Impact of Multidisciplinary Team Meetings on Decision Making in Vascular Surgery: A Prospective Observational Study

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1	Impact of Multidisciplinary Team Meetings on Decision Making in Vascular Surgery: A
2	Prospective Observational Study
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17	WHAT THIS PAPER ADDS

18 Multidisciplinary team meetings (MDTs) are strongly recommended in several areas of vascular disease in most guidelines (class I), yet available evidence is lacking (level C). In this study, the 19 impact that multidisciplinary discussion had on the treatment of vascular patients was prospectively 20 21 evaluated. The results showed that the MDT frequently led to significant changes in the treatment decision compared with the treatment recommendation from a single specialist. Although further 22 research will be required to determine the concordance of treatment recommendations between 23 multidisciplinary teams and clinical decision algorithms, this study supports the guideline 24 recommendation to include structured multidisciplinary decision making for vascular patients. 25

Objective: This cohort study aimed to prospectively determine the impact of multidisciplinary team
 meetings (MDTs) on treatment plans in vascular patients.

Methods: The weekly MDT at the institution consists of a structured discussion of vascular cases in 28 29 the presence of at least one representative of each specialty from vascular surgery, angiology, and interventional radiology. Participants were asked to examine the cases entered on the digital MDT 30 platform and to fill in forms with a detailed open text treatment recommendation for each patient. 31 Individual recommendations were compared with the final MDT decision, which was based on a 32 shared decision upon discussion of clinical and radiological data. The primary endpoint was the 33 agreement rate. The rate of decision implementation was determined to verify the adherence to MDT 34 recommendations. 35

36 Results: Four hundred consecutive case discussions in 367 patients between November 2019 and March 2021 were included, excluding patients needing urgent treatment, yielding MDT discussion in 37 88.5% of carotid artery cases, 83% of aorto-iliac cases, and 51.7% of peripheral arterial cases, which 38 included 56.9% of the chronic limb threatening ischaemia cases. The overall average agreement rate 39 was 71% \pm 41%. Analysis according to the specialty of the attending physician showed agreement 40 rates of 82% \pm 30% for senior vascular surgeons, 62% \pm 44% for junior vascular surgeons, 71% \pm 41 43% for interventional radiologists, 58% \pm 50% for angiologists (p < .001), and 75% \pm 38% 42 considering only senior practitioners. The inter-rater agreement, resulted in kappa coefficients of 0.60 43 -0.68 for senior vascular surgeons, 0.29 - 0.31 for junior vascular surgeons, 0.39 - 0.52 for 44 interventional radiologists, and 0.25 for angiologists. The MDT treatment decision was implemented 45 in 353 (96.2%) cases. 46

47 Conclusion: The impact of MDT discussion on treatment recommendations and the adherence to
48 MDT recommendations were significant and in line with results reported from other specialties.

49 Keywords: Intervention, Multidisciplinary, Vascular

50 <H1>INTRODUCTION

51 Multidisciplinary team meetings (MDTs) were originally introduced in the care of patients with 52 cancer to address the growing complexity of decision making due to a significant increase of available 53 treatment options.^{1,2}

The clinical effectiveness of MDTs has subsequently been demonstrated in other areas of 54 healthcare such as congestive heart failure,³ chronic pulmonary disease,⁴ and diabetic foot care.⁵ 55 Relevant guidelines and some national societies strongly recommend (class I) MDTs in vascular 56 surgery.⁶⁻¹¹ Following these recommendations, the constitution and use of vascular MDTs are 57 spreading in several countries worldwide. However, evidence on the effectiveness of MDTs in terms 58 of clinical outcome is still limited (evidence level C). Given the time and resources that are required 59 for a soundly constituted MDT, efforts have been made to produce more robust evidence of their 60 effectiveness in selected areas of vascular surgery.^{12–14} 61

