



Complications of intracoronary abciximab bolus-only versus standard protocol during percutaneous coronary intervention in acute coronary syndrome



Muhammad Tariq Shakoor*, Samia Ayub, Sajid Dhakam

Samia Ayub Mount Auburn Hospital, Cambridge, MA Sajid Dhakam, Aga Khan University, Karachi, Pakistan

ARTICLE INFO

Article history:

Received 26 February 2014

Accepted 10 March 2014

Available online 19 March 2014

Keywords:

Primary percutaneous coronary intervention

Acute coronary syndrome

Abciximab

ABSTRACT

Background: Abciximab reduces major adverse cardiac events in patients with ST elevation myocardial infarction undergoing primary percutaneous coronary intervention (pPCI). Standard protocol is intravenous abciximab bolus during PCI plus abciximab infusion for 12–18 h post pPCI. Intracoronary (IC) abciximab bolus administration results in high local drug concentrations and hence it should have higher antiplatelet effect. In this study, we assess the short-term efficacy and safety of IC compared to IV bolus of abciximab in ACS patients during pPCI.

Methods: We compared the clinical outcomes between the IC (n = 56) and standard protocol (n = 170) group of patients. Primary endpoints included bleeding/vascular/ischemic complications and MACE.

Results: The two groups were similar with respect to baseline characteristics. IC abciximab bolus only reduced bleeding complications, with no moderate bleed versus 7.2% in standard protocol group (p value 0.04). Ischemic/vascular complications had statistically insignificant difference between the two groups.

Conclusion: We found no significant difference between IC abciximab bolus only and standard abciximab therapy in terms of ischemic/vascular complications and MACE. But there was higher risk of moderate bleed in standard therapy group. The IC bolus route of abciximab may be superior to the intravenous route. Prospective randomized trials are warranted to validate these findings.

© 2014 The Authors. Published by Elsevier Ireland Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/3.0/>).

1. Introduction

Primary percutaneous coronary intervention (pPCI) is the ideal and standard regimen in restoring epicardial perfusion in a ST-elevation myocardial infarction (STEMI) [1]. Adjunctive therapy with glycoprotein IIb/IIIa receptor inhibitor (GPI) aims at coronary microcirculation and improves the myocardial tissue perfusion which has considerable prognostic impact [2,3]. There is robust data available in literature that supports the beneficial anti-ischemic effects of GPI use during PCI decreasing major adverse cardiac events (MACE) [4–6].

Intravenous abciximab is the standard route of administration, and has been studied in various clinical trials. Standard protocol is intravenous abciximab bolus during PCI plus abciximab infusion for 12–18 h post pPCI. If given as an intracoronary (IC) bolus, it is expected to produce high local concentrations at the PCI site with higher anti platelet action, although at present clinical experience in the efficacy of intracoronary abciximab administration is limited [3,7–10]. Hence we are conducting this study in order to compare the short-term efficacy and safety of IC compared to IV bolus of abciximab in ACS patients during pPCI.

2. Methods

2.1. Patient population

The study was approved by our ethical and research committee. Patient consent for analysis of their data was standard. There were a total of 170 patients in the standard therapy group versus 56 patients in IC abciximab bolus only.

Inclusion criteria: We included all ACS patients who underwent PCI from November 2007–December 2009 and received IC or IV bolus of abciximab with the procedure.

Exclusion criteria: Patients who presented with cardiogenic shock, those who could not get the drug due to any compelling contraindications or got GPI other than abciximab were excluded from the study population.

2.2. Periprocedure pharmacology

All the patients got standard therapy for acute coronary syndrome like aspirin (300 mg), clopidogrel (300–600 mg) and intravenous heparin (60 units/kg) before they were wheeled to the cath lab, as per standard guidelines. Abciximab was given as 0.25 mg/kg bolus plus 0.125 µg/kg/min infusion for 12 h or 0.15–0.25 mg/kg IC bolus only

* Corresponding author at: Baystate Medical Center, MA, United States. Tel.: +1 413 231 2431 (Cell).

E-mail address: mts2703@hotmail.com (M.T. Shakoor).

during the coronary intervention, and hence the two groups were IC abciximab bolus only or IV abciximab bolus plus infusion.

2.3. Study endpoints

Our primary endpoints were vascular, bleeding, ischemic complications and MACE as summarized in Table 1. Vascular complications included pseudoaneurysm, arteriovenous fistula, dissection and loss of distal pulse. Bleeding complications were classified as major, moderate and mild as per GUSTO classification [11]. It included percutaneous entry site bleeding and bleeding other than the entry site (e.g. retroperitoneal, gastrointestinal, genitourinary), diagnosed on clinical grounds but confirmed by further imaging.

