Management of acute mesenteric ischaemia: Results of a worldwide survey

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Original article

Management of acute mesenteric ischaemia: Results of a worldwide survey

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SUMMARY

Background: Acute mesenteric ischaemia (AMI) is a condition with high mortality. This survey assesses current attitudes and practices to manage AMI worldwide.
Methods: A questionnaire survey about the practices of diagnosing and managing AMI, endorsed by several specialist societies, was sent to different medical specialists and hospitals worldwide. Data from individual health care professionals and from medical teams were collected.
Results: We collected 493 individual forms from 71 countries and 94 team forms from 34 countries. Almost half of respondents were surgeons, and most of the responding teams (70%) were led by surgeons.
Most of the respondents indicated that diagnosis of AMI is often delayed but rarely missed. Emergency revascularisation is often considered for patients with AMI but rarely in cases of transmural ischaemia (intestinal infarction). Responses from team hospitals with a dedicated special unit (14 team forms) indicated more aggressive revascularisation.
Abdominopelvic CT-scan with intravenous contrast was suggested as the most useful diagnostic test, indicated by approximately 90% of respondents. Medical history and risk factors were thought to be more important in diagnosis of AMI without transmural ischaemia, whereas for intestinal infarction, plasma lactate concentrations and surgical exploration were considered more useful.
In elderly patients, a palliative approach is often chosen over extensive bowel resection. There was a large variability in anticoagulant treatment, as well as in timing of surgery to restore bowel continuity.
Conclusions: Delayed diagnosis of AMI is common despite wide availability of an adequate imaging modality, i.e. CT-scan. Large variability in treatment approaches exists, indicating the need for updated guidelines. Increased awareness and knowledge of AMI may improve current practice until more robust

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evidence becomes available. Adherence to the existing guidelines may help in improving differences in treatment and outcomes.

1. Introduction

Acute mesenteric ischaemia (AMI) is a multidisciplinary emergency, requiring involvement of several different medical specialties [1,2]. Different forms of AMI are encountered and managed by different medical specialties (e.g., emergency care physicians, vascular surgeons, interventional radiologists, visceral surgeons, gastroenterologists, intensivists) and different approaches for diagnostics and management exist.

The pathophysiology and clinical presentation of AMI depend on the type of AMI (arterial occlusion, mesenteric venous thrombosis, non-occlusive ischaemia (NOMI)). AMI is a multistep time-dependent process involving vascular insufficiency, followed by an ischemic damage to the bowel wall starting from mucosal side and associated with bacterial translocation, and leading without treatment to intestinal necrosis, multiorgan failure and death. Attempting to improve patient care, the World Society of Emergency Surgery and the European Society for Vascular Surgery each released their first guidelines for the management of AMI in 2017 [3,4]. These guidelines disagree regarding the definition of AMI and on whether to include or exclude large bowel ischaemia but agree that early diagnosis and prompt revascularisation is essential to reduce mortality and bowel resection rates. Consensus exists that contrast-enhanced biphasic CT-Angiography with 1-mm slices is the first line imaging modality to diagnose AMI [5]. Indeed, several large studies combine to show a sensitivity of 93% and specificity of close to 100%, with positive and negative predictive values of 94% and 100%, respectively [4–7]. There are few recommendations and no general consensus regarding the use and timing of antibiotics, therapeutic anticoagulation, anti-aggregation, most appropriate nutrition and best revascularisation strategies [3,4].

Accounting for less than 0.1% of hospital admissions AMI is a rare medical condition [8]. The incidence of AMI increases exponentially with age and comorbidities [9–11] making it more common in the elderly. Most available studies are retrospective and single-centre. The outcome of AMI has not drastically improved over the last decades [12] despite the wide availability of CT-scanning and major developments in endovascular revascularisation techniques. Different underlying pathophysiological mechanisms leading to AMI and the lack of sensitive and specific clinical and laboratory parameters to predict the presence of AMI result in delayed diagnosis and hamper improvement in clinical care such as has been seen in acute coronary care. A delay in diagnosis is associated with mortality and severe morbidity [13]. A widespread historical belief that acute mesenteric ischemia is a deadly condition, together with difficulties in prospectively studying this multifaceted and uncommon disease, has further inhibited research and progress in this field. Still, some preliminary evidence suggests that a multidisciplinary approach implemented in a special unit can achieve high survival rates and lower morbidity [2,14,15]. However, a uniform algorithm for diagnosis and management of AMI is currently not available, and awareness of the clinical entity of AMI among different specialists as well as the availability of specific treatment modalities and special units in different institutions seem to be highly variable. No studies are available that describe these differences in clinical practice and treatment of AMI, and the current survey is a first step attempting to fill this gap.

2. Methods

We conducted a survey concerning the practices of diagnosis and management of AMI by different medical specialists and hospitals worldwide. To obtain information both from individual health care workers and from medical teams too, we created two similar questionnaires (Supplements 1 and 2), one to be completed by one individual (Individual Form), and one to be completed as a team effort within one institution (Team Form).

The team survey was slightly adapted based on feedback from the individual survey (additional questions and/or answering options on diagnostics, antibiotics, anticoagulation, anti-aggregation and nutrition therapy were added). With adding more diagnostic options for diagnosis of NOMI in the team form we increased the maximum number of answers from 3 to 5.

The questionnaires included questions about the hospital site, the medical specialty of the respondent or all team members, and on diagnostics and management of AMI in general and with respect to two hypothetical cases.

The aim of our survey was to describe current practices and variances in approach of the management of patients with AMI worldwide.

2.1. Definitions

For the purposes of a unified approach, we provided the following definitions [16] for participants in the survey:

Acute Mesenteric Ischaemia (AMI): a condition caused by inadequate blood flow through the mesenteric vessels, leading to ischaemia and ultimately necrosis of the bowel wall.

Stage of AMI; intestinal ischaemia: intestinal injury related to impaired or disrupted perfusion that can potentially be reversed. This mesenteric vascular insufficiency may be occlusive or non-occlusive in origin.

Stage of AMI; intestinal infarction: irreversible transmural necrosis of the intestine due to ischaemia.

Mechanism of AMI; occlusive mesenteric ischaemia: decreased mesenteric blood flow due to high-grade stenosis or occlusion of mesenteric vessels (arterial or venous).

Mechanism of AMI; non-occlusive mesenteric ischaemia (NOMI): decreased mesenteric blood flow without high-grade stenosis or occlusion of specifically identifiable (larger) mesenteric vessels. The mechanisms of NOMI include severe vasoconstriction (especially if accompanied by hypovolaemia), low cardiac output and compression of mesenteric vessels due to increased intra-abdominal pressure.

Throughout the manuscript the results are presented separately for the following categories:

Individual: all individual responses.

TEAM: responses from the multidisciplinary teams from the hospitals without a special unit.

