ORIGINAL ARTICLE

Acute outcome of chronic total occlusion (CTO) recanalizsation in the elderly

Jan-Erik Guelker, MD[1,2], Thomas Rock, MD[1,2], Rainer Ott, MD[1,2], Marcus Katoh, Prof[3], Knut Kroeger, Prof[4], Rosemarie Guelker, MSc[5], Heinrich G Klues, Prof[1,2], Dong-In Shin, MD[1,2], Alexander Bufe, MD[1,2,6]

[1] Heartcentre Niederrhein, Department of Cardiology, Helios Clinic Krefeld, Germany, [2] Institute for Heart and Circulation Research, University Cologne, Germany, [3] Department of Diagnostic and Interventional Radiology, Helios Clinic Krefeld, Krefeld, Germany, [4] Department of Vascular Medicine, Helios Clinic Krefeld, Krefeld, Germany, [5] RWI - Leibniz-Institute for Economic Research, Essen, Germany, [6] University Witten/Herdecke, Witten, Germany

SUMMARY

Objectives: Percutaneous coronary intervention (PCI) of total chronic total occlusion (CTO) still remains a major challenge in interventional cardiology. There is only insignificant knowledge reported in the literature about age differences in CTO recanalization. We analyzed in this study the issue of the impact of age on procedural characteristics, complications and short-term outcome.

Methods: Between 2012-2016 we included 440 patients. They underwent PCI for at least one CTO. Antegrade and retrograde CTO techniques were applied. The retrograde approach was used only after failed antegrade intervention. Continuous data are presented as the mean ± standard deviation; categorical data are presented as numbers and percentages unless otherwise specified. We used Two-samplet-t-test with equal variance to test the significant differences of the variables between the two cohorts.

Results: Procedural success proved independently of age. There was no significant interaction between age and procedural success (p=0.5). Complication rates were low in both groups (2.7% vs. 4%; p=0,4) with no difference in statistical significance.

Conclusions: Our study suggests that in an aging society patients with severe coronary artery disease and chronical total occlusions an interventional therapy should be used more intensively. It can be performed safe and feasible.

KEY WORDS:
Coronary artery disease; chronic total occlusion; elderly; acute outcome

INTRODUCTION

Recanalization of chronic total occlusion (CTO) still remains a major challenge in modern interventional cardiology. A CTO is defined as a complete coronary artery occlusion lasting more than three months following Thrombolysis in Myocardial Infarction (TIMI) flow grade 0.[1] The overall prevalence of a CTO has been reported to be as high as 30% among patients with a clinical indication for coronary angiography.[2] Due to new interventional techniques and the use of dedicated materials the average success rates of CTO recanalization increased steadily during the last years. In experienced hands the recanalization rates are above 85%.[3]

Regarding to the World Health Organisation (WHO) most developed countries have accepted the chronological age of 65 years as a definition of 'elderly'.[4] So far there is only limited knowledge about recanalization rates in these patients and merely few trials exist that included a significant number of older patients. It has been reported that a higher patients age is associated with increased risk of postoperative complications after coronary artery bypass graft (CABG) surgery which might be an alternative therapy, and a lower procedural success rate following percutaneous coronary intervention (PCI).[5,6]

Until now older patients are often treated non - invasively to avoid presumed major complications, which are suspected as age - related increased.[7] As people are getting older this strategy should be reconsidered on the basis of convincing data.

The aim of our retrospective study was to evaluate and compare procedural characteristics, complications and short-term outcome of CTO-PCI in patients aged ≥65 years to those <65 years in a setup of 440 consecutive patients between 2012 and 2015.

MATERIALS AND METHODS

A total of 440 consecutive patients who underwent a CTO recanalization in a high-volume centre were included in this retrospective study. 264 patients were younger than 65 years, 176 patients were 65 years of age or older. All patients underwent PCI for at least one CTO.