Retrospectively comparing clinical outcomes with results preceding the introduction of MDTs 62 would be biased by the evolution of devices and techniques. The retrospective quality assessment of 63 MDTs is mostly based on the determination of the rate of adherence to MDT decisions, defined as 64 the rate of decision implementation, which is a good indicator of MDT structural quality but does not 65 necessarily warrant better clinical outcomes. In this study, the MDT was hypothesised to lead to 66 significantly more weighed decisions in clinical practice compared with single physician based 67 68 decisions. Given the difficulties in providing evidence for the usefulness of MDTs, this study aimed to assess the impact of a multidisciplinary discussion on the treatment plan proposed by individual 69 physicians. 70

71 <H1>MATERIALS AND METHODS

72 <H2>Study design and patient selection

This prospective cohort study was carried out in the Vascular Unit of the Ente Ospedaliero Cantonale,
Ticino, Switzerland, which consists of a Vascular Surgery Division, Service of Angiology, and
Service of Interventional Radiology, serving four hospitals in southern Switzerland. The study

protocol was evaluated by the local ethics committee, who waived informed consent in accordance 76 77 with Swiss legislation. The study protocol was not published or registered a priori. At the institution a formally structured MDT was established in 2011, with weekly discussion of 78 vascular cases. The regulatory protocol requires the presence of at least one vascular surgeon, one 79 interventional radiologist, and one angiologist as core participants at each session. Additionally, the 80 discussion of supra-aortic vessel cases, and of thoracic aortic and of vascular access cases requires 81 the presence of at least one neurologist and one neuroradiologist, one cardiac surgeon, and one 82 nephrologist respectively. To optimise resources, revascularised patients with diabetes are discussed 83 in a separate diabetic foot MDT in the presence of a vascular surgeon, a foot surgeon, a 84 85 diabetologist, a specialised nurse, and an orthotic technician. Physicians with vascular activity from all four hospitals are required to present all vascular cases for discussion and to actively participate 86 at the MDT, excluding only urgent cases requiring intervention sooner than the upcoming MDT. All 87 88 cases to be discussed have to be entered on a digital platform accessible to all MDT participants no later than 3 hours before the multidisciplinary team session. Besides all digitally available clinical 89 data and imaging, the primary clinician was required to register all relevant information, including 90 the patient's personal preferences, compliance, general condition, quality of life and living 91 92 conditions, and all information deemed useful to meet a treatment decision. For this study, only core 93 MDT participants (three senior vascular surgeons, two junior vascular surgeons, two interventional radiologists, and two angiologists) were surveyed. Additional specialists who participated in the 94 MDT discussion of specific cases did not participate in the study because of their limited 95 96 involvement. Participating physicians were required to provide a treatment recommendation in open text format in a column on the patient presentation chart. This solution was preferable to a multiple 97 choice system, which would have generated a bias based on the determination of the available 98 treatment options to choose from. Specification of treatment details was encouraged, such as type of 99 conduit, treatment timing, type of endovascular device to be used, and all major specifications 100 101 regarding the procedure. If the physician was unable to propose a treatment, two additional options

were available, namely justified abstention (e.g., need for further investigation or clinical 102 information) and unjustified abstention. The open text recommendations were returned to the 103 principal investigator before the beginning of the MDT session. The MDT final decisions, which 104 were electronically recorded at the end of the discussion, were compared with the written single 105 physician recommendations by two independent reviewers, who had not participated in the MDT 106 session. The following criteria were applied to determine the agreement: (1) inherently different 107 procedures and different timing of procedures were considered as non-agreement; (2) similar 108 procedures with no evidence supporting one choice over the other were considered in agreement; 109 and (3) Similar procedures with evidence supporting one choice over the other were considered 110 non-agreement 111

