

The Impact of Heart Team Discussion on Decision Making for Coronary Revascularization in Patients with Complex Coronary Artery Disease

Louise Kezerle¹, Eli Yohanan², Avshalom Cohen³, Miri Merkin¹, Yaron Ishay¹, Jean Marc Weinstein¹, and Carlos Cafri¹

¹Soroka University Medical Center

²Ben-Gurion University of the Negev

³Clalit Health Services

June 1, 2020

Abstract

Background and aim: Revascularization guidelines support routine heart team (HT) discussion of appropriate patients. The effect of HT on decision making and clinical outcomes hasn't been explored. The aim of our study is to investigate the impact of the HT on the mode and delay to revascularization. Methods: We compared data from a prospective cohort of consecutive patients with multivessel coronary artery disease referred for HT discussion between 2016-2017 (HT group) with a historic control group of patients matched according to clinical and angiographic characteristics treated between 2005-2015 (No HT group). Results: There were 93 patients in each group. The HT group and the No HT groups had a similar rate of ACS as well as cardiovascular risk factors and significant left ventricular (LV) dysfunction. No difference was observed in the mean Society of Thoracic Surgery (STS) score (2.5 ± 3 vs. 3 ± 3 $p=0.32$) and the mean SYNTAX score was low and similar in both groups (21 ± 6 vs. 19 ± 6 $p=0.59$). The treatment recommendations changed greatly, with 63% of patients being referred for coronary artery bypass grafting (CABG) after HT discussion but only 23% in the no HT group ($p<0.01$). HT discussion led to a significant delay to PCI (8 ± 5 vs. 1.8 ± 4 days, $p=0.02$), while surgical revascularization times were not affected. Conclusion: HT discussion in patients with multivessel CAD was associated with an increased referral to CABG but led to a significant delay in revascularization by angioplasty. The impact of these findings on patient satisfaction and outcome should be further investigated.

INTRODUCTION

Treatment based on multidisciplinary decision making is the cornerstone of current patient-centered therapeutics in certain medical fields such as oncology [1]. Recently, this approach has also been applied to the field of coronary interventions. The decision-making process leading to coronary revascularization is straightforward in many clinical and angiographic settings, and recommendation for either percutaneous coronary intervention (PCI) or coronary artery bypass graft surgery (CABG) can be made in the catheterization laboratory immediately after the diagnostic coronary angiogram. However, many patients presenting with comorbidities or/and complex coronary anatomy may require a more global assessment in order to choose the optimal revascularization strategy.

The SYNTAX score was developed to grade the severity of coronary lesions based on objective anatomical criteria [2]. This score was validated in a cohort of stable coronary patients, and a higher score reflects more complex disease and a greater risk for percutaneous interventions, indicating a preference for CABG over

PCI [3, 4]. This score, however, being purely anatomical, still fails to describe the level of risk and benefit to the specific patient, which comprise an intricate interplay between demographic, clinical and anatomical characteristics. These difficulties led to the understanding that the treatment of the patient with multivessel or high risk coronary artery disease should be individualized [5]. For this purpose, the 2010 European Society of Cardiology (ESC) on coronary revascularization introduced the concept of a Heart Team (HT), composed of cardiac surgeons, clinical cardiologists and interventional cardiologists. [6] Nonetheless, this recommendation is based on expert opinion and the impact of this strategy on the decision making process and specially on clinical outcomes has not been widely investigated.

Since 2015, the Soroka University Medical Center, a tertiary hospital in Southern Israel has implemented an institutional protocol regarding which patients should be brought for HT discussion. The main purpose of this study is to examine the influence of the HT discussion on the selection of the revascularization approach as well on the delay to revascularization. Furthermore, we sought to evaluate the concordance between the HT-recommended treatment of choice with the initial approach suggested by the interventional cardiologist upon finishing the diagnostic angiogram.

MATERIALS AND METHODS

2.1 Study Design and Population

This study compared consecutive patients prospectively referred to HT discussion in the Soroka University Medical Center from 2016 to 2017 (HT Group) and a matched retrospective cohort of patients who underwent coronary angiography between the years 2005 and 2015 (No HT Group).