Ischemic complications comprised of peri-procedural CK-MB elevation (≥ 3 times upper normal limit), acute or subacute stent thrombosis, unplanned CABG and repeat target vessel revascularization.

MACE was the composite of death, urgent target vessel revascularization and periprocedural CK-MB elevation ≥ 3 times upper normal limit. Data was retrieved from the files of the respective patients by the research staff that was not related to the cardiac intervention.

2.4. Statistical analysis

Statistical analysis was performed using SPSS 17. Percentages were used to express categorical data and Chi-square test was used for comparison. Continuous variables were expressed as mean \pm standard deviation and compared with Student *t* test. A *p*-value of ≤ 0.05 was considered significant.

3. Results

3.1. Baseline clinical characteristics

They were similar in both the groups as reported in Table 2, however there was a higher prevalence of dyslipidemia in bolus plus infusion group ($p < 0.01$). Also more people had a history of prior PCI in the bolus only group with statistical significant *p* value. All the patients received aspirin, clopidogrel and heparin in their initial emergency management. When we take a look at acute coronary syndrome distribution between two groups, bolus only group has higher number of STEMI patients and standard therapy group mainly consists of unstable angina and NSTEMI but *p* value was not significant. All the variations in the baseline characteristics were adjusted by using logistic regression.

3.2. Angiographic characteristics

Angiographic characteristics were almost the same in both the groups as shown in Table 3. Except more patients in standard therapy group achieved post PCI TIMI III flow as compared to bolus only group and probably it can be described by more high risk lesions in bolus only group.

Table 1
Study endpoints.

Study endpoints	Description
Vascular complications	Pseudoaneurysm, AV fistula, dissection, loss of distal pulse
Bleeding complications	Mild, moderate and major
Ischemic complications	Peri-procedural CK-MB elevation (≥ 3 times upper normal limit), acute or subacute stent thrombosis, unplanned CABG, repeat target vessel revascularization
MACE (major adverse cardiac events)	Composite of death, urgent target vessel revascularization and periprocedural CK-MB elevation ≥ 3 times upper normal limit

Table 2
Baseline clinical characteristics.

	Standard therapy (n = 170)	IC bolus only (n = 56)	<i>p</i>
Family history of premature CAD (<50 years) (%)	38 (22.4)	13 (23.2)	0.89
Dyslipidemia (%)	122 (71.8)	22 (39.3)	<0.01
Diabetes (%)	60 (35.3)	16 (28.6)	0.36
Hypertension (%)	87 (51.2)	30 (53.6)	0.76
Smoking (%)	62 (36.5)	22 (39.3)	0.71
Prior history of CHF (%)	6 (3.5)	2 (3.6)	0.98
Prior MI (%)	36 (21.2)	12 (21.4)	0.97
Cerebrovascular disease (%)	6 (3.5)	0	0.15
Peripheral vascular disease (%)	0	1 (1.8)	0.08
Previous CABG (%)	5 (2.9)	3 (5.4)	0.39
Previous PCI (%)	8 (4.7)	13 (23.2)	<0.01
Medications			
Aspirin (%)	170 (100)	54 (96.4)	0.06
Clopidogril (%)	156 (91.8)	54 (96.4)	0.38
Heparin (%)	139 (81.8)	45 (80.4)	0.81
Angina/NSTEMI/STEMI (%)	35 (22)/32 (20.1)/92 (57.9)	5 (8.9)/10 (17.9)/41 (73.2)	0.06

3.3. Vascular/bleeding complications

We found no difference in terms of vascular complications. But when bleeding complications were stratified into major, moderate and mild, we found that moderate bleed was higher in standard therapy group as compared to bolus only group (*p* value = 0.04) as per Table 4.

3.4. Ischemic complication and MACE

Ischemic complications had statistically insignificant difference between the two groups. MACE for in hospital stay was the same in both groups. Study endpoints summarized in Table 5.

4. Discussion

Glycoprotein IIb/IIIa receptors are present on the platelet surface and mediate the final common pathway of platelet aggregation, which plays an important role in the formation of a platelet plug [12]. GPI are potent platelet antagonists that inhibit aggregation of platelets at the site of a disrupted plaque during PCI. There are three well known GPI; abciximab, eptifibatid and tirofiban. Some studies show that eptifibatid and tirofiban are non-inferior to abciximab and some show abciximab is superior [13–15]. Most of the hospitals don't use abciximab because of the cost issues [16].

