PCI	64 (2.9)	61 (3.0)	2 (1.3)	1 (1.7)	.369
Family history of CAD	620 (27.9)	546 (27.1)	47 (31.3)	27 (45.8)	.064
Gensini scores	31.9 ± 33.3	32.3 ± 33.6	28.1 ± 30.1	26.1 ± 28.2	.130
LM	1.3 ± 6.4	1.3 ± 6.4	1.5 ± 7.5	0.7 ± 3.7	.706
LAD	16.1 ± 20.0	16.2 ± 20.1	16.0 ± 19.5	12.4 ± 17.1	.359
RCA	5.6 ± 9.7	5.9 ± 9.9	3.5 ± 7.8	3.5 ± 6.9	.004
LCx	6.8 ± 12.9	6.9 ± 13.1	5.4 ± 9.6	7.8 ± 14.4	.334

Results are presented as mean ± standard deviation or n (%). The P values represent the difference between the 3 groups.

AMI = acute myocardial infarction, CAD = coronary artery disease, DBP = diastolic blood pressure, LAD = left anterior descending branch, LCx = Left circumflex branch, LM = left main coronary artery, MI = myocardial infarction, NSTEMI = non-ST elevation myocardial infarction, PCI = percutaneous coronary intervention, RCA = right coronary artery, SBP = systolic blood pressure, STEMI = ST elevation myocardial infarction.

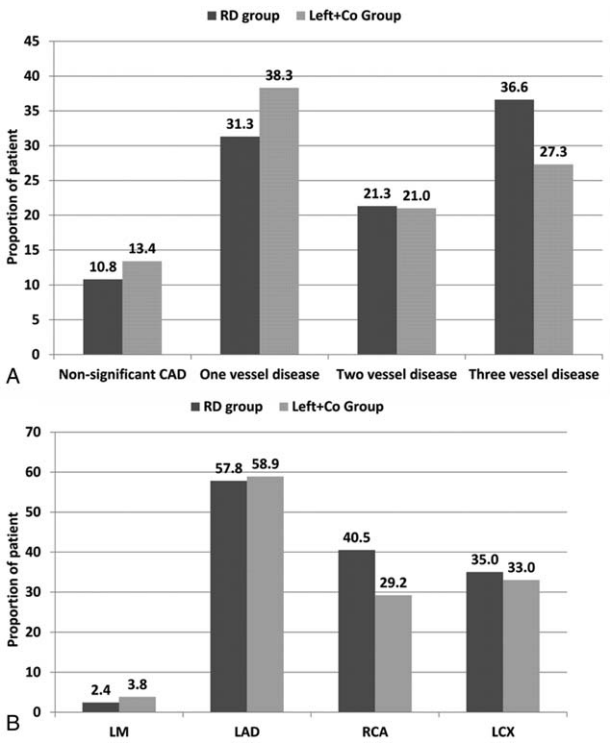

Figure 1. The distribution of RD group and Left+Co group in different coronary vessel disease (A) and location of significant stenosis (B).

smoking status, diabetes mellitus, hypertension, hyperlipidemia, family history of CAD, and coronary dominance). A *P*-value $<.05$ was considered statistically significant. All statistical analyses were conducted using SPSS, version 18.0 (SPSS Inc., Chicago, IL).

3. Results

3.1. Baseline characteristics

This study recruited 2225 patients (2016 with RD, 150 with LD, and 59 with CD). Baseline characteristics of the patient population, categorised by coronary artery dominance, were shown in Table 1. The mean age of all patients (1545 men, 680 women) was 58.5 ± 10.3 years. There was no significant difference in demographic characteristics, CAD risk factors, and medical history among the 3 groups.

3.2. CAG results of patients

Patients were divided into the RD, LD, and CD groups, based on CAG results. Patients in the RD group tended to have a higher Gensini score of the right coronary artery than patients in the LD and CD groups ($P=.004$). Two hundred forty-six (11.0%) patients had no significant stenosis, 711 (32.0%) had single-vessel disease, 474 (21.3%) had 2-vessel disease, and 794 (35.7%) were diagnosed as having triple-vessel disease. In addition, patients with RD had a higher proportion of triple-vessels disease (36.6% vs 27.3%, $P=.008$) and significant stenosis in the right coronary artery (RCA) (40.5% vs 29.2%, $P=.001$) than left-CD group (Fig. 1A and B).