The inclusion criteria for the registry were based on an institutional protocol specifically designed for selecting patients for HT discussion. In summary, patients were included if they presented with stable coronary artery disease (CAD) or with stabilized acute coronary syndromes (ACS), defined as hemodynamically stable patients, at least 48 hours since the last ischemic complaint, who were diagnosed with left main (LM) and/or multivessel coronary disease with low SYNTAX score (< 23) and low perioperative risk as assessed by the Society of Thoracic Surgeons (STS) score ($< 4\%$) [7]. Patients were also included if presenting with single vessel disease considered high risk for PCI due to left anterior descending (LAD) artery origin lesions or complex bifurcation lesions of the proximal LAD. Patients with LM and /or multivessel disease with an intermediate or high SYNTAX score (> 23) were discussed by the HT if they were classified as being of moderate or high perioperative risk (STS risk score $> 4\%$) or due to co-morbidities that could influence the clinical outcome after cardiac surgery. Patients presenting with ST elevation MI (STEMI) could be included if there were clinical and electrocardiographic signs of reperfusion and/ or if the patient presented in the evolved phase of STEMI and had been pain-free for at least 48 hours before admission.

If a patient met the institutional criteria for HT discussion after the diagnostic angiogram, the procedure was concluded, and the case brought for discussion within 24 hours. The HT was composed of interventional cardiologists, clinical cardiologists and cardiothoracic surgeons. A member of the clinical team treating the patient was also present. Afterwards, the treating physician presented the revascularization strategy recommended by the HT to the patient and their family, along with the advantages and disadvantages of both treatments. The patient then made an informed decision whether to proceed with the HT recommended therapy or to opt for the alternative, when feasible [8, 9].

The retrospective cohort was composed of patients that underwent coronary angiographies between the years 2005 and 2015 with matching diagnosis and complexity of coronary disease, identified from our institutional database. Angiographic data was individually reviewed by an unbiased interventional cardiologist to ensure appropriate matching.

2.2 Data analysis

Demographic and clinical characteristics of the patients were analyzed. The diagnosis at admission was divided in three categories: Stable Angina, Unstable Angina and Myocardial Infarction (NSTEMI/evolved

STEMI). The angiographic characteristics were expressed as the number of vessels with significant stenoses as well as the SYNTAX score [2]. The perioperative risk was defined by the STS score [7].

The primary outcomes for this study were the proportion of patients referred to each revascularization modality in the HT and No HT groups and the time to revascularization from the initial diagnostic coronary angiography.

2.3 Statistical Analysis

The statistical analysis was performed using the SPSS version 21 program. Variables were presented as number and percentage or as mean \pm standard deviation for discrete and continuous variables respectively. A two-sample t-test test was used for continuous data, and a χ^2 test for categorical data. A two-sided p value less than 0.05 was considered significant.

This study was approved by the Institutional Committee on Human Research of our institution.

RESULTS

The HT and the No HT groups included 93 patients each. The mean age was 66 ± 12 years and the majority of patients in both groups were men (65%). There were no differences in the percentage of patients with comorbidities and in other baseline clinical characteristics of both groups except for a higher rate of previous PCI in the No HT group (47% vs. 26%, $p < 0.05$). The great majority of patients in both groups presented with acute coronary syndromes (90%) with a high prevalence of NSTEMI or evolved STEMI patients (64%). No differences were observed in the complexity of the coronary artery disease according either to the number of vessels with significant stenosis or the SYNTAX Score. Significant three vessel disease or left main disease was seen in 75% of the HT group and 80% of the No HT group ($p = 0.49$). Baseline characteristics are presented in Table 1.

The mean SYNTAX score was similar between groups (19 ± 6 in the No HT and 21 ± 6 in the HT group, $p = 0.589$) although there was a trend for a greater percentage of patients with low SYNTAX scores in the No HT group (75.3% in the No HT and 59.6% in the HT group $p = 0.06$). The mean perioperative risk according to the STS score was low and similar in both groups (3 ± 2 vs. 3 ± 3). Again, there was a trend for a higher percentage of patients with intermediate and high STS scores in the No HT group, compared to the HT group (22% vs 8% and 12% vs 8% respectively, $p = 0.052$). (Table 2)

A significant difference in the modality of treatment chosen in each period was observed. In cases treated without HT discussion, PCI was the most frequent method of treatment, being employed in 69% of cases. During the HT period we observed a radical change in treatment recommendations, with most patients being referred to CABG (63%) (Figure 1). This corresponds to a 174% increase in the use of surgical revascularization.

