
GUIDELINES VASCULAR SECTION

Guidelines on the diagnosis, treatment and management of visceral and renal arteries aneurysms: a joint assessment by the Italian Societies of Vascular and Endovascular Surgery (SICVE) and Medical and Interventional Radiology (SIRM)

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ABSTRACT

The objective of these Guidelines is to provide recommendations for the classification, indication, treatment and management of patients suffering from aneurysmal pathology of the visceral and renal arteries. The methodology applied was the GRADE-SIGN version, and followed the instructions of the AGREE quality of reporting checklist. Clinical questions, structured according to the PICO (Population, Intervention, Comparator, Outcome) model, were formulated, and systematic literature reviews were carried out according to them. Selected articles were evaluated through specific methodological checklists. Considered Judgments were compiled for each clinical question in which the characteristics of the body of available evidence were evaluated in order to establish recommendations. Overall, 79 clinical practice recommendations were proposed. Indications for treatment and therapeutic options were discussed for each arterial district, as well as follow-up and medical management, in both candidate patients for conservative therapy and patients who underwent treatment. The recommendations provided by these guidelines simplify and improve decision-making processes and diagnostic-therapeutic pathways of patients with visceral and renal arteries aneurysms. Their widespread use is recommended.

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KEY WORDS: Aneurysm; Renal artery; Vascular surgical procedures; Practice guideline; Systematic review.

These Guidelines have been accepted by the Italian National Institute of Health, and published in Italian language on 28th of April 2023 on the National Guidelines System (<https://snlg.iss.it/>).

Aim of the study was to present Italian Guidelines on the management of Visceral and Renal arteries Aneurysm disease, developed in accordance with the instructions of the National Guidelines System (SNLG) Methodological Manual, and approved by the Italian National Institute of Health.

The main objective of these Guidelines is to provide the correct diagnostic and therapeutic pathway, to be shared between doctor and patient, to guide and optimize the diagnostic and treatment decisions.

The methodology applied in these Guidelines is the GRADE-SIGN version,¹ also referring to the methodological indications contained in the Procedures for the submission and evaluation of Guidelines for publication in the SNLG - Operational Manual² and the Methodological Manual for the production of clinical practice guidelines,³ by the National Center for Clinical Excellence, Quality and Safety of Care (CNEC). The Guidelines were developed according to the AGREE quality of reporting checklist⁴ and, once completed, were assessed using the AGREE II tool.⁵

The multidisciplinary panel included the following specializations: vascular surgery, interventional radiology, angiology, and general medicine. In addition to the Italian Society of Vascular and Endovascular Surgery (SICVE)

and the Italian Society of Medical and Interventional Radiology (SIRM), which were the proposing societies, the Italian Society of Angiology and Vascular Pathology (SIAPAV) and the Italian Interdisciplinary Society for Primary Care (SIICP) were involved from the production of these Guidelines. The Guidelines were also evaluated in terms of applicability for the patient by the Vascular Patients Association Titocotoccati, which shared and approved all the proposed recommendations. Guidelines were built in accordance with the same methodology adopted for the development of previously published official national guidelines.^{6, 7} The systematic review processes and the interpretation of selected evidence to build recommendations are available in the Supplementary Digital Material 1 (Supplementary Table I-XIII, Supplementary Figure 1-22, Supplementary Text File 1).

Diagnosis and screening

PICO 1.1 Clinical question

In patients with suspected aneurysm/pseudoaneurysm of visceral or renal artery, is computed tomography (CT) angiography more accurate than other modalities for the diagnosis and indication for treatment?

Recommendation⁸⁻¹³

In patients with suspected aneurysm/pseudoaneurysm of the visceral or renal artery, CT angiography is suggested

as the preferred imaging modality for the diagnosis and indication for treatment, in both urgent and elective cases.

Good Practice Point (GPP) recommendation.

PICO 1.2 Clinical question

Should patients diagnosed with visceral or renal artery aneurysms be screened with additional imaging to look for potential concomitant aneurysms in different locations to prevent complications, instead of forgoing further diagnostic examinations?

Recommendation

In patients diagnosed with visceral or renal artery aneurysms, careful evaluation of radiological images is suggested to assess the presence of concurrent aneurysms in the examined regions.

Good Practice Point (GPP) recommendation.

PICO 1.3 Clinical question

Should patients with visceral or renal artery aneurysms be screened for associated underlying pathologies?

Recommendation

In patients with visceral or renal artery aneurysms, screening for associated underlying pathologies is suggested, such as fibromuscular dysplasia tests and ultrasound examination for concomitant popliteal artery aneurysms.^{14, 15}

Good Practice Point (GPP) recommendation.

Indications and treatment options: renal artery aneurysms

PICO 2.1.1 Clinical question

In a patient with an aneurysm/pseudoaneurysm of the renal arteries, when is it justified to propose a surgical/endovascular treatment compared to medical therapy/follow-up alone to improve the outcome?

Recommendations¹⁶⁻²³

In case of renal artery aneurysm with a diameter greater than or equal to 3 cm and with acceptable operative risk, elective repair is recommended.

Strong recommendation for (level of evidence 2++).

The treatment of a renal artery aneurysm with a diameter of less than 3 cm is suggested in the following cases: distal location, saccular morphology, and rapid growth.