Special Unit: All teams who stated having a dedicated unit for the management of intestinal vascular emergencies or acute

intestinal failure ("yes" to a question 1b in Supplement 2) were identified as "special units" and presented as respective subgroup.

2.2. Endorsement and distribution of the survey

The European Society of Clinical Nutrition and Metabolism (ESPEN) endorsed the survey as a project initiated by the Special Interest Group for Acute Intestinal Failure (SIG-AIF) of ESPEN. Thereafter, ESPEN distributed the Individual Form of the Survey to all its active members. To further distribute the individual form, we contacted international and national societies of different specialties (surgery, intensive/critical care, vascular surgery, gastroenterology, radiology, anesthesiology) and asked for endorsement and distribution of the survey. The survey was eventually endorsed and distributed by the European Society of Intensive Care Medicine (ESICM), the World Society of Emergency Surgery (WSES) and the Abdominal Compartment Society (WSACS) and in-principle endorsed by the World Federation of Intensive and Critical Care (WFICC). Additionally, many national societies (Supplement Table 1) endorsed and distributed the survey. Endorsing societies sent the link to the individual survey form to their members and/or published the link in their newsletters. Additionally, SIG-AIF members sent the Individual Form to their personal contacts. At least one reminder was sent by each society involved. All respondents were given the option to enter their personal e-mail address in the event that they were interested in further studies on AMI. After the closing date for the individual survey, we evaluated the answers and adjusted the draft team form as follows: we added questions about the diagnostic approach (indocyanine green (ICG), angiography, contrast-enhanced ultrasound (CEUS)) and about antibiotic use and anticoagulation/anti-aggregation therapy. The team form was sent to the participants in the individual survey who had given their contact details, with instructions on how to complete the team survey (one team per hospital, including all key clinicians involved in the treatment of AMI patients). In cases where several people from one hospital had filled in the individual form, they were contacted as a collective and asked to join their efforts in completing the team form. The team survey was also distributed by SIG-AIF members to their personal contacts. In total, the team survey was sent to 287 hospitals in 61 countries.

2.3. Data collection

We used the data collection platform "Form Assembly" to build the survey and to collect the data. The survey was built as a closed survey and the results were only accessible to the investigator. To keep the questionnaire streamlined, we used some simple conditional questions. It was optional to add personal information. It was only possible to send the completed questionnaire once, but respondents were able to review and change their own answers. The IP address of the respondents was used to identify potential duplicate entries from the same user. If there were duplicates with a complete and an incomplete questionnaire, the incomplete one was removed. The completion rate of the individual questionnaire was 82% and of the team questionnaire 86%. We analysed complete as well as incomplete questionnaires. There were no incentives to fill out the form. Responses from individuals were collected from 1st of April to 30th June 2021. Responses from teams were collected from 1st October to 31st of December 2021. After the closing dates of the survey, data were transferred to SPSS for analysis.

2.4. Statistics

Statistical analysis was performed using SPSS (Version 25). Descriptive analyses were performed using standard statistical parameters.

2.5. Ethics

No patient data were involved. No personal data of responders were processed. Therefore, requirements for formal ethical approval were waived.

3. Results

3.1. General

After clearing 9 duplicates, 493 responses from 71 countries were analysed (Supplement Fig. 1). The completion rate was 82%. Most of the missing data from the 90 incomplete datasets were with regard to hospital type and profession. For the team survey, from 287 invited sites we received 95 replies (response rate 33%). Most of the participants were surgeons (individuals: 47%; team responders: 45%) and most were employed at a university or teaching hospital (60% of individuals, 73% of teams), followed by regional hospitals (15% versus 14%), specialized hospitals (6% versus 9%) or other institutions (1% versus 0%), mostly private hospitals. Specialized hospitals were defined as hospitals providing specialized care (e.g. oncology, orthopedic surgery) not related to AMI. Overall, there was a high percentage of European and especially Italian teams (32%) participating. More details are shown in Table 1. More details about the profession of the individuals are shown in the Supplement Fig. 2a.

The great majority of the participating teams (Supplement Fig. 2b) were composed of general surgeons, intensivists, vascular surgeons, and in 70% of the teams the general surgeon had the lead. 21% of the teams meet daily, 21% once per week and the rest less frequently. In 18% of cases teams were created solely to complete this survey.

3.2. Hospital type

Almost all respondents (individual 97%; team responders 99%) were personally involved in the management of AMI patients, whereas 1% of the individual respondents answered that they typically refer these patients to another hospital, and 1% of the individual respondents neither manage nor refer these patients. Most participating hospitals (83%) accepted referrals, with a small proportion (16%) receiving patients from the whole country.

Table 1
General survey data & sites.

	Individual	Team
Forms received:	502	95
Duplicates removed:	9	1
Forms complete:	403 (82%)	82 (86%)
Forms analyzed:	**493**	**94**
Participating …		
countries	71	34
cities	299	92
hospitals	493	94
university/teaching hospitals	294 (60%)	68 (73%)
specialist hospitals	30 (6%)	9 (9%)
local/regional hospitals	75 (15%)	14 (14%)
other hospitals	6 (1%)	0 (0%)
missing information	88 (18%)	3 (3%)

According to individual replies patients with AMI were most commonly managed in the ICU (intensive care unit), HDU (high dependency unit) and surgical wards, followed by combined medical/surgical wards and medical wards (Supplement Fig. 3). From the team responses, including those with a special unit, management was most likely in surgical wards and ICU.

Fourteen team hospitals reported having a dedicated special unit for the management of intestinal vascular emergencies or acute intestinal failure in their institution and a majority of institutions (individual 67% versus team 64% responses) have a multidisciplinary nutritional support team consisting of surgeons (42%/48%), physicians (47%/56%), nurses (47%/52%) and dieticians (57%/63%).

3.3. Emergency services management

Participants were asked about their perception of general awareness of AMI in patients with acute abdominal pain presenting in the emergency ward. Most of respondents answered that the diagnosis of AMI is often delayed but rarely missed, as shown in Fig. 1. However, around one third of respondents still felt that the diagnosis was often missed.

When comparing the leading diagnostic elements, the most cited diagnostic test for both ischaemia and infarction is abdominal CT with intravenous contrast media (ischaemia 85% versus 96%; infarction 92% versus 93%). A history of postprandial abdominal pain, unintentional weight loss and the presence of cardiovascular risk factors are perceived to be most helpful in diagnosis of ischaemia, whereas raised plasma lactate and diagnostic laparoscopy or laparotomy were considered most important in case of infarction. A contrast-enhanced ultrasound, the use of ICG, and of CT scan without contrast media are rarely considered. More details are shown in Supplement Fig. 4.