In vitro studies have demonstrated that there is nearly complete saturation of glycoprotein IIb/IIIa receptors with abciximab concentration of 0.034 $\mu\text{mol/L}$, which corresponds to an IV bolus of 0.15 mg/kg. This abciximab concentration inhibits 75% of the mechanical effects of

Table 3
Angiographic characteristics.

	Standard therapy %	IC bolus only %	<i>p</i> -Value
Vessel disease			
Single vessel	48.9	43.8	0.76
Double vessel	37.8	46.9	
Triple vessel	10.4	6.3	
TIMI flow			
Pre I/II/III	13/8.4/46.6	12.5/3.1/34.4	0.24
Post I/II/III	1.5/9.9/88.5	3.1/9.4/81.3	0.03
Direct stenting	17.6	37.5	0.04
Aspiration device	30.2	31.3	
PCI to graft	0.8	0	0.65
PCI to >single vessel	0.1	0.01	0.54
Lesion risk			
Low/medium/high	9.9/41.2/46.6	9.4/6.3/78.1	0.002
No reflow	6.9	3.1	0.11

Table 4
Vascular and bleeding complications.

	Standard therapy (n = 170)	IC bolus only (n = 56)	p
Percutaneous entry site complications (%)	24 (21.6)	7 (12.5)	.15
Bleeding (req. surgery/transfusion) (%)	16 (14.4)	6 (10.7)	.50
Occlusion (%)	0	0	
Loss of distal pulse (%)	5 (4.5)	0	.10
Dissection (%)	0	0	
Pseudo-aneurysm (%)	1 (0.9)	1 (1.8)	.62
AV-fistula (%)	0	0	
Peripheral embolization (%)	0	0	
Infection (%)	3 (2.7)	0	.21
Thrombocytopenia (%)	4 (3.6)	3 (5.4)	.60
Bleeding not related to percutaneous entry site (%)	13 (11.7)	2 (3.6)	.08
Retroperitoneal bleeding (%)	1 (0.9)	0	.48
Gastrointestinal bleeding (%)	6 (5.4)	1 (1.8)	.27
Genital-Urinary bleeding (%)	4 (3.6)	1 (1.8)	.51
Bleeding-other/unknown cause (%)	3 (2.7)	0	.21
Major bleed (%)	0	0	
Moderate bleed (%)	8 (7.2)	0	.04
Mild bleed (%)	25 (22.5)	7 (12.5)	.12

platelets on fibrin [17]. This stands as a strong base to hypothesize that small dose of local abciximab bolus is enough to achieve maximum efficacy.

The standard practice of GPI administration is, as an intravenous bolus during the PCI procedure followed by a prolonged 12 to 18 h of infusion [18,19]. The need for an infusion was established by the evaluation of c7E3 (chimeric monoclonal-antibody Fab fragment directed against the platelet glycoprotein IIb/IIIa receptor) for the prevention of ischemic complications in EPIC trial which supported that the primary composite endpoint death, myocardial infarction and urgent revascularization reduced a greater degree in the arm with abciximab bolus followed by a 12-hour infusion, compared with IV abciximab bolus-only at 30 days and at late follow-up [18]. However bleeding complications were higher in the former group. We should consider the fact that the EPIC trial was conducted during the percutaneous transluminal coronary balloon angioplasty (PTCA) era, when threat of acute thrombotic complications outweighed over the concerns of bleeding. With the advent of stents and thienopyridine use, there has been a considerable decrease in the incidence of acute stent thrombosis.

In our study no difference was seen in stent thrombosis or other ischemic complications between the two groups. Also in hospital stay MACE was statistically similar in both bolus and bolus plus infusion arms, this is in accordance with Kini et al. [20], but literature does show reduction of long term outcomes of death and MI in patients who got intracoronary bolus of abciximab rather than the regular intravenous route [9].

In literature, decrease in vascular/bleeding complication was found with bolus dosing versus infusion, [21] however in our study statistically significant difference was not found between the two groups, although when, the variable, bleeding was stratified into major, moderate and

Table 5
Study endpoints.