Inclusion criteria were angina pectoris with a Canadian Cardiovascular Society (CCS) classification III and/or a positive functional ischemia test by magnetic resonance imaging (MRI) or transthoracic echocardiography in the territory of the occluded artery of more than 10%. Both, antegrade and retrograde CTO techniques were applied, and the procedures were performed in a standardized manner via femoral artery using 7-french guiding catheters. To prevent thrombembolic complications heparin was given during the intervention guided by the activated clotting time (> 250 sec.). In the majority of cases bilateral injections of contrast fluid were performed to determine the length of the occlusion and the existence of intercoronary collaterals. Only drug-eluting stents (DES) were implanted. After PCI a dual antiplatelet therapy consisting of 100 mg of aspirin once

This article was accepted: 8 August 2017
Corresponding Author: Jan-Erik Guelker
Email: jan-erik.guelker@helios-kliniken.de

Table I: baseline and procedural characteristics

Variable	< 65 (n=264)		>=65 (n=176)		p-Wert	Level of
Group	Mean	Std. Dev.	Mean	Std. Dev.		significance
Age (y)	55,1	7,04	72,4	4,95	0,000	***
Male (%)	88,6	0,32	74,4	0,44	0,000	***
Hight (cm)	176,72	7,10	171,88	8,1	0,000	***
Weight (kg)	88,84	15,35	82,34	13,36	0,000	***
Diabetes (%)	20,8	0,41	34,7	0,48	0,001	**
Smoker (%)	60,6	0,49	29,5	0,46	0,000	***
PAD (%)	5,7	0,23	0,0	0,39	0,000	***
Hypertension (%)	72,7	0,45	88,6	0,32	0,000	***
Family history for CAD (%)	33,7	0,47	23,3	0,42	0,019	*
Prior CABG (%)	5,7	0,23	13,1	0,34	0,007	**
Prior MI (%)	33,0	0,47	33,0	0,47	1,000	NS
CTO in LAD (%)	26,9	0,44	30,1	0,46	0,463	NS
CTO in LCX (%)	12,1	0,33	14,2	0,35	0,525	NS
CTO in RCA (%)	60,6	0,49	55,1	0,50	0,253	NS
Coronary 1 vessel disease (%)	29,9	0,46	17,6	0,38	0,003	**
Coronary 2 vessel disease (%)	36,7	0,48	42,0	0,50	0,265	NS
Coronary 3 vessel disease (%)	32,7	0,47	39,8	0,49	0,130	NS
Lenght of occlusion (mm)	40,86	16,70	38,18	16,56	0,099	NS
Ejection Fraction	58,41	9,03	58,68	8,94	0,756	NS
Length of stent	68,53	26,80	61,00	27,66	0,010	*

legend: * p<0.05; ** p<0.01; *** p<0.001; NS: not significant
CAD:coronary artery disease; CABG:coronary artery bypass graft; CTO:chronic total occlusion; LAD:left anterior descending; LCX:left circumflex; MI:myocardial infarction; RCA:right coronary artery; PAD:peripheral artery disease

Table II: In-Hospital Clinical Events

	< 65 (n=264)	>=65 (n=176)
In-hospital death	0	0
Myocardial Infarction	0	0
Hämatoma	6	4
Cardiac tamponade	2	1
Emergent CABG	0	0

CABG: coronary artery bypass graft

daily indefinitely and 75 mg clopidogrel daily for at least 6 months was continued. An Angio-Seal vascular closure device (St. Jude Medical, USA) was used to seal the access.
Techniques used for the retrograde approach were the standard "true" retrograde wire crossing, the kissing wire technique, the controlled antegrade and retrograde tracking (CART), and the reverse CART techniques with or without a knuckle wire. If required the manoevers were guided by intravascular ultrasound (IVUS) to understand the local anatomy and identify the exact entry point of the CTO.

Procedural success was defined as successful recanalization of the CTO and restoration of TIMI III flow. A composite safety endpoint summarizing severe complications such as all-cause mortality, vessel perforation, myocardial infarction (MI) and thrombembolic events was evaluated for all patients.