3.4. Management of mesenteric ischaemia

Overall, 37% of the individual and 42% of the team respondents indicated that patients with mesenteric infarction rarely undergo

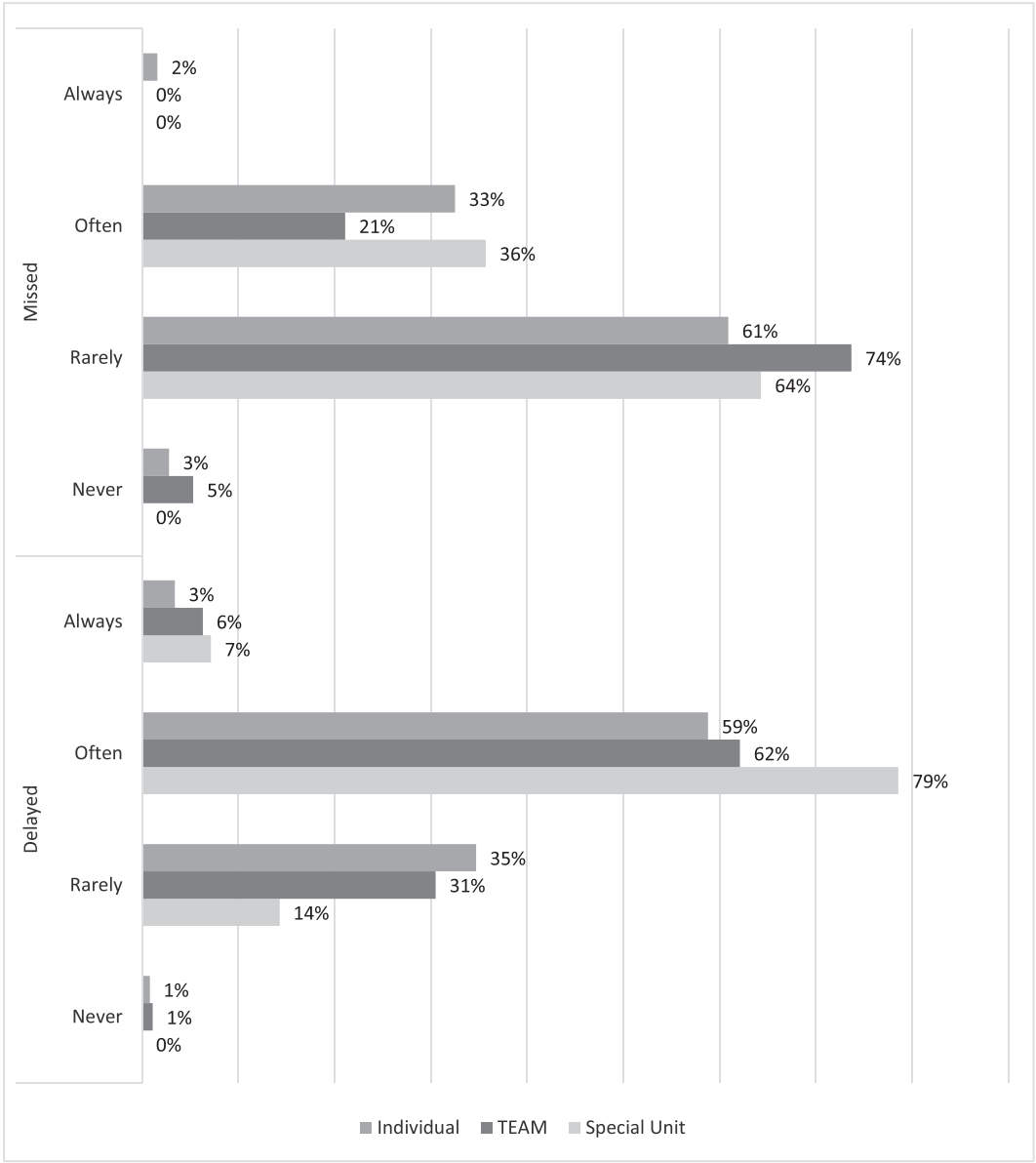

Fig. 1. How often do you feel that the diagnosis of AMI is delayed or missed?

emergency revascularisation procedures. At the same time, 46% of the teams (but only 31% of individual respondents) indicated that an emergency revascularisation procedure is often performed in their hospital in patients with mesenteric ischaemia which has not yet progressed to infarction (Fig. 2).

Interventional treatment options in AMI without clinical signs of infarction consist of endovascular or surgical revascularisation. Team respondents considered interventions more often than individual respondents. Endovascular treatment and surgical revascularisation are performed at equal rates while revascularisation was the preferred choice of treatment in special units (Fig. 3).

If angioplasty and/or bypass surgery is not performed at the respondent's hospital, 44% of the individual respondents but only 11% of the teams would refer patients to another hospital. Respondents' reactions following the individual questionnaire led to the inclusion of supplementary questions in the team questionnaire. This provided additional information regarding the perception of medical treatment options in the management of AMI (Supplement Fig. 5). Overall, there was extensive variation regarding the use, timing and duration of antibiotics, therapeutic anticoagulation and platelet aggregation inhibitors between different teams.

Antibiotic therapy is considered by 60% of team respondents and by 57% of special units. The main reason to start antibiotics was diagnosis of mesenteric ischaemia (37%), while unstable haemodynamics or elevated inflammation markers were not a part of this decision-making process. Therapeutic anticoagulation was a treatment option described by 68% of team respondents and 64% of special units, whereas the respective numbers for platelet aggregation inhibitors were 70% and 86%. The teams perceived that