Good Practice Point (GPP) recommendation.

It is suggested to treat renal artery pseudoaneurysms regardless of size, due to the high risk of rupture.

Good Practice Point (GPP) recommendation.

In the patient with symptomatic renal artery aneurysm/pseudoaneurysm, urgent intervention is recommended regardless of the size of the aneurysm.

Strong recommendation for (level of evidence 2++).

Emergency repair is recommended in case of ruptured renal artery aneurysm/pseudoaneurysm.

Strong recommendation for (level of evidence 2++).

In patients of childbearing age with renal artery aneurysm and with acceptable operative risk, treatment is suggested even in the case of diameters of less than 3 cm, taking into account the specific peculiarities of the individual case.

Good Practice Point (GPP) recommendation.

PICO 2.1.2 Clinical question

Which intervention/procedure is preferable in terms of outcome in patients with renal artery aneurysm/pseudoaneurysm?

Recommendations^{16, 17, 24-30}

In elective patients with an aneurysm/pseudoaneurysm of the renal artery and acceptable operative risk, consider open surgical treatment.

Conditional recommendation for (level of evidence 2++).

It is suggested to consider *ex-vivo* repair with autotransplant rather than nephrectomy in case of distal renal artery aneurysms.

Good Practice Point (GPP) recommendation.

In case of aneurysm/pseudoaneurysm of renal artery main branch, consider an endovascular approach with stent placement if the anatomy is judged favorable and logistically achievable. Consider endovascular embolization of a distal branch aneurysm in patients judged at high risk for the open repair.

Conditional recommendation for (level of evidence 2++).

Indications and treatment options: splenic artery aneurysms

PICO 2.2.1 Clinical question

When is it justified to propose surgical/endovascular treatment, compared with medical therapy/follow-up alone, to improve the outcomes of patients with a splenic artery aneurysm/pseudoaneurysm?

Recommendations^{16, 31-57}

Emergency treatment is recommended in case of ruptured splenic artery aneurysms/pseudoaneurysms.

Strong recommendation for (level of evidence 2+).

Emergency treatment is recommended in case of symptomatic splenic artery aneurysms/pseudoaneurysms regardless of size, due to the high risk of rupture.

Strong recommendation for (level of evidence 2+).

The treatment of splenic artery pseudoaneurysms is recommended as soon as possible, regardless of size, due to the high risk of rupture.

Strong recommendation for (level of evidence 2+).

In cases of splenic artery aneurysms greater than or equal to 3 cm in diameter, elective treatment is recommended, unless major contraindications exist.

Strong recommendation for (level of evidence 2+).

Consider elective treatment in case of splenic artery aneurysms ranging from 2 to 3 cm in diameter, unless major contraindications exist.

Conditional recommendation for (level of evidence 3).

Surveillance of true splenic artery aneurysms is suggested in case of: 1) less than 3 cm in diameter, 2) demonstrated dimensional stability, 3) significant comorbidities, 4) limited life expectancy.

Good Practice Point (GPP) recommendation.

In case of splenic artery aneurysms less than 2 cm in diameter, elective treatment is suggested in case of demonstrated and rapid volumetric growth, unless major contraindications exist.

Good Practice Point (GPP) recommendation.

In case of splenic artery aneurysm in liver transplant patient or patients with portal hypertension, consider treatment regardless of size, unless major contraindications exist.

Conditional recommendation for (level of evidence 3).

In case of splenic artery aneurysm in women of child-bearing age, treatment is suggested if there is demonstrated and rapid volumetric growth and regardless of size, unless major contraindications exist.

Good Practice Point (GPP) recommendation.

PICO 2.2.2 Clinical question

In a patient with a splenic artery aneurysm/pseudoaneurysm, which intervention/procedure should be carried out in order to obtain better outcomes?

Recommendations^{31, 41-43, 52, 53, 55, 58-71}

In the emergency setting, it is recommended to choose the type of treatment (surgical *versus* endovascular) for rup-

tured splenic artery aneurysm/pseudoaneurysm on the basis of its feasibility.

Strong recommendation for (level of evidence 2+).

In the elective setting, it is recommended to choose the type of treatment (surgical *versus* endovascular) for splenic artery aneurysms/pseudoaneurysms on the basis of clinical, anatomical, multidisciplinary, and logistic assessments.

Strong recommendation for (level of evidence 2+).

Whenever possible, based on clinical, anatomical, multidisciplinary, and logistic assessments, it is suggested to prefer the endovascular treatment over a surgical solution, because of its less invasiveness, fewer complications, cost-effectiveness.

Good Practice Point (GPP) recommendation.

Whenever possible, based on clinical, anatomical, multidisciplinary, and logistic assessments, it is suggested to prefer the surgical treatment over endovascular solutions in cases of giant aneurysms (more than 5 cm in diameter) causing compressive effects.

Good Practice Point (GPP) recommendation.

Indications and treatment options: celiac artery aneurysms

PICO 2.3.1 Clinical question

In patients with celiac artery aneurysm/pseudoaneurysm, when is surgical and/or endovascular intervention indicated against medical therapy alone to reduce the risk of rupture?

Recommendations^{16