To establish a robust back-up of the guiding catheter an EBU catheter was introduced to the left coronary artery and either a JR4- or an IMA or a Multipurpose- or an Amplatz catheter to the right coronary artery. The selection of coronary guide wires followed a standardized concept of a "step-up" guidewire strategy starting with tapered polymer soft tip - and ending up with super-stiff guidewires (up to 12-g wires). Two kinds of microcatheters were used: the Finecross microcatheter (Terumo, Japan) for the antegrade approach, and the Corsair (Asahi Intecc, Japan) microcatheter for the retrograde access.

The Finecross catheter has a tapered shape, the diameter decreases from 2.6 F at the end to 1.8 F at the tip. The outside coating is hydrophilic, the inside coating polytetrafluoroethylene. Thus, it allows an optimal crossing of the lesion, and the impedance of the inside wire is very low. The Corsair catheter has a tapered soft tip and a hydrophilic polymer. This ensures optimal preconditions to cross the septal collateral channels and to exchange intraluminal wires.

Statistical Analysis
Continuous data are presented as the mean ± standard deviation; categorical data are presented as numbers and percentages unless otherwise specified. We used Two-samplet-t-test with equal variance to test the significant differences of the variables between the two cohorts.

RESULTS

Baseline and procedural characteristics of both groups undergoing attempted CTO recanalization are summarized in table I.

Older patients had more frequent a diabetes mellitus (p=0.001), a peripheral arterial disease (p=0.0004) and an atrial hypertension (p=0.0004). On the other hand they had