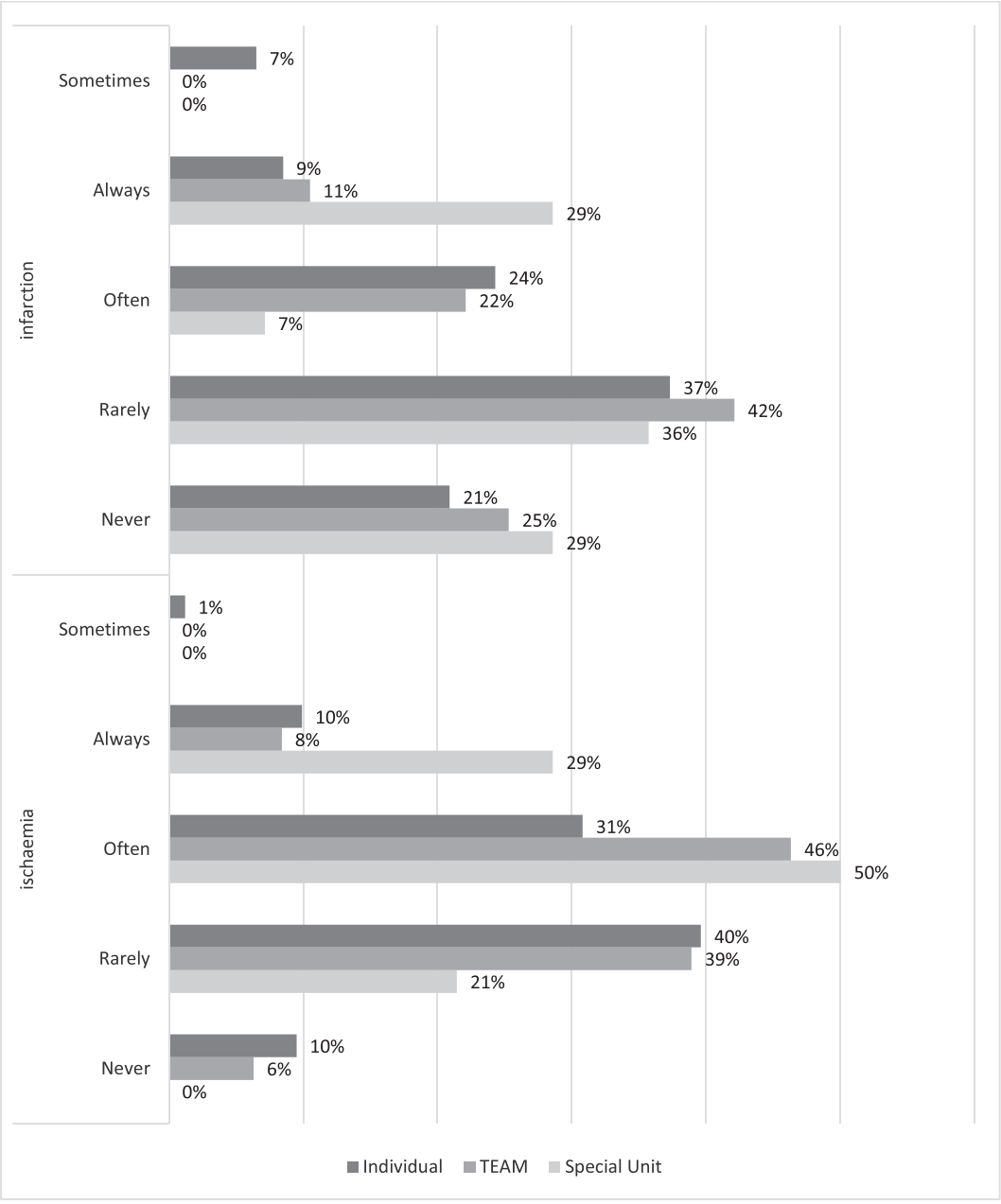

Fig. 2. Probability of emergency revascularisation procedures “infarction vs ischaemia".

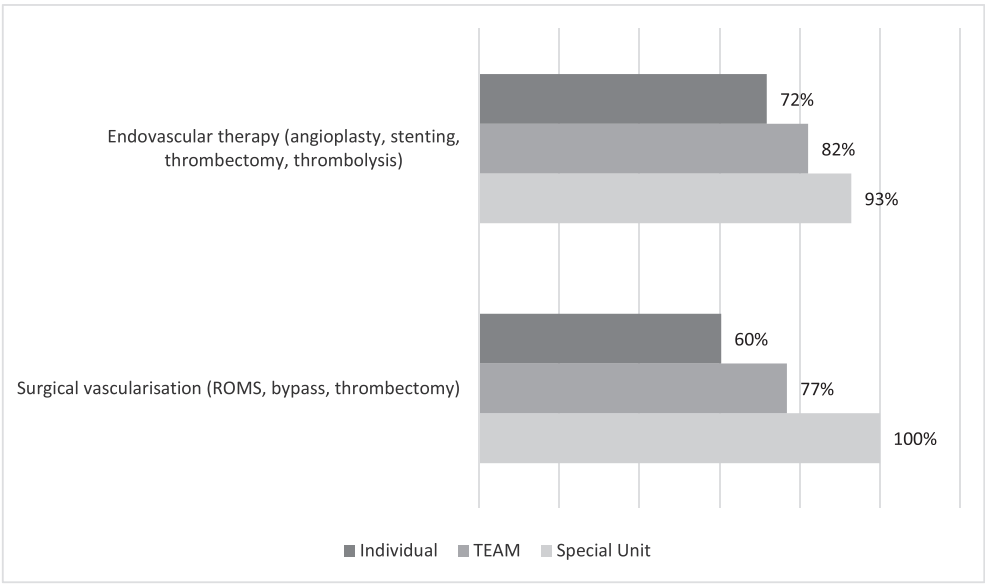

Fig. 3. Surgical vs. endovascular treatment of mesenteric ischaemia.

therapeutic anticoagulation is used in their hospital for venous thrombosis (64%) and less frequently for arterial thrombosis (36%) and arterial embolism (45%). Platelet aggregation inhibitors are considered more often in arterial thrombosis (50%) than in arterial embolism (35%), with less frequent use in other forms of AMI. Both are rarely considered in NOMI. The perception of the recommended duration of therapeutic anticoagulation (Fig. 4) is particularly variable, whereas platelet aggregation inhibitors (Fig. 5) are generally recommended lifelong.

3.5. Diagnostics of non-occlusive mesenteric ischaemia (NOMI)

In total, 66% of respondents manage patients with non-occlusive mesenteric ischaemia in the ICU (level 3 of care). For diagnosis of NOMI, 97% of the teams but only 61% of individual respondents consider a CT-scan with contrast media to be useful (Team data Fig. 6, Individual data Supplement Fig. 6), and contrast-enhanced ultrasound (CEUS) and indocyanine green (ICG) are rarely used (3% and 7%, respectively). Remarkable differences between team and individual evaluations were also observed for perceived usefulness of other diagnostic indicators such as unexplained elevation of plasma lactate, unexplained uncontrolled septic shock and increased intra-abdominal pressure. Angiography, laparoscopy and endoscopy were less often considered in the diagnostic process by individual respondents (Supplement Fig. 6., 5 instead of 3 top answers were allowed in Team form, precluding direct comparisons).

3.6. Management of mesenteric infarction

Extended intestinal resection is favored by most participants when signs of extensive necrosis are present, but primary diagnostic laparoscopy is also frequently considered. Surgical revascularisation is evaluated far more often than endovascular treatment. In the management of a patient with established mesenteric infarction, 96% of the teams and 86% of the individual respondents would perform major intestinal resection when there were signs of extensive necrosis. Further, diagnostic laparoscopy and surgical revascularisation are more often considered in patients with intestinal infarction than medical or endovascular therapy. Again, we see that endovascular therapy and surgical revascularisation are more preferred in centres with a special unit (Fig. 7).

The main reasons for the use of antibiotics were diagnosis of mesenteric infarction (37%), while unstable haemodynamics or elevated inflammation markers were not considered in the decision-making process. Much as in mesenteric ischaemia, in mesenteric infarction therapeutic anticoagulation was prescribed for 3–6 months (Fig. 4).