On the other hand, there was a significant increase in the time from diagnostic angiography to revascularization in the HT group (8.5 ± 4 days) in comparison with the No HT group (1.8 ± 5 days). (Table 3). When examining this variable according to revascularization strategy, time to CABG was similar in both the HT and No HT groups (7 ± 8 vs 8 ± 5 , $p = 0.75$) but the time to PCI was substantially longer in the HT group compared to the No HT group (0.39 ± 2 vs 8 ± 6 $p < 0.01$).

DISCUSSION

This study shows that the implementation of Heart Team discussion in the decision-making process of patients with complex coronary artery disease was associated with a profound change in the strategy for revascularization characterized by an increased rate of CABG with a reduction in the rate of PCI. Moreover, HT discussion was associated with a significant delay in the time to PCI in comparison with patients treated in earlier periods before the establishment of the HT.

The Heart Team has been recommended as standard care for patients with complex CAD since the publication of the European and American guidelines for myocardial revascularization in 2010 [6, 10]. This recommen-

dation, while intended to provide interdisciplinary sharing of knowledge and experience in decision-making, is based solely on expert opinion. As such, little is known about the impact of this approach on rates of revascularization methods and on short and long-term outcomes as well as immediate peri-procedural risks and potential benefits in each individualized setting.

The main finding of our study was a significant change in the revascularization modalities before and after HT implementation. In fact, there was an increase in CABG recommendations from 23% without HT to 63% in the HT group with a parallel decrease in the rate of PCI. There are a few possible explanations for this substantial change: first, the baseline characteristics of the patients was slightly different. Despite individual matching, a trend for a lower STS score was observed in the patients in the No HT group. This difference however should have favored a surgical approach within this group, and these were not the results that were noted.

In addition, the mean SYNTAX score and the proportion of patients with intermediate or high SYNTAX scores was numerically higher in patients discussed by the HT, although not statistically significant. This may reflect the fact that the patients in the HT group had more complex coronary anatomy hence being referred to surgery more often. In fact, the past two decades have seen a myriad of trials [2, 11-16] seeking to answer the question of which strategy provides better short and long term outcomes for complex CAD while balancing patient satisfaction and costs, mainly in the setting of stable disease. In summary, most trials on multivessel disease show a survival advantage of CABG over PCI according to anatomical complexity as assessed by the SYNTAX score, while there are no clear benefits to either treatment when it comes to isolated LM disease. Based on these findings, an intermediate or high SYNTAX score is recognized by recent revascularization guidelines as a class IA indication for CABG over PCI [4, 17]. Furthermore, the FREEDOM randomized trial [18] compared CABG to PCI solely in diabetic patients with multivessel disease and found reduced mortality associated with the surgical approach. The accumulation of data on the subject as well as updated guideline recommendations might have influenced the change in revascularization strategies seen in our study in the last few years. Supporting this observation is the fact that the operator in the HT period between 2016 and 2017 recommended CABG in 57% of the cases whereas only 23% of operators during the No HT period (2005-2015) referred the patients for surgery.

Other factors such as personal tendencies and beliefs of the cardiologists involved as well as financial or professional interests that could influence the revascularization decision are neutralized by the HT discussion leading to a change in treatment strategies. This point was emphasized in a study by Abdulrahman *et al* [19] that described how HT recommendations changed according to which professionals were present at the discussion.

Our findings are similar to recent reports in the literature. In 2016, Bonzel *et al* . [20] described that between 46-66% of patients discussed by the HT were referred to isolated CABG. They also demonstrated that the patients referred to PCI had a low rate of need for CABG during long term follow up with no increase in mortality after 2 years. Also, a possible intrinsic bias of the interventional cardiologist in recommending PCI as a primary revascularization approach was noticed in a study by Sanchez *et al* [21] that used the HT to review decisions on revascularization strategies based on SYNTAX and STS scores and on Appropriate Use Criteria for coronary revascularization. They found that 34.9% out of 301 patients who had undergone PCI in the past two years had an inappropriate or uncertain indication for angioplasty as recommended by the HT.