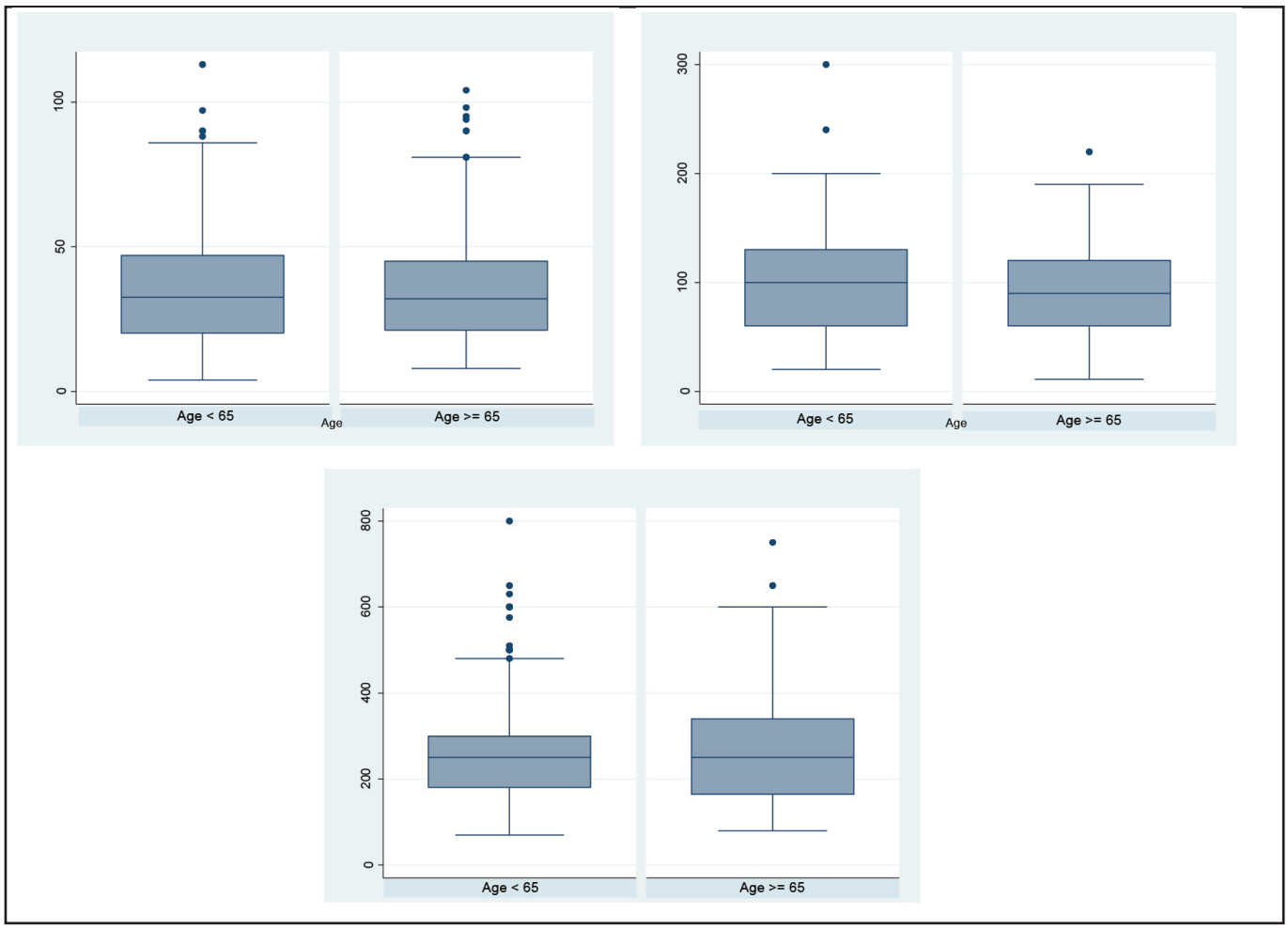

Fig. 1: Fluoroscopy time, examination time and amount of contrast medium.

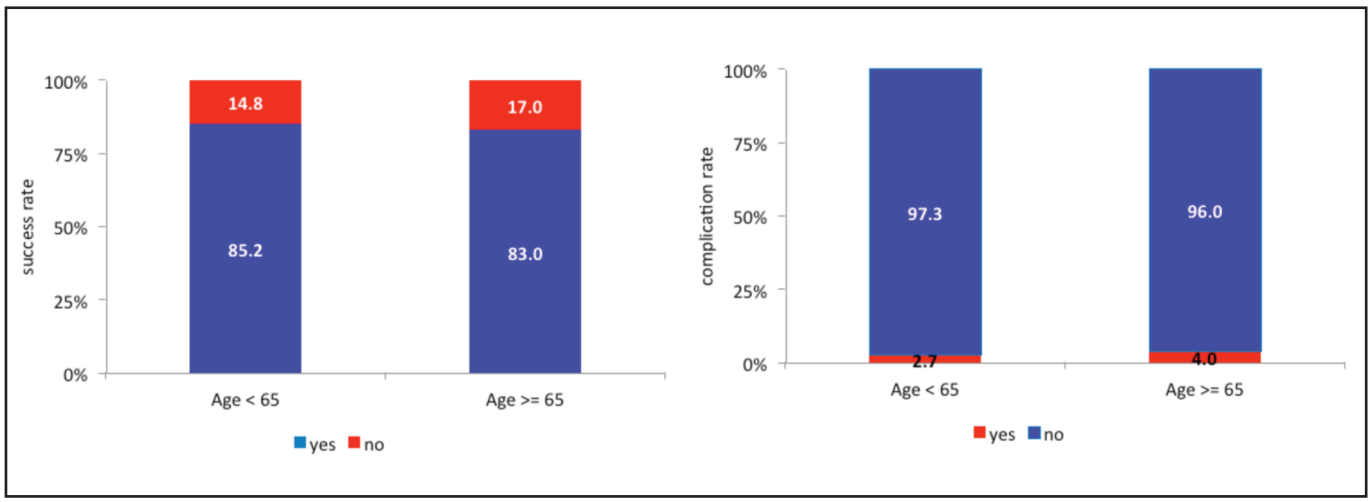

Fig. 1: Success rates and complication rates for the two groups.

not so often a family history for a coronary artery disease (p=0.0019). They were less often smokers (p=0.0004) but had more often a coronary artery bypass graft (CABG) surgery (p=0.007).