Age-dependency of the decision-making process was assessed using examples of a clinical case aged either 45 or 80 years old who had extensive small and large bowel infarction, but no other comorbidities affecting life expectancy. In the individual form we asked respondents to give only one answer (Supplemental Fig. 7), while in the team form multiple options were possible to select (Fig. 8). In the 80-year-old patient, individuals considered starting a palliative process in 44% as did 70% of teams. In the younger patient, bowel resection and planned second look surgery was the most frequently chosen option (49% individuals and 77% of teams). Resection and primary anastomosis or jejunostomy in younger patients were frequently considered by special units.

3.7. Postoperative management of patients after a mesenteric infarction

Second look laparotomy is considered as standard management in a minority of hospitals, nonetheless around two thirds of respondents indicated that it is considered sometimes or often. After bowel resection, 40% of the individuals and 56% of the teams would reconsider arterial revascularisation, if not performed before, whereas 29% of the individuals and 26% of the teams would not. After extensive bowel resection, there is a general agreement on the relevance of parenteral nutrition support (individual respondents 92% vs. teams 97%), but external referral of a patient if such support was not available was rare (11%/3%). Achieving haemodynamic stability was an important criterion prior to starting parenteral nutrition (individual 42% versus team 47%), followed by “within 72 h” and “immediately“. A few would wait until one week after surgery before nutritional support would be offered. Commencing oral or enteral nutrition is mostly guided by the evidence of bowel activity (individual 44% versus teams 42%). Long term parenteral

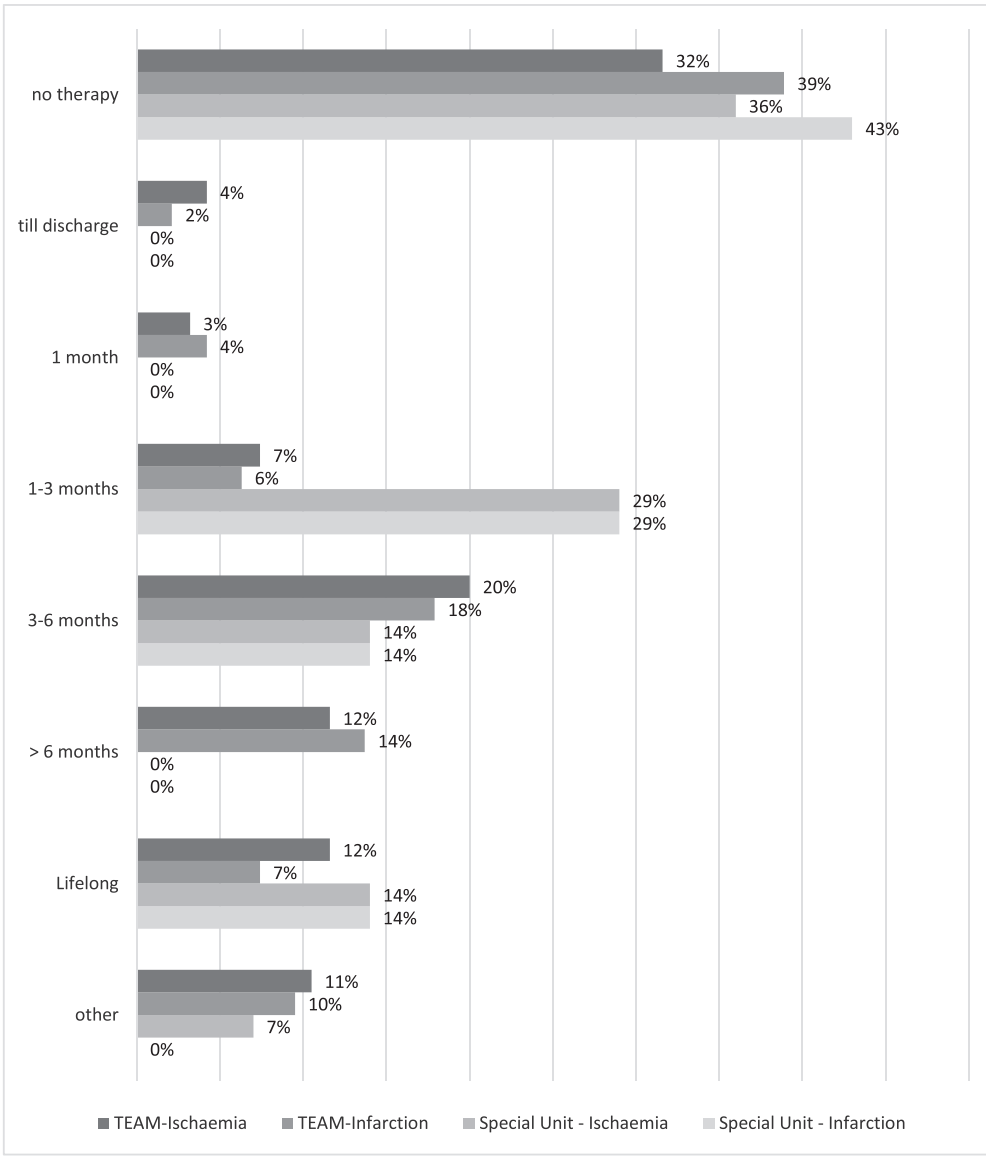

Fig. 4. Comparison of anticoagulation therapy duration in ischaemia and infarction. This question was included only in the team questionnaire. 68% of all teams (64% of the special units) considered anticoagulation therapy in ischaemia and 61% (57% of the special units) in infarction.

nutrition support would be offered by a specialized team in two thirds of the hospitals (individual 61% vs. teams 63%). Enteroclysis in the case of a distal mucus fistula is considered by 20% of the individual and 25% of the team respondents. This decision seems to be dependent on the length of residual downstream bowel (32%/45%) and the absence of distal strictures (30%/40%), while the arterial blood supply is less often evaluated. Almost all respondents consider restoration of intestinal continuity if a jejunostomy and viable distal bowel are present. There is wide heterogeneity regarding the timing of such a procedure, ranging from prior to discharge to more than 6 months afterwards (Fig. 9).

4. Discussion

Recommendations on the management of AMI are based on scarce evidence in the literature and the two sets of international guidelines on this topic from 2017 [3,4], while recent updated guidelines by WSES [17] were published after our survey. Our practice survey, representing individual health care workers and treatment teams from hospitals around the world, demonstrates a large variability of interventional and medical treatment strategies. This could be explained by the low awareness regarding this rare disease, at least partially explained by the absence of clear evidence-based guidance in many aspects of AMI. As summarized also by the most recent guidelines, due to the absence of randomized controlled trials, there is only low to moderate evidence in the literature [17].