Justified abstentions were considered in agreement only if the MDT decision also 112 recommended further investigation or integration of missing information, whereas unjustified 113 abstention was always categorised as non-agreement. The principal investigator subsequently 114 compared the evaluations of the reviewing physicians and presented all discrepancies for discussion 115 and resolution at the next MDT. All patients with vascular disease, who were discussed in the 116 multidisciplinary vascular board from November 2019 to March 2021, were prospectively included. 117 Patients requiring urgent treatment sooner than the upcoming MDT session were excluded. All cases 118 that were not entered for multidisciplinary discussion were also excluded. MDT sessions without the 119 required core participants were cancelled and the cases were rescheduled for the following session. 120 If the additionally required specialists for carotid, thoracic aortic, and vascular access cases were not 121 present, the related case was rescheduled for discussion at the next MDT. Junior and senior 122 practitioners were separated in the secondary endpoint analysis with a threshold of five years of post-123 specialty training.¹⁵ The aim of this subanalysis was to assess the impact that MDTs may have on the 124 training of junior specialists. Participating physicians were informed about the study and were 125 provided with the study protocol. 126

127 <H2>Data collection and endpoints

For every patient, data were anonymised with limited access. Data included the date of board 128 discussion; vascular segment or pathology (supra-aortic, thoracic aorta, aorto-iliac segment, endoleak 129 related, peripheral arterial, arterio-venous fistulas, visceral arteries, central venous, arterio-venous 130 malformations); proposed treatment of senior and junior vascular surgeons, interventional 131 radiologists, and angiologists; decision of the primary clinician, and final board decision. All patients 132 were followed up until completion of recommended treatment. When conservative treatment was 133 recommended, it was considered implemented if it was maintained until new clinical events occurred. 134 The primary endpoint was the agreement rate with the final MDT decision, which was 135 determined by two independent reviewers. The secondary endpoints were the agreement rate in 136 subgroup analysis according to specialty, experience, vascular district, or pathology involved and 137 between the primary physician and other attending physicians who had no previous clinical encounter 138 with the patient. The variability of agreement over time in junior vascular surgeons was also analysed. 139 Junior practitioners from other specialties do not routinely participate in MDT sessions and could not 140 be included in the study. The rate of decision implementation was determined, and the reasons for 141 non-implementation were followed up. The inter-rater agreement¹⁶ was defined as the degree of 142 accordance among independent participants to the vascular board who assessed the same patients. 143

144 <H2>Statistical analysis

Descriptive statistics were presented as absolute frequencies for categorical variables with mean and standard deviation or median with interquartile ranges (IQRs) and 95% confidence interval (95% CI) for continuous variables. The chi-squared test was used to compare dichotomous values, whereas analysis of variance was used to compare continuous variables.

149 Cohen's kappa coefficient was used to measure the inter-rater agreement, also providing the 150 95% CI. The sample size of 187 cases was estimated assuming a Cohen's kappa of 0.44, a minimum 151 acceptable kappa (k0) of .2, a two-tailed significance level of .05, and a power of $.8.^{17-19}$ Statistical 152 significance was considered at p < .05 and the Bonferroni adjustment was used to correct the p value

threshold in case of multiple comparisons for the primary outcome. Statistical analyses were
performed using MedCalc Statistical Software version 20.013 (MedCalc Software Ltd., Ostend,
Belgium; https://www.medcalc.org; 2021).

156 **<H1>RESULTS**

Four hundred case discussions in 367 patients took place at the multidisciplinary vascular board 157 between November 2019 and March 2021. Thirty-two (8.7%) cases were discussed in multiple 158 sessions, of which 31 were discussed twice and one was discussed three times, the latter because of 159 intercurrent clinical events and change in the patient's preference. Fourteen (3.8%) cases were re-160 presented by the treating physician to propose a change in treatment recommendation or a re-161 162 discussion after further findings: in two cases the original treatment recommendation was confirmed. The MDT was cancelled twice for unattendance of the required participants and all cases were re-163 scheduled for the following session. Fifty-four cases (13.5%) pertained to supra-aortic vessels, 16 164 (4.0%) to thoracic aorta, 131 (32.7%) to aorto-iliac segment pathologies, 33 (8.3%) to endoleaks after 165 endovascular repair of aortic lesions, 98 (24.5%) to peripheral arterial disease, 21 (5.2%) to dialysis 166 access, 29 (7.2%) to visceral arteries, 12 (3.0%) to central venous disease, and six (1.5%) to arterio-167 venous malformations. Of all non-urgent cases, 99.2% were discussed and included in the study, 168 excluding amputations and peripheral venous cases. Three patients with intermittent claudication 169 170 were directly referred to the interventional radiologist by an external angiologist without MDT discussion. During the study time, 141 urgent cases were treated without prior MDT discussion, 171 yielding a multidisciplinary discussion in 88.5% of carotid artery cases, and 83% of aorto-iliac cases, 172 173 51.7% of peripheral arterial cases (56.9% of chronic limb threatening ischaemia cases, 95.1% of intermittent claudication cases, 4.7% of acute and acute on chronic ischaemia cases). The study period 174 overlapped the first two Covid-19 waves in Switzerland. During the pandemic there was a decrease 175 in consultations, in non-urgent referrals and in elective activity. This increased the proportion of 176 urgent treatments (37.2% of all cases), most of which (74.6%) could not be discussed at the MDT. 177