3.3. Association between triple-vessel disease and right dominance

Results of multinomial logistic regression analysis of risk factors associated with coronary vessel stenosis were shown in Table 2. Age (odds ratio [OR] 1.028, 95% confidence interval [CI] 1.012–1.044, $P<.001$) and sex (OR 1.446, 95% CI 1.006–2.137, $P=.046$) were significantly different between the single-vessel disease group and control group. Age, sex, smoking status, diabetes mellitus, and hypertension were all correlated with double-vessel disease and triple-vessel disease. In addition to other risk factors above, RD was also shown to be independently associated with triple-vessel disease when comparing with the control group (OR 1.768, 95% CI 1.057–2.956, $P=.030$).

4. Discussion

Coronary artery dominance is classified as LD, RD or CD depending on the origin of the posterior descending artery.[4,9,22] In patients with LD, most left ventricular myocardial are supplied by the poster lateral branches and posterior descending artery originating from the left circumflex artery.[23] In contrast, the IVS is supplied by the posterior descending branch of the RCA in individuals with RD. Additionally, the IVS is shared by the RCA and left circumflex artery in CD.[24]

CAD is a major cause of death and disability in developed countries.[25] Previous guidelines of CAD treatment emphasised on emergency treatment PCI treatment should be supplemented with antiplatelet agents, which may prevent formation of coronary thrombus.[26,27] CAG is also used to detect coronary artery stenosis, and it shows the coronary dominance at the same time.[28] Scoring system was usually used to evaluated the severity of coronary artery stenosis in clinical practice. SYNTAX score is a tool to select revascularization strategies while Gensini score is a

Table 2

Multinomial logistic regression analysis for coronary vessel disease.

	One vessel disease vs control		Two vessel disease vs control		Three vessel disease vs control	
Variable	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Right dominance	0.991 (0.617–1.593)	.971	1.301 (0.768–2.202)	.328	1.768 (1.057–2.956)	.030
Age	1.028 (1.012–1.044)	<.001	1.053 (1.036–1.071)	<.001	1.071 (1.054–1.089)	<.001
Sex	1.466 (1.006–2.137)	.046	2.380 (1.580–3.584)	<.001	3.655 (2.465–5.419)	<.001
Smoking	1.434 (0.963–2.135)	.076	1.554 (1.023–2.361)	.039	1.788 (1.201–2.660)	.004
Diabetes	1.485 (0.854–2.581)	.161	2.284 (1.305–3.997)	.004	3.892 (2.284–6.632)	<.001
Hypertension	1.120 (0.821–1.528)	.473	1.617 (1.159–2.256)	.005	1.545 (1.125–2.123)	.007
Hyperlipidemia	1.316 (0.797–2.175)	.283	1.299 (0.756–2.232)	.344	1.747 (1.050–2.906)	.032
Family history of CAD	1.136 (0.804–1.607)	0.470	1.198 (0.826–1.738)	.340	1.165 (0.816–1.664)	.400

95% CI = 95% confidence interval, CAD = coronary artery disease, OR = odds ratio.

quick way to qualified the coronary stenosis.[29,30] In this study, we used Gensini score to investigate the association between coronary dominance and CAD and found that RD group prone to have high Gensini score than those with LD and CD. Many previous studies have shown that an LD system is predictive for the prognosis of patients with coronary emergencies. A study of 1131 patients showed that LD was associated with a significantly increased risk of 30-day mortality and early re-infarction after ST-elevated myocardial infarction.[31] Goldberg et al[6] demonstrated that LD was a risk factor for increased long-term mortality in patients with acute coronary syndrome. However, the relationship between RD and clinical manifestations in patients with CAD is unknown.

Currently, the overwhelming majority of research has focused on the role of the LD coronary system in the prognosis of CAD. A previous study with a large population described a different prevalence of TVD between RD and LD.[22] However, they did not perform further analysis to verify the association of RD with TVD. In our study, patients with RD tended to have a high prevalence of TVD and significant stenosis in the RCA. Results of multinomial logistic regression showed that RD maybe a predictor for TVD. All these findings suggest that RD dominance may play a detrimental role in the severity of CAD. Moreover, we also investigate the role of RD in the TVD stratified by gender and the subgroup analysis showed that no significant interactions were not found in this analysis. Therefore, the assessment of coronary vessel dominance with CAG would facilitate risk stratification in clinics.