AMI patients are managed in different hospital units, although admission to surgical wards and ICU or high-care units is often preferred. Several hospitals report having a specialized AMI unit, although they might be overrepresented in this study due to their interest in AMI. While specialized acute coronary care and stroke units are common in modern large hospitals, an intestinal stroke or intestinal failure unit is rare. With an increasing incidence of AMI due to increased life expectancy as well as reductions in AMI-related mortality, more patients with short bowel syndrome may

increase the need for such special units. Most individual and completed team surveys were from European centres. Therefore, a representative analysis of intercontinental differences in diagnostic and therapeutic management of AMI is not feasible and our overall results may not apply to other countries and continents. A high percentage of respondents were surgeons and surgeon-led teams. Therefore, a meaningful comparative analysis of treatment considerations by different specialties is not possible.

Many respondents reported that the diagnosis of AMI is often delayed or missed. AMI is a time-sensitive diagnosis where non-specific symptoms and the absence of specific diagnostic biomarkers combined with low awareness due to the low incidence of AMI are probably the main factors responsible for the delay in diagnosis, and consequently also in management. Based on our results, computed tomography with intravenous contrast is recognized to be the most useful element in diagnosing AMI and is widely available. This is in line with current literature and guidelines [3–5]. Importantly, however, scanning in both arterial and venous phases is necessary to exclude AMI and the likelihood of a correct AMI diagnosis is higher if suspicion of AMI is mentioned in the referral to the radiologist [18]. The incidence of AMI rises with age [20] and therefore AMI should be considered earlier in older patients with any clinical pointers. Another important point is that if there is a suspicion of AMI, the common concern about the renal function with application of contrast media is clearly outbalanced by the immediate risk of death through AMI [5,19]. In contrast, the diagnosis of AMI might be delayed or missed in younger patients because of the lower prevalence at younger ages. In our survey, age appeared a major factor in decision-making when choosing between potentially curative and palliative treatment. Adequate treatment of AMI is associated with lower mortality [2,14,15], but it is less clear what the effect on morbidity is and whether this depends on age or other parameters such as co-morbidities. A lack of specific biomarkers and specific phenotypes result in a clinical picture of AMI that is less clear than the clinical features of acute coronary syndrome or cerebrovascular ischaemia. Moreover, the greater awareness of clinicians of these two conditions increases clinical suspicion and consequently usefully influences diagnostic accuracy. The key to early diagnosis is a high level of clinical suspicion. Given that the correct diagnostic method is widely available, we think that increasing awareness and knowledge of AMI carries real potential to improve on the current practice and outcomes of

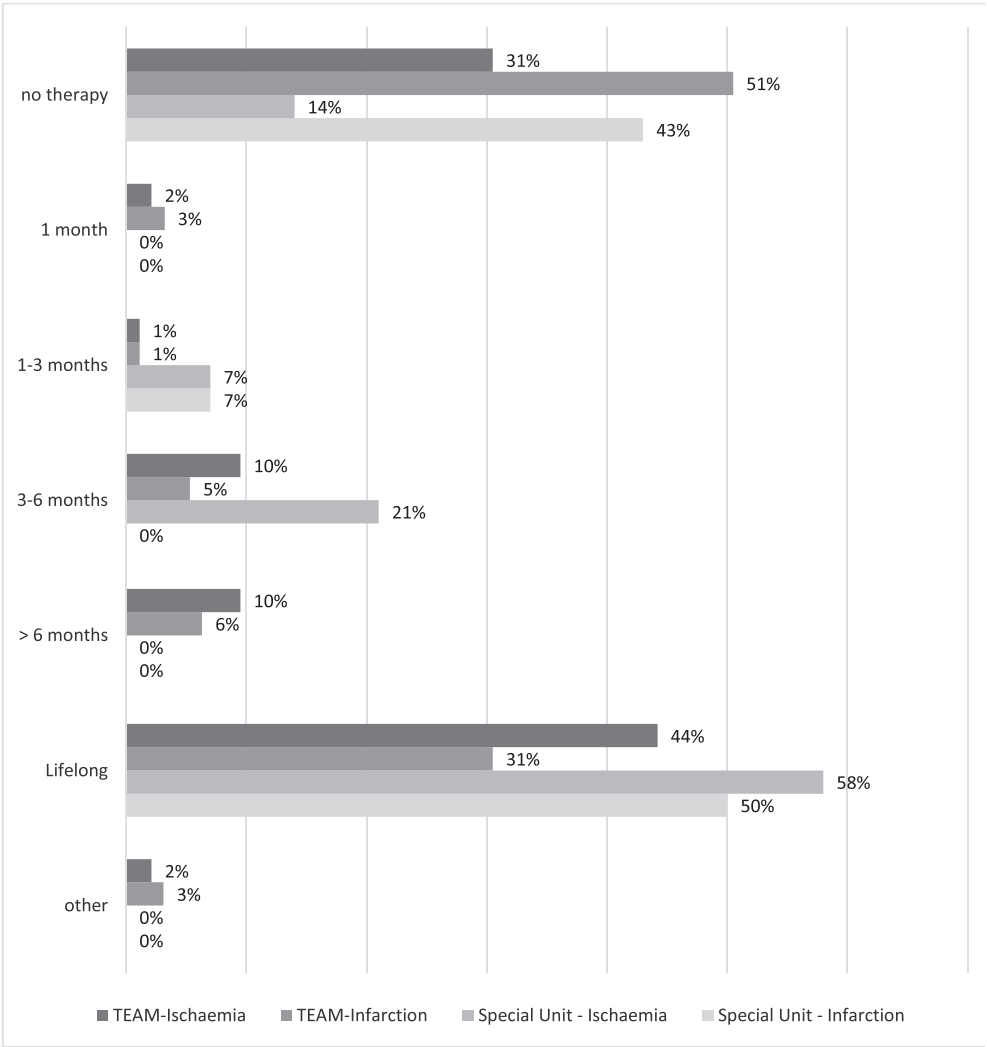

Fig. 5. Comparison of anti-aggregation therapy duration in ischaemia and infarction. This question was included only in the team questionnaire. 69% of all teams (86% of the special units) considered anti-aggregation therapy in ischaemia and 49% of all teams (57% of the special units) in infarction. In infarction, anti-aggregation is mostly recommended lifelong.