Another important finding of the present study is that the decision to bring the case to HT discussion was associated with a significant delay in the performance of revascularization. Indeed, we observed a significant increase in "time to PCI" from an average of 0.36 days to 8 days, while the time to CABG did not differ substantially. This was most probably due to a limitation in institutional resources, but could also occur in other hospitals should the HT approach be systematically adopted. Taking into account that the population analyzed included 90% of patients with ACS, such a delay may be associated with potential risks for this population. According to the European Society of Cardiology/European Association for Cardio-Thoracic Surgery (ESC/EACTS) guidelines on myocardial revascularization [6], PCI or CABG should be

performed within 6 weeks after angiography for patients presenting stable coronary disease and within 2 weeks for patients with a high-risk coronary anatomy. For patients presenting with ACS the recommended time frame for revascularization is shorter, based on adverse events that may occur while on the waiting list for revascularization. Guidelines for the management of patients with non-ST elevation acute coronary syndromes (NSTEMI-ACS) [22] recommend an invasive strategy in moderate to high-risk patients. The timing of the intervention in those patients is dependent on the patient's baseline risk factors and extend up to 72 hours from initial presentation. The HT approach potentially promotes delays in time to revascularization which was evident in the population that was ultimately treated by PCI, in conflict with the aforementioned recommendations. Multiple trials investigated and confirmed the value of early revascularization in patients with NSTEMI (8), although the clinical significance and major events rate during the waiting period until revascularization after the HT have not been investigated. The present study was not designed to examine such clinical outcomes, which would be valuable data to be reported in follow up research.

Nevertheless, a 2018 single center [9] study of 1000 consecutive patients concluded that the HT approach was feasible, with decision making and treatment following within a short time after referral and largely in accordance with clinical guidelines. This study however, included mainly patients referred from a community setting and as such the mean time to revascularization of 6 weeks was considered safe and appropriate.

Our study has a number of limitations. First, this was an observational study with a retrospective attempt of matching patients on the basis of clinical and angiographic variables. Despite this attempt, numerical differences in the number of patients with previous PCI, the complexity of CAD and surgical risk were observed between groups. This potential selection bias could explain differences in the choice of type of revascularization between the two periods. Secondly, our sample size might have been small to detect differences in characteristics between the groups. Third, there was no long-term outcome follow up of the patients treated with and without HT discussion. Further research into the impact of HT discussions on clinical outcomes would be most certainly welcome.

Nonetheless, this is to the best of our knowledge the first study to analyze the change in revascularization policy associated with the introduction of systematic, institutional HT discussions for complex CAD.

CONCLUSION

In conclusion, HT discussion for selection of the modality of revascularization in patients with complex coronary artery disease is associated with an increased rate of referral for CABG. This process is associated with a significant delay in the time to revascularization by PCI, which could pose potential risks for acute patients.

ACKNOWLEDGMENTS

This study was conducted as part of the requirements for MD degree from the Goldman Medical School at the Faculty of Health Sciences, Ben-Gurion University of the Negev.

Author contributions

Kezerle L – Data collection, interpretation, drafting article

Yohanan E – Data collection, data interpretation and drafting the article

Cohen A – Overview of data collection

Merkin M, Ishay Y, Weinstein JM – critical revision of the article

Cafri C – Study design, data analysis and statistics, approval of article

References

1. Dubois, C., et al., *Multidisciplinary work in oncology: Population-based analysis for seven invasive tumours*. Eur J Cancer Care (Engl), 2018. **27** (2): p. e12822.