Younger patients suffered from a single vessel disease (p=0.003) often with the right coronary artery (RCA) as the target CTO vessel. The length of the occlusion and the ejection fraction (EF) were similar in both groups. Interestingly young patients displayed more often a tortuous CTO segment (p=0.03).

There were no differences with respect to the amount of contrast fluid (260.08±119.35 ml vs. 268.47±130.94 ml; p=0.488), fluoroscopy time (36.5±21.21 min vs. 36.3±20.61 min; p=0.942) and examination time (101.08±44.66 min vs. 95.95±42.82 min; p=0.230) as well as the number of stents and the stent diameter (fig 1).

The success rates were comparable in both groups. 83.0% of the older patients and 85.2 % of the patients younger than 65 years of age could be treated successfully (fig2). There was no significant difference between age and procedural success (p=0.445).

Complication rates were low in both groups (2.7% vs 4%; p=0,40) with no statistical difference between both groups (p=0.439). They included mostly vascular complications such as hematoma and cardiac tamponade which could be treated with a pericardiocentesis and without severe consequences (table II).

The Japanese CTO - Score (J-CTO) reflecting lesion complexity was not significant different in both groups (p=0.061).

DISCUSSION

The elderly represent the fastest growing sector of the population in the western society.[10] The worldwide population of people 65 years of age and older are expected to increase to 20 percent of the population by 2050 and the prevalence and severity of CAD increases with age in both men and women.[11]

The limited representation of older patients in clinical trials means fewer available data about the effectiveness of various strategies in this population. The decision making on how to proceed with revascularization, when to perform PCI and when to prefer cardiac surgery is still a matter of debate in the absence of reliable data.

Due to several comorbidities elderly patients are still a challenge for both interventional cardiologists and cardiac surgeons. Earlier studies suggest that this comorbidities in patients above 65 years may impair long-term clinical outcomes after PCI.[8] Also for patients with a CTO it was reported that procedure related complications may be increased.[9] Previous data demonstrated that cognitive dysfunction was identified up to 10% after CABG in an elderly cohort. [12]

Our retrospective study shows that older patients with a severe CAD including a CTO can be treated successfully using modern and advanced interventional technologies and materials without severe sustained complications. Several retrospective data on revascularisation in elderly patients have shown that PCI can be performed with an acceptable risk in selected patients, but in contrast to our study, that the frequency of in-hospital complications is increased compared with younger patients. [14-15]

Graham et al. high-lighted that older patients could benefit the most from PCI and our data demonstrate that there is no age dependent difference between outcome, success rates and complication rates and in accordance with previous data. Our study shows that the success rate of CTO-PCI has improved and can now reach even up to 83% in elderly patients. [13]

Deferring to data presented by André et al. our findings could prove that there is no increase in the fluoroscopy and examination times in an elderly cohort.[9]

In the light of these results and reflecting that CABG surgery is associated with a significantly higher morbidity and mortality in the elderly cohort we conclude that PCI including CTO - PCI should be considered more often in patients with advanced coronary clinical symptoms and need for revascularization.[10] Additionally, our findings suggest that these patients should be offered an invasive assessment despite their high cardiac risk profile and previous revascularisations.

STUDY LIMITATIONS

There are some study limitations. This is a retrospective study and all data are collected from a single-center. The results of this study could be influenced by selection criteria, operator experience, and varying techniques used by the operators. Furthermore, there is no follow-up beyond the in-hospital phase and some data concerning the cardiovascular risk like cholesterol, the kidney function or a prior stroke are not available as well as data e.g. on contrast nephropathy. Another possible limitation is that the matched and un-matched data used in this study were already collected so the analyze was based on a watching technique.