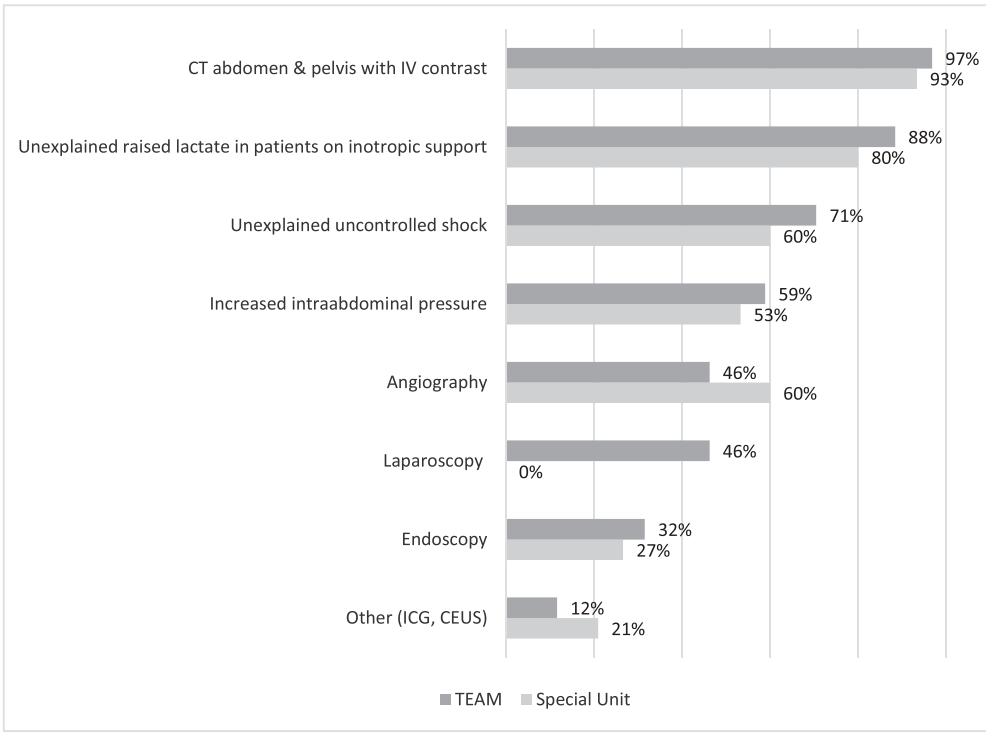

Fig. 6. Diagnostics of non-occlusive mesenteric ischaemia (NOMI) – TEAM data. Maximum of 5 answers were allowed.

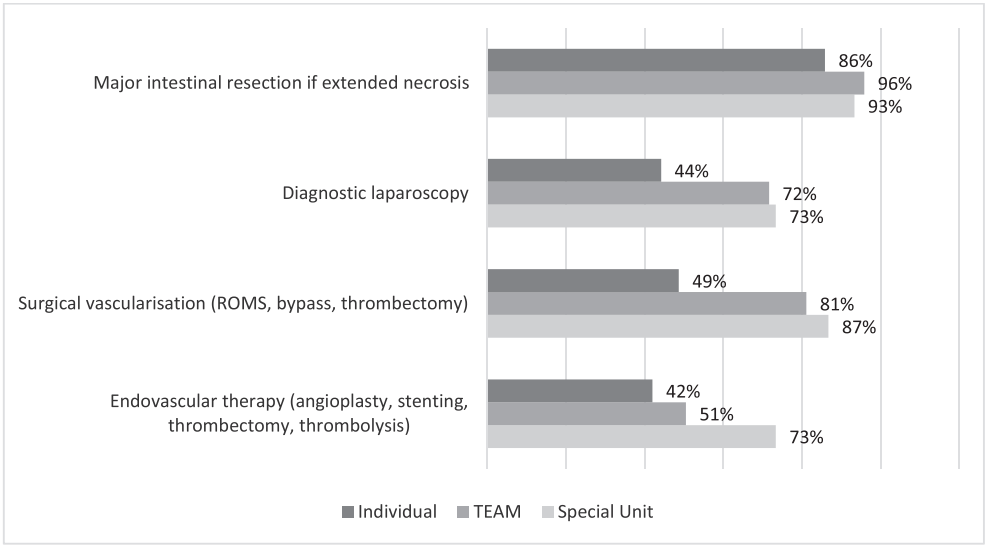

Fig. 7. Surgical vs. endovascular treatment of mesenteric infarction. ROMS = retrograde open mesenteric stenting.

AMI. Available evidence consists largely of retrospective single-centre studies carried out over many years or even decades, but a prospective multicentre study has now been initiated and will allow for a better description of epidemiology as well as a structured analysis of current practice [21]. Moreover, information from this large observational study will provide opportunity to distinguish phenotypes of confirmed vs. suspected but eventually not confirmed AMI, and should serve for better planning of future studies on diagnostics (e.g. biomarkers) and management of AMI.

Although the respondents in the present study probably had a special interest in AMI and might have more up to date knowledge, large variations in diagnostics and management were observed. Revascularisation techniques were more often considered by dedicated "special units" than by other respondents. When intestinal infarction in AMI is present or suspected, revascularisation was less often considered as primary therapy. Endovascular therapy was considered more often than surgical revascularisation, which concurs with the recent trends seen in reviews of the current