2. Serruys, P.W., et al., *Percutaneous coronary intervention versus coronary-artery bypass grafting for severe coronary artery disease*. N Engl J Med, 2009. **360** (10): p. 961-72.
3. Girasis, C., et al., *SYNTAX score and Clinical SYNTAX score as predictors of very long-term clinical outcomes in patients undergoing percutaneous coronary interventions: a substudy of SIrolimus-eluting stent compared with pacliTAXel-eluting stent for coronary revascularization (SIRTAX) trial*. Eur Heart J, 2011. **32** (24): p. 3115-27.
4. Kappetein, A.P., et al., *Current percutaneous coronary intervention and coronary artery bypass grafting practices for three-vessel and left main coronary artery disease. Insights from the SYNTAX run-in phase*. Eur J Cardiothorac Surg, 2006. **29** (4): p. 486-91.
5. Head, S.J., et al., *The rationale for Heart Team decision-making for patients with stable, complex coronary artery disease*. Eur Heart J, 2013. **34** (32): p. 2510-8.
6. Neumann, F.J., et al., *[2018 ESC/EACTS Guidelines on myocardial revascularization. The Task Force on myocardial revascularization of the European Society of Cardiology (ESC) and European Association for Cardio-Thoracic Surgery (EACTS)]*. G Ital Cardiol (Rome), 2019. **20** (7-8 Suppl 1): p. 1S-61S.
7. Shahian, D.M., et al., *The Society of Thoracic Surgeons 2008 cardiac surgery risk models: part 1—coronary artery bypass grafting surgery*. Ann Thorac Surg, 2009. **88** (1 Suppl): p. S2-22.
8. Rui, A., et al., *Are the guidelines for coronary artery revascularization, according to the syntax score, being correctly applied, by a heart team?* 2015, Journal of Cardiothoracic Surgery. p. A 183.
9. Domingues, C.T., et al., *Heart Team decision making and long-term outcomes for 1000 consecutive cases of coronary artery disease*. Interact Cardiovasc Thorac Surg, 2019. **28** (2): p. 206-213.
10. Patel, M.R., et al., *ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2016 Appropriate Use Criteria for Coronary Revascularization in Patients With Acute Coronary Syndromes: A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and the Society of Thoracic Surgeons*. J Am Coll Cardiol, 2017. **69** (5): p. 570-591.
11. Mohr, F.W., et al., *Coronary artery bypass graft surgery versus percutaneous coronary intervention in patients with three-vessel disease and left main coronary disease: 5-year follow-up of the randomised, clinical SYNTAX trial*. Lancet, 2013. **381** (9867): p. 629-38.
12. Boudriot, E., et al., *Randomized comparison of percutaneous coronary intervention with sirolimus-eluting stents versus coronary artery bypass grafting in unprotected left main stem stenosis*. J Am Coll Cardiol, 2011. **57** (5): p. 538-45.
13. Park, S.J., et al., *Randomized trial of stents versus bypass surgery for left main coronary artery disease*. N Engl J Med, 2011.**364** (18): p. 1718-27.
14. Park, S.J., et al., *Trial of everolimus-eluting stents or bypass surgery for coronary disease*. N Engl J Med, 2015.**372** (13): p. 1204-12.
15. Mäkilä, T., et al., *Percutaneous coronary angioplasty versus coronary artery bypass grafting in treatment of unprotected left main stenosis (NOBLE): a prospective, randomised, open-label, non-inferiority trial*. Lancet, 2016. **388** (10061): p. 2743-2752.
16. Head, S.J., et al., *Mortality after coronary artery bypass grafting versus percutaneous coronary intervention with stenting for coronary artery disease: a pooled analysis of individual patient data*.Lancet, 2018. **391** (10124): p. 939-948.
17. Holmes, D.R., et al., *The heart team of cardiovascular care*.J Am Coll Cardiol, 2013. **61** (9): p. 903-7.

18. Farkouh, M.E., et al., *Strategies for multivessel revascularization in patients with diabetes*. N Engl J Med, 2012.**367** (25): p. 2375-84.
19. Abdulrahman, M., et al., *Impact of Hierarchy on Multidisciplinary Heart-Team Recommendations in Patients with Isolated Multivessel Coronary Artery Disease*. J Clin Med, 2019. **8** (9).
20. Bonzel, T., V. Schächinger, and H. Dörge, *Description of a Heart Team approach to coronary revascularization and its beneficial long-term effect on clinical events after PCI*. Clin Res Cardiol, 2016.**105** (5): p. 388-400.
21. Sanchez, C.E., et al., *Revascularization heart team recommendations as an adjunct to appropriate use criteria for coronary revascularization in patients with complex coronary artery disease*. Catheter Cardiovasc Interv, 2016. **88** (4): p. E103-E112.
22. Damman, P., et al., *2015 ESC guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: comments from the Dutch ACS working group*. Neth Heart J, 2017. **25** (3): p. 181-185.

Hosted file

Figure 1.docx available at <https://authorea.com/users/328537/articles/455773-the-impact-of-heart-team-discussion-on-decision-making-for-coronary-revascularization-in-patients-with-complex-coronary-artery-disease>

Hosted file

Table 1.docx available at <https://authorea.com/users/328537/articles/455773-the-impact-of-heart-team-discussion-on-decision-making-for-coronary-revascularization-in-patients-with-complex-coronary-artery-disease>

Hosted file

Table 2.docx available at <https://authorea.com/users/328537/articles/455773-the-impact-of-heart-team-discussion-on-decision-making-for-coronary-revascularization-in-patients-with-complex-coronary-artery-disease>

Hosted file

Table 3.docx available at <https://authorea.com/users/328537/articles/455773-the-impact-of-heart-team-discussion-on-decision-making-for-coronary-revascularization-in-patients-with-complex-coronary-artery-disease>