The current study has several limitations. First, our study was retrospective, so it is difficult to conclude whether a relationship between RD and TVD exists. Second, the left CD group was relatively small, which was ascribed to the small population of patients with LD and CD. Thus, a larger population may have stronger statistical power. Finally, the patients were recruited exclusively from a single centre in the northwest region of China. Therefore, a study with a multicentral and long period of observation should be undertaken to verify our findings.

In conclusion, right coronary dominance was associated with a higher prevalence of TVD than LD and CD. RD may serve as an independent risk factor for triple-vessel CAD.

Author contributions

Data curation: Ya Gao, Qi Guo, Jingjing Zhang, Bin Yan.
Formal analysis: Liyuan Peng.
Funding acquisition: Bin Yan.
Investigation: Liyuan Peng, Xincheng Guo, Bangjiang Fang, Bin Yan.
Methodology: Xincheng Guo, Qi Guo, Jingjing Zhang, Bangjiang Fang.
Project administration: Bin Yan.
Software: Liyuan Peng, Ya Gao, Jingjing Zhang.
Writing – original draft: Liyuan Peng, Xincheng Guo.
Writing – review & editing: Bangjiang Fang, Bin Yan.

References

[1] Gorlin R. Coronary anatomy. Major Prob Int Med 1976;11:40–58.
[2] Leaman DM, Brower RW, Meester GT, et al. Coronary artery atherosclerosis: severity of the disease, severity of angina pectoris and compromised left ventricular function. Circulation 1981;63:285–99.
[3] Angelini P, Velasco JA, Flamm S. Coronary anomalies: incidence, pathophysiology, and clinical relevance. Circulation 2002;105:2449–54.
[4] Bazzocchi G, Romagnoli A, Sperandio M, et al. Evaluation with 64-slice CT of the prevalence of coronary artery variants and congenital anomalies: a retrospective study of 3,236 patients. La Radiol Med 2011;116:675–89.
[5] Knaapen M, Koch AH, Koch C, et al. Prevalence of left and balanced coronary arterial dominance decreases with increasing age of patients at autopsy. A postmortem coronary angiograms study. Cardiovasc Pathol 2013;22:49–53.
[6] Goldberg A, Southern DA, Galbraith PD, et al. Coronary dominance and prognosis of patients with acute coronary syndrome. Am Heart J [Comparative Study Research Support, Non-U S Gov't] 2007;154: 1116–22.
[7] Veltman CE, de Graaf FR, Schuijf JD, et al. Prognostic value of coronary vessel dominance in relation to significant coronary artery disease determined with non-invasive computed tomography coronary angiography. Eur Heart J 2012;33:1367–77.
[8] Parikh NI, Honeycutt EF, Roe MT, et al. Left and codominant coronary artery circulations are associated with higher in-hospital mortality among patients undergoing percutaneous coronary intervention for acute coronary syndromes: report From the National Cardiovascular Database Cath Percutaneous Coronary Intervention (CathPCI) Registry. Circ Cardiovasc Qual Outcomes 2012;5:775–82.
[9] Kuno T, Numasawa Y, Miyata H, et al. Impact of coronary dominance on in-hospital outcomes after percutaneous coronary intervention in patients with acute coronary syndrome. PLoS One 2013;8:e72672.
[10] Watanabe Y, Sakakura K, Taniguchi Y, et al. Determinants of in-hospital death in acute myocardial infarction with triple vessel disease. Int Heart J 2016;57:697–704.
[11] Zeymer U, Vogt A, Zahn R, et al. Predictors of in-hospital mortality in 1333 patients with acute myocardial infarction complicated by cardiogenic shock treated with primary percutaneous coronary intervention (PCI); results of the primary PCI registry of the Arbeitsgemeinschaft Leitende Kardiologische Krankenhausarzte (ALKK). Eur Heart J 2004;25:322–8.
[12] Joint Committee for Developing Chinese guidelines on Prevention and Treatment of Dyslipidemia in AdultsChinese guidelines on prevention and treatment of dyslipidemia in adults. Zhonghua Xin Xue Guan Bing Za Zhi 2007;35:390–419.
[13] Centers for Disease Control and Prevention (CDC)Vital signs: current cigarette smoking among adults aged >/=18 years—United States, 2005–2010. MMWR Morb Mortal Wkly Rep 2011;60:1207–12.
[14] Ryden L, Standl E, Bartnik M, et al. Guidelines on diabetes, pre-diabetes, and cardiovascular diseases: executive summary. The Task Force on Diabetes and Cardiovascular Diseases of the European Society of Cardiology (ESC) and of the European Association for the Study of Diabetes (EASD). Eur Heart J 2007;28:88–136.
[15] Mancia G, Fagard R, Narkiewicz K, et al. 2013 ESH/ESC Guidelines for the management of arterial hypertension: the Task Force for the management of arterial hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). J Hypertens 2013;31:1281–357.
[16] Ryan TJ, Antman EM, Brooks NH, et al. 1999 update: ACC/AHA guidelines for the management of patients with acute myocardial infarction. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction). J Am Coll Cardiol 1999;34:890–911.
[17] Levine GN, Bates ER, Blankenship JC, et al. 2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Society for Cardiovascular Angiography and Interventions. Circulation [Consensus Development Conference] 2011;124:e574–651.
[18] Pelter MM, Al-Zaiti SS, Carey MG. Coronary artery dominance. Am J Crit Care 2011;20:401–2.
[19] Ilia R, Rosenshtein G, Cafri C, et al. Left anterior descending artery length in left and right coronary artery dominance. Coronary Artery Dis 2001;12:77–8.
[20] Jeong JW, Jeong MH, Yun KH, et al. Echocardiographic epicardial fat thickness and coronary artery disease. Circ J 2007;71:536–9.
[21] Gensini GG. A more meaningful scoring system for determining the severity of coronary heart disease. Am J Cardiol 1983;51:606.
[22] Vasheghani-Farahani A, Kassaian SE, Yaminisharif A, et al. The association between coronary arterial dominancy and extent of coronary artery disease in angiography and paraclinical studies. Clin Anat (New York, NY) 2008;21:519–23.