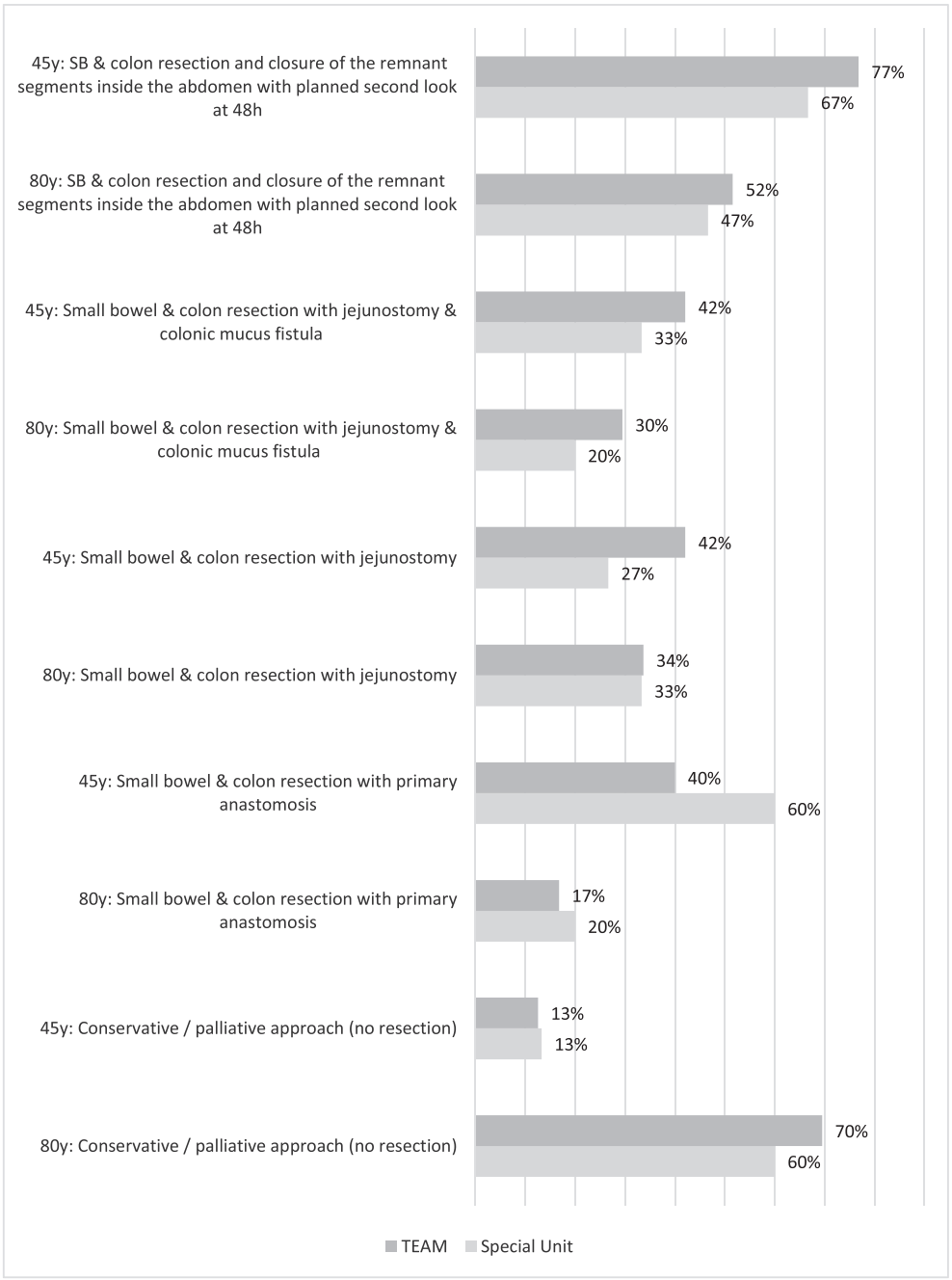

Fig. 8. Mesenteric infarction, treatment options depending on age (TEAM data). Multiple answers were allowed. Each option was answered with yes/no, allowing several options to be selected.

literature [22,23]. While there are clear guidelines on indication, timing, duration of anticoagulation and anti-aggregation therapy in acute coronary syndrome, no such consensus exists for AMI. This is also reflected in our survey with a high variability in medical treatment for different forms of AMI and for ischaemia vs. infarction. This may partly be explained by the paucity of evidence and recommendations in the first published guidelines on the management of AMI.

A similar large variability was found in the indication for antibiotic therapy. Although a strong (1 B) recommendation for standardized use of antibiotics in AMI is given in the Clinical Practice Guidelines of the European Society for Vascular Surgery [4], only 68% of respondents considered routine antibiotic treatment. In line with the absence of clear recommendations for the management of nutrition support, for second look laparotomy or the timing of surgery to re-establish bowel continuity, a wide heterogeneity in the management of these aspects was also observed in our survey. However, there was general agreement on the importance of the restoration of enteral continuity when feasible.

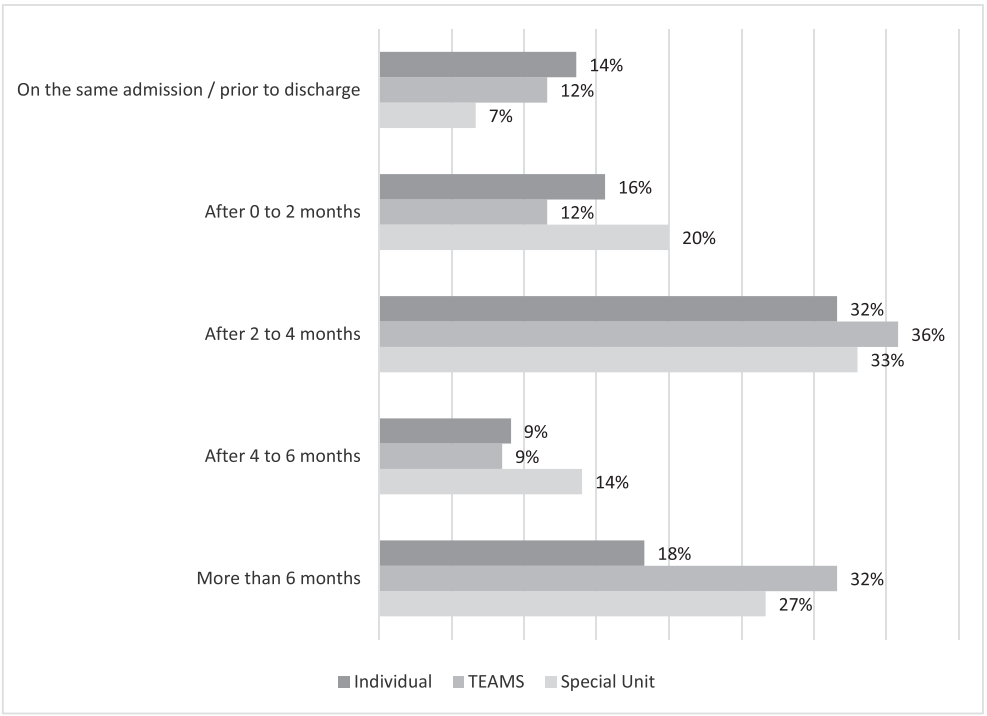

Fig. 9. Timing of continuity surgery.

5. Conclusion

The diagnosis and management of acute mesenteric ischaemia is heterogeneous. Our survey highlights that delayed or even missed diagnosis of mesenteric ischaemia is common despite wide availability of CT-scanning as a diagnostic method of choice. Clearer guidance for early diagnosis and management, including providing clinical criteria that identify poor outcome are necessary. Establishment of clinical algorithms for the diagnosis and treatment of AMI analogous to the diagnostic and treatment approaches in acute coronary syndrome and stroke are needed. Increasing awareness and knowledge of the clinical entity of AMI is an important first step to improve current clinical practice.

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Author contribution

Benjamin Hess: Project administration; Data collection; Data analysis and interpretation; Resources; Writing - original draft; Visualization; Writing - review & editing. **Martin Cahenzli**: Resources; Writing - original draft; Writing - review & editing. **Alastair Forbes:** Conceptualization; Resources; Writing - review & editing. **Rosa Burgos:** Conceptualization; Resources; Writing - review & editing. **Federico Coccolini:** Resources; Writing - review & editing. **Olivier Corcos:** Conceptualization; Writing - review & editing. **Mette Holst:** Conceptualization; Resources; Writing - review & editing. **Øivind Irtun:** Conceptualization; Resources; Writing - review & editing. **Stanislaw Klek:** Conceptualization; Resources; Writing - review & editing. **Loris Pironi:** Conceptualization; Resources; Writing - review & editing. **Henrik Højgaard Rasmussen:** Conceptualization; Resources; Writing - review & editing. **Mireille J Serlie:** Conceptualization; Resources; Writing - review & editing. **Ronan Thibault:** Conceptualization; Resources; Writing - review & editing. **Simon Gabe:** Conceptualization; Resources; Writing - review & editing. **Annika Reintam Blaser:** Conceptualization; Resources; Writing - original draft; Writing - review & editing.

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Appendix A. Supplementary data

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