Although the minimum requirement for MDT validity was the presence of one senior vascular 178 surgeon, one interventional radiologist, and one angiologist, in 47% of discussed cases a second 179 radiologist was present, in 98% two or more senior vascular surgeons were present, and in 93% at 180 least one junior vascular surgeon was present and in 34% a second angiologist was present. Three 181 hundred and sixty-eight (92%) cases had at least one clinical assessment with the primary clinician 182 prior to MDT presentation. On average, the agreement rate with final board decision was $71\% \pm 41\%$ 183 considering all participants. Subgroup analyses according to specialty and years of experience (Fig. 184 1) showed agreement in $82\% \pm 30\%$ for senior vascular surgeons, $62\% \pm 45\%$ for junior vascular 185 surgeons, 71% \pm 43% for interventional radiologists, 58% \pm 50% for angiologists (p < .001 between 186 all groups except between angiologists and junior surgeons) and 75% \pm 38% considering only senior 187 188 practitioners regardless of specialty. No significant difference (p = .18) was observed when comparing the agreement rates of the primary clinician (69% \pm 48%) with those of other attending 189 physicians (75% \pm 41%). According to the Bonferroni adjustment for multiple comparisons, a p value 190 threshold of .005 was considered statistically significant. Therefore, a significant difference in 191 agreement rate could be still detected between all specialties except for junior surgeons vs. 192 angiologists who scored similarly. 193

A detailed subgroup analysis according to the vascular segment and pathology is shown in 194 195 Table 1. Regarding the inter-rater agreement, the kappa coefficient was 0.59 (95% CI 0.50 - 0.68), 0.66 (95% CI 0.58 - 0.75), and 0.67 (95% CI 0.59 - 0.76) for senior vascular surgeons, 0.24 (95% CI 0.59 - 0.76)196 CI 0.12 – 0.37) and 0.25 (95% CI 0.13 – 0.38) for junior vascular surgeons, 0.35 (95% CI 0.22 – 197 198 0.48) to 0.49 (95% CI 0.36 - 0.61) for interventional radiologists, and 0.13 (95% CI 0 - 0.34) for the angiologists. The MDT decision was implemented in 353 (96.2%) cases. Of the 12 non-implemented 199 cases, four patients refused treatment; two patients were treated elsewhere; two patients were found 200 to have concomitant disease deemed prohibitive at pre-operative work up; three patients had severe 201 complications due to treatment of a concomitant disease; and one patient died from myocardial 202 203 infarction before treatment. No patients were lost to treatment implementation follow up.

To assess the impact of MDTs on the training of young vascular surgeons, the variability of agreement over time for junior vascular surgeons was analysed by dividing the study period in three equal segments and comparing their performance. The agreement rate was 59.6% \pm 46.1% in the first period and 65.1% \pm 44.3% in the last. However, this difference did not reach statistical significance (p = .33).