	Standard therapy % (n = 170)	IC bolus only % (n = 56)	p-Value
Vascular complications	18.9 (21)	12.5 (7)	0.29
Bleeding complications	11.7 (13)	3.6 (2)	0.08
Periprocedural CK-MB elevation >3× upper normal limit	67.9 (19)	74.5 (38)	0.52
Stent thrombosis	1.8 (2)	0	0.31
Urgent target vessel revascularization	1.8 (2)	0	0.31
Death	3.6 (4)	3.6 (2)	0.98
MACE (in hospital stay)	71.9 (23)	75 (39)	0.75

minor, reduction in moderate bleed was observed in the bolus only group ($p = 0.04$).

Data advocates that IC bolus administration targets at the PCI site precisely and therefore decrease the infarct size and improves microvascular perfusion [3,21]. According to CICERO trial (N = 530) IC administration of abciximab is associated with improved myocardial reperfusion as assessed by myocardial blush grade and a smaller enzymatic infarct size [22]. This may be the reason that despite high-risk lesions ($p < 0.01$) in the bolus only group we were able to achieve post PCI TIMI III flow also seen by Romagnoli et al. [23].

Four meta-analysis studies comparing IC versus IV abciximab administration in the setting of pPCI have been published recently and all spreading a consistent message, showing superiority of IC over IV administration of abciximab regarding clinical outcome further reinforcing our results [24–31]. Holger Thiele and colleagues reported no mortality difference between interventions in the AIDA STEMI trial [24] but this randomized control trial has been criticized a lot with respect to study methodology [32].

Also in some recent trials researchers concluded that abciximab bolus only was associated with similar outcomes compared with bolus followed by infusion [33,34] and it is of notice that in the new treatment regimen there is not only a decrease in the dose of the bolus, but also infusion is discontinued relative to the standard treatment strategy. Moreover, the route of administration is IC, which will provide high local concentrations of abciximab at the PCI site. As mentioned above this therapeutic range of bolus is adequate to inhibit maximum platelet aggregation in order to produce the desired anti-platelet action. Therefore by administering an appropriate dosage of bolus (according to the weight of a patient) that lies within this therapeutic range, and not giving the infusion of abciximab we bring down the cost substantially down which is one of the biggest hurdle towards using abciximab in most of the hospital. Another big randomized trial (COCTAIL II) is on its way, comparing IC bolus versus standard protocol, with the endpoint of number of cross-sections with thrombus area more than 10% immediately after stent implantation [35]. Hopefully this study will help us in revising the protocol.

5. Study limitations

It is a descriptive type of study. Another major limitation of this study is the sample size of the bolus only group, because intracoronary abciximab bolus dose is an emerging strategy.

6. Conclusion

We found no significant difference between IC abciximab bolus only and standard abciximab therapy in terms of ischemic, vascular complications and MACE. But there was higher risk of moderate bleed in standard therapy group. Hence, adopting a bolus only GPI strategy via IC route would not only provide the desired early protective anti-ischemic action but also reduce the bleeding complications. The IC bolus route of abciximab may be superior to the intravenous route. Prospective randomized trials are warranted to validate these findings.

References

- [1] Antman EM, Anbe DT, Armstrong PW, Bates ER, Green LA, Hand M, et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction: executive summary. *Circulation* 2004;110:588–636.
- [2] Lerman A, Holmes DR, Herrmann J, Gersh BJ. Microcirculatory dysfunction in ST-elevation myocardial infarction: cause, consequence, or both? *Eur Heart J* 2007;28:788–97.
- [3] Thiele H, Schindler K, Friedenberger J, Eitel I, Färnau G, Grebe E, et al. Intracoronary compared with intravenous bolus abciximab application in patients with ST-elevation myocardial infarction undergoing primary percutaneous coronary intervention. The randomized Leipzig immediate percutaneous coronary intervention abciximab IV versus IC in ST-elevation myocardial infarction trial. *Circulation* 2008;118:49–57.