CONCLUSION

A decrease in invasiveness of therapeutic strategies from aggressive approaches such as a CABG surgery towards minimal invasive procedures is a general tendency in medicine and required to reduce complications. Our study has demonstrated the feasibility of CTO-PCI in patients ≥65 years. Sophisticated PCI combined with CTO-PCI is a minimal invasive approach if compared to CABG. These techniques should be used more frequently and further advanced in the future. Our data suggest that further studies concentrating on details in outcome should be performed to establish an alternative treatment for elderly patients with the need for myocardial revascularization.

REFERENCES

1. Stone GW, Kandzari DE, Mehran R, Colombo A, Schwartz RS, Serruys PW et al. Percutaneous recanalization of chronically occluded coronary arteries: a consensus document: part I. Circulation. 2005; 112: 2364–2372
2. Werner GS, Gitt AK, Zeymer U et al. Chronic total coronary occlusions in patients with stable angina pectoris: impact on therapy and outcome in present day clinical practice. Clin Res Cardiol. 2009; 98: 435-41
3. Bufe A, Haltern G, Dinh W, Wolfertz J, Schleiting H, Guelker H. Recanalisation of coronary chronic total occlusions with new techniques including the retrograde approach via collaterals. Neth Heart J. 2011; 19(4): 162-7.
4. World Health Organization. World Health Statistics 2013. Geneva: Definition of an older or elderly person; 2013
5. Mohan R, Amsel BJ, Walter PJ. Coronary artery bypass graftingin the elderly - a review of studies on patients older than 64,69 or 74 years. Cardiology. 1992; 80: 215-25.
6. Forman DE, Berman AD, McCabe CH, Baim DS, Wei JY. PTCA in the elderly: the ''young-old''versus the''old-old''. J Am Geriatr Soc. 1992; 40: 19-22.
7. Rosengren A, Wallentin L, Simoons M, et al. Age, clinicalpresentation, and outcome of acute coronary syndromes inthe Euroheart acute coronary syndrome survey. Eur Heart J. 2006; 27: 789-95.
8. Boudou N, Roncalli J, Lhermusier T, Moudens G, Celse D, Fourcade J, Elbaz M, Baixas C, Puel J, Carrie D. Long-term clinical outcome after percutaneous coronary interventions in the elderly: results for 512 consecutive patients. EuroIntervention. 2008; 3(4): 512-7.
9. André R, Dumonteil N, Lhermusier T, Lairez O, Van Rothem J, Fournier P, Elbaz M, Carrié D, Boudou N. In-hospital and long-term outcomes after percutaneous coronary intervention for chronic total occlusion in elderly patients: A consecutive, prospective, single-centre study. Archives of Cardiovascular Disease. 2016; 109, 13-21.
10. Ryan TJ, Graham TP, Annas GJ, DeMaria AN, Fost NC, Fuster V. Harvey JC. Levinsky NG, McCullough LB, Rettig RA, Schwartz WJ, Sundwall DN, Talner NS, Wigle ED, Willman VL: Task Force 111: Perspectives on the allocation of limited resources in cardiovascular medicine. J Am Coll Cardiol. 1990; Vol. 16, No. 1: I-36.
11. Alcaíno M, Lama D. Coronary Artery Disease in the Elderly. Atherosclerotic Cardiovascular Disease. 2011
12. Jensen BO, Hughes P, Rasmussen LS, Pedersen PU, Steinbrüchel DA. Cognitive Outcomes in Elderly High-Risk Patients After Off-Pump Versus Conventional Coronary Artery Bypass Grafting. Circulation. 2006; 113: 2790-5.
13. Graham MM, Ghali WA, Faris PD, et al. Survival after coro-nary revascularization in the elderly. Circulation. 2002; 105: 2378-84.
14. Thompson RC, Holmes DR, Grill DE, et al. Changing outcome of angioplasty in the elderly. J Am Coll Cardiol 1996; 27: 8-14.
15. Batchelor WB, Anstrom KJ, Muhlbaier LH, et al. Contemporary outcome trends in the elderly undergoing percutaneous coronary interventions: results in 7472 octogenariens. J Am Coll Cardiol 2000; 36: 723-30.