209 <H1>DISCUSSION

Most recent guidelines strongly recommend a structured multidisciplinary approach for the treatment 210 of vascular patients. However, strong evidence supporting the effectiveness of MDTs in terms of 211 improved clinical outcome is difficult to obtain even in cancer care^{20,21} and is lacking in the treatment 212 213 of many areas of vascular disease. Moreover, the organisation and implementation of MDTs remain time and resource consuming. The present study found that individual treatment recommendations 214 were in agreement with MDT decisions in 71% of cases considering all participants, regardless of 215 216 specialty and years of post-specialisation experience. Even when including only practitioners with at least five years of post-specialty experience, the agreement rate did not exceed 75%. Senior vascular 217 surgeons and interventional radiologists displayed the highest agreement rates (82% and 71%) due to 218 their detailed knowledge of available treatment options. Senior vascular surgeons displayed the 219 highest agreement rate in most areas. This may indicate an excessive influence in the discussion and 220 221 decision process, which represents a potential bias. When observing the general trend in agreement rates, the performance of interventional radiologists significantly decreased in the discussion of supra-222 aortic vessel disease. The reason for this was the difference in experience between the two 223 224 interventional radiologists who participated in the study, where one had limited experience in treatment in this area. In this study, the agreement rate of angiologists was significantly lower in most 225 areas. This can be explained by the fact that strict parameters in evaluating the agreement of two 226 proposed treatments were applied. Different technical aspects, such as type of approach and type of 227 materials used, for which there is available evidence, where considered not equivalent in the 228 229 evaluation by the two reviewers. At the institution angiologists do not take part in interventional

procedures, which may limit their knowledge of some technical aspects of open and endovascular 230 procedures. Interestingly, the shared decision did not match any of the proposed treatments in five 231 cases, indicating that multidisciplinary discussion generated an option that had not been considered 232 during individual evaluation. Even though it is a small percentage, it highlights the synergistic effect 233 of structured case discussions. The wide standard deviation (SD) in the results indicates that there 234 was a relevant variability in the number of specialists who agreed with the MDT decision. The overall 235 results are comparable with data published for a thoracic multidisciplinary tumour board,²² where 236 MDT recommendations differed from the initial treatment plan in 26% of patients with oesophageal 237 cancer and 40% of patients with lung cancer. 238

The rate of decision implementation has often been used as a MDT structural quality indicator. This study showed an implementation rate of 96.2%. This is in the upper end of reported rates that ranged between 69% and 97%.^{13,22–26} Strategies to yield a high rate of implementation in cancer MDTs have been thoroughly studied and described in some relevant reviews.^{27,28}

The common impression among participating physicians in this study was that the extra time spent to carefully evaluate the cases before the MDT was greatly outweighed by an increase in quality and time efficiency of the MDT discussion itself. Junior participants also seemed to profit more from the multidisciplinary discussion by being required to provide a treatment plan prior to discussion. However, the progression of their agreement rate over the study period did not reach statistical significance.

249 **<H2>***Study limitations*

This study has limitations. Primarily, the treatment plans proposed by the MDT attending physicians other than the primary clinician, who has had at least one clinical encounter with the patient in most cases, are mostly based on clinical data and imaging. A personal encounter together with a direct physical examination of the patient may influence the choice of a recommended treatment. To mitigate this effect, all primary clinicians were asked to provide essential information about quality of life, level of fitness, and personal preference on the electronic platform prior to MDT discussion.

These patient centred assessments carry by default some degree of personal interpretation by the 256 primary clinician, who may have influenced the individual decision of other physicians. This strategy 257 may have reduced the decisional difference between the primary clinician and all other attending 258 physicians, making it non-significant (69% \pm 48% and 75% \pm 41%, respectively). It is also important 259 to acknowledge that the results reported are relevant to the setting of the MDT. The development of 260 a treatment strategy is known to be affected by the expertise and by several infrastructural parameters. 261 There is also a lack of consensus regarding the constitution and ruling of MDTs. For these reasons it 262 is difficult to determine the exact applicability to other centres across Europe and globally. 263