- [4] Topol EJ, Lincoff AM, Kereiakes DJ, Kleiman NS, Cohen EA, Ferguson JJ, et al. Multi-year follow-up of abciximab therapy in three randomized, placebo-controlled trials of percutaneous coronary revascularization. *Am J Med* 2002;113:1–6.
- [5] EPISTENT Investigators. Randomised placebo-controlled and balloon-angioplasty-controlled trial to assess safety of coronary stenting with use of platelet glycoprotein-IIb/IIIa blockade. *Lancet* 1998;352:87–92.
- [6] Investigators IMPACT-II. Randomised placebo-controlled trial of effect of eptifibatid on complications of percutaneous coronary intervention: IMPACT-II. Integrilin to Minimise Platelet Aggregation and Coronary Thrombosis-II. *Lancet* 1997;349:1422–8.
- [7] Bellandi F, Maioli M, Gallopin M, Toso A, Dabizzi RP. Increase of myocardial salvage and left ventricular function recovery with intracoronary abciximab downstream of the coronary occlusion in patients with acute myocardial infarction treated with primary coronary intervention. *Catheter Cardiovasc Interv* 2004;62:186–92.
- [8] Galache Osuna JG, Sánchez-Rubio J, Calvo I, Diarte JA, Lukic A, Placer LJ. Does intracoronary abciximab improve the outcome of percutaneous coronary interventions? A randomized controlled trial [in Spanish]. *Rev Esp Cardiol* 2006;59:567–74.
- [9] Kakkar AK, Moustapha A, Hanley HG, Weiss M, Caldito G, Misra P, et al. Comparison of intracoronary vs. intravenous administration of abciximab in coronary stenting. *Catheter Cardiovasc Interv* 2004;61:31–4.
- [10] Wöhrle J, Grebe OC, Nusser T, Al-Khayer E, Schaible S, Kochs M, et al. Reduction of major adverse cardiac events with intracoronary compared with intravenous bolus application of abciximab in patients with acute myocardial infarction or unstable angina undergoing coronary angioplasty. *Circulation* 1840–1843;107:2003.
- [11] Rao SV, O'Grady K, Pieper KS, Granger CB, Newby LK, Mahaffey KW, et al. A comparison of the clinical impact of bleeding measured by two different classifications among patients with acute coronary syndromes. *J Am Coll Cardiol* Feb 21 2006;47(4):809–16 [Epub 2006 Jan 26].
- [12] Harker LA. Role of platelets and thrombosis in mechanisms of acute occlusion and restenosis after angioplasty. *Am J Cardiol* 1987;60(Suppl.):20B–8B.
- [13] Valgimigli M, Campo G, Percoco G, Bolognese L, Vassanelli C, Colangelo S, et al. The MULTISTRATEGY randomized trial. *JAMA* 2008;299(15):1788–99.
- [14] Zeymer U, Margenet A, Haude M, Bode C, Lablanche JM, Heuer H, et al. EVA-AMI trial. *JACC* Aug 3 2010;56(6):463–9.
- [15] Deliargyris EN, Upadhyaya B, Applegate RJ, Kutcher MA, Gandhi SK, Sane DC. Superior in-hospital and 30-day outcomes with abciximab versus eptifibatid: a contemporary analysis of 495 consecutive percutaneous coronary interventions. *J Invasive Cardiol* 2004;16(11).
- [16] Investigators PRICE. Comparative 30-day economic and clinical outcomes of platelet glycoprotein IIb/IIIa inhibitor use during elective percutaneous coronary intervention: Prairie ReoPro versus Integrilin Cost Evaluation (PRICE) trial. *Am Heart J* Mar 2001;141(3):402–9.
- [17] Collet JP, Montalescot G, Lesty C, Soria J, Mishal Z, Thomas D, et al. Disaggregation of in-vitro preformed platelet-rich clots by abciximab increases fibrin exposure and fibrinolysis. *Arterioscler Thromb Vasc Biol* 2001;21:142–8.
- [18] The E.P.I.C. Investigators. Use of a monoclonal antibody directed against the platelet glycoprotein IIb/IIIa receptor in high-risk coronary angioplasty. *N Engl J Med* 1994;330:956–61.
- [19] The E.S.P.R.I.T. investigators. Novel dosing regimen of eptifibatid in planned coronary stent implantation (ESPRIT): a randomised, placebo-controlled trial. *Lancet* 2000;356:2037–44.
- [20] Kini AS, Chen VH, Krishnan P, Lee P, Kim MC, Mares A, et al. Bolus-only versus bolus + infusion of glycoprotein IIb/IIIa inhibitors during percutaneous coronary intervention. *Am Heart J* 2008 Sep;156(3):513–9.
- [21] Gu YL, Kampinga MA, Wieringa WG, Fokkema ML, Nijsten MW, Hillege HL, et al. Intracoronary versus intravenous administration of abciximab in patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention with thrombus aspiration: the comparison of intracoronary versus intravenous abciximab administration during emergency reperfusion of ST-segment elevation myocardial infarction (CICERO) trial. *Circulation* 2010 Dec 21;122(25):2709–17.