[23] Eyuboglu M, Ekinci MA, Karakoyun S, et al. Fragmented QRS for risk stratification in patients undergoing first diagnostic coronary angiography. Arq Bras Cardiol 2016;107:299–304.
[24] Moriwaki K, Dohi K, Omori T, et al. A survival case of fulminant right-side dominant eosinophilic myocarditis. Int Heart J 2017;58:459–62.
[25] Sanchis-Gomar F, Perez-Quilis C, Leischik R, et al. Epidemiology of coronary heart disease and acute coronary syndrome. Ann Translat Med 2016;4:256.
[26] Bundhun PK, Janoo G, Teeluck AR, et al. Adverse clinical outcomes associated with a low dose and a high dose of aspirin following percutaneous coronary intervention: a systematic review and meta-analysis. BMC Cardiovasc Disord 2016;16:169.
[27] Bundhun PK, Yanamala CM, Huang F. Should a prolonged duration of dual anti-platelet therapy be recommended to patients with diabetes mellitus following percutaneous coronary intervention? A systematic review and meta-analysis of 15 studies. BMC Cardiovasc Disord 2016;16:161.
[28] Levine GN, Bates ER, Bittl JA, et al. 2016 ACC/AHA Guideline Focused Update on Duration of Dual Antiplatelet Therapy in Patients With Coronary Artery Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines: An Update of the 2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention, 2011 ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery, 2012 ACC/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease, 2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction, 2014 AHA/ACC Guideline for the Management of Patients With Non-ST-Elevation Acute Coronary Syndromes, and 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery. Circulation 2016;134:e123–55.
[29] Bundhun PK, Bhurtu A, Huang F. Worse clinical outcomes following percutaneous coronary intervention with a high SYNTAX score: A systematic review and meta-analysis. Medicine 2017;96:e7140.
[30] Bundhun PK, Yanamala CM, Huang F. Percutaneous coronary intervention, coronary artery bypass surgery and the SYNTAX score: a systematic review and meta-analysis. Sci Rep 2017;7:43801.
[31] Veltman CE, van der Hoeven BL, Hoogslag GE, et al. Influence of coronary vessel dominance on short- and long-term outcome in patients after ST-segment elevation myocardial infarction. Eur Heart J [Research Support, Non-U S Gov't] 2015;36:1023–30.