The activity of angiologists and their degree of involvement in interventional procedures may 264 also vary greatly between different centres and countries. As mentioned in Materials and Methods, 265 participating physicians were informed about the study and its aims, making results potentially 266 influenced by observer bias. A further limitation is intrinsic to the structure of the MDT that does not 267 268 involve anaesthetists in the discussion. The presence of anaesthetists at the MDT would likely reduce the need for multiple case discussions and may further reduce non-implementation rates. Another 269 critical aspect is that the MDT generated treatment recommendation is not independent from the 270 individual recommendation of each physician, who will have different degrees of influence on the 271 shared decision. In order to avoid this, the study should have been conducted using individual 272 273 treatment recommendations from physicians who did not participate in the MDT discussion. This was unfortunately not feasible in this setting. Groupthink,²⁹ where disagreement exists but is not 274 expressed, and excessive dominance by some attending physicians are two potential biases to all 275 276 MDTs but are difficult to quantify and to prevent. Additionally, there is a risk, in this study, of excessive influence by senior vascular surgeons who consistently showed the highest agreement rate 277 in most areas. However, analyses to detect this bias is complex and goes beyond the purpose of the 278 study. From a statistical perspective, results were collected as percentages and did not follow a normal 279 280 distribution. Therefore, it was decided not to use medians with IQR because differences between specialist groups would not be displayed, considering the reduced number of specialists for each 281

discipline. Although reporting the results with mean \pm SD is not ideal, it is largely accepted in medical statistics in these cases. Finally, a selection bias exists from the exclusion of patients needing urgent treatment before the next scheduled MDT. It is believed that this represents a real world situation since most structured MDTs will not be able to secure the discussion of all urgent cases.

286 <H2>Conclusion

The impact of the MDT was clinically significant when comparing single physician treatment recommendations with treatment plans generated after multidisciplinary discussion. This finding supports the guideline recommendations to routinely adopt a structured multidisciplinary discussion in several areas of vascular disease. The adherence to MDT treatment recommendations was in the upper end when compared with available data from literature.

292 CONFLICT OF INTEREST

293 None.

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Table 1. Rates of agreement with final vascular board decision.								
Vascular district	Number of cases	Senior vascular	Junior vascular	Interventional radiologists	Angiologists	р		
		surgeons	surgeons					
Overall	400	82 ± 30*†‡	$62 \pm 45^{*}$	$71\pm43^\dagger$	$58\pm50^{\ddagger}$	<.001		
Supra-aortic vessels	54	$85 \pm 27^*$	64 ± 45	$44\pm49^*$	64 ± 50	.004		
Thoracic aorta	16	78 ± 30	37 ± 50	50 ± 52	50 ± 58	.098		

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Aorto-iliac segment	131	$81 \pm 31^{*\dagger}$	$62 \pm 43^{*}$	$77 \pm 39^{\ddagger}$	$52\pm51^{\dagger\ddagger}$	<.001
Endoleaks	33	70 ± 35	52 ± 50	78 ± 39	62 ± 52	.15
Peripheral arteries	98	87 ± 24	70 ± 43	78 ± 39	62 ± 51	.008
Dialysis access	21	81 ± 29	67 ± 49	50 ± 41	50 ± 58	.12
Visceral arteries	29	79 ± 37	60 ± 42	75 ± 43	50 ± 55	.21
Central veins	12	83 ± 33	54 ± 45	71 ± 39	100 ± 0	.22
Malformations	6	92 ± 38	20 ± 45	83 ± 41	100 ± 0	.046

391 Continuous variables are expressed as mean percentage \pm standard deviation for agreement with

392 board decisions.

- 393 *^{†‡}Indicate a statistically significant difference between groups (p < .005).
- **Figure 1.** Histogram depicting the agreement rate of the different specialists with the final
- 395 multidisciplinary team decision considering all vascular districts discussed.

Journal Prevention





ournalPre

Short title: Impact of Multidisciplinary Team Meetings

Figure 1: follow pages E1 and E2

Supplementary material

Supplementary file, MDM digital platform with translation

Supplementary file, MDM protocol

Supplementary file, Patient MDM form, with translation

Supplementary file, Regolamento_MDM Vascolare

Supplementary file, Regulation MDM translated

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