- [22] Romagnoli E, Burzotta F, Trani C, Mazzari MA, Biondi-Zoccai GG, De Vita M, et al. Angiographic evaluation of the effect of intracoronary abciximab administration in patients undergoing urgent PCI. *Int J Cardiol* 2005;105:250–5.
- [23] Thiele H, Wöhrle J, Neuhaus P, Brosteanu O, Sick P, Prondzinsky R, et al. Intracoronary compared with intravenous bolus abciximab application during primary percutaneous coronary intervention: design and rationale of the Abciximab Intracoronary versus intravenously Drug Application in ST-Elevation Myocardial Infarction (AIDA STEMI) trial. *Am Heart J* Apr 2010;159(4):547–54.
- [24] Shimada YJ, Nakra NC, Fox JT, Kanei Y. Meta-analysis of prospective randomized controlled trials comparing intracoronary versus intravenous abciximab in patients with ST-elevation myocardial infarction undergoing primary percutaneous coronary intervention. *Am J Cardiol* 2012;109:624–8.
- [25] Piccolo R, Gu YL, Iversen AZ, Dominguez-Rodríguez A, de Smet BJ, Mahmoud KD, et al. Clinical impact of intracoronary abciximab in patients undergoing primary percutaneous coronary intervention: an individual patient data pooled analysis of randomized studies. *Heart* 2012. <http://dx.doi.org/10.1136/heartjnl-2011-301101>.
- [26] Wang Y, Wu B, Shu X. Meta-analysis of randomized controlled trials comparing intracoronary and intravenous administration of glycoprotein IIb/IIIa inhibitors in patients with ST-elevation myocardial infarction. *Am J Cardiol* 2012;109:1124–30.
- [27] Navarese EP, Kozinski M, Obonska K, Margheri M, Gurbel PA, Kubica J, et al. Clinical efficacy and safety of intracoronary vs. intravenous abciximab administration in STEMI patients undergoing primary percutaneous coronary intervention: a meta-analysis of randomized trials. *Platelets* June 2012;23(4):274–81.
- [28] Thiele H, Wöhrle J, Hambrecht R, Rittger H, Birkemeyer R, Lauer B, et al. Intracoronary versus intravenous bolus abciximab during primary percutaneous coronary intervention in patients with acute ST-elevation myocardial infarction: a randomised trial. *Lancet* 2012;379:923–31.
- [29] Prati F, Capodanno D, Pawlowski T, Ramazzotti V, Albertucci M, La Manna A, et al. Local delivery versus intracoronary infusion of abciximab in patients with acute coronary syndromes. *JACC Cardiovasc Interv* Sep 2010;3(9):928–34.
- [30] Iversen A, Abildgaard U, Galloe A, Hansen PR, Galatius S, Madsen JK, et al. Intracoronary compared to intravenous bolus abciximab during primary percutaneous coronary intervention in ST-segment elevation myocardial infarction (STEMI) patients reduces 30-day mortality and target vessel revascularization: a randomized trial. *J Interv Cardiol* 2011;24(2).
- [31] Eitel I, Friedenberger J, Fuernau G, Dumjahn A, Desch S, Schuler G, et al. Intracoronary versus intravenous bolus abciximab application in patients with ST-elevation myocardial infarction undergoing primary percutaneous coronary intervention: 6-month effects on infarct size and left ventricular function. *Clin Res Cardiol* May 2011;100(5):425–32 [Epub 2010 Dec 2].
- [32] Idriss A. Mortality in intracoronary versus intravenous abciximab. *Lancet* July 7 2012;380(9836):25.
- [33] Bagur R, Bertrand OF, Rodés-Cabau J, Larose E, Rinfret S, Nguyen CM, et al. Long term efficacy of abciximab bolus-only compared to abciximab bolus and infusion after transradial coronary stenting. *Catheter Cardiovasc Interv* Dec 1 2009;74(7):1010–6.
- [34] Bertrand OF, Rodés-Cabau J, Larose E, Nguyen CM, Roy L, Déry JP, et al. One-year clinical outcome after abciximab bolus-only compared with abciximab bolus and 12-hour infusion in the randomized early discharge after transradial stenting of coronary arteries (EASY) study. *Am Heart J* 2008 Jul;156(1):135–40.
- [35] Prati F, Di Vito L, Ramazzotti V, Imola F, Pawlowski T, Matera L, et al. Randomized trial of standard versus ClearWay-infused abciximab and thrombectomy in myocardial infarction: rationale and design of the COCTAIL II study. *J Cardiovasc Med (Hagerstown)* 2013 May;14(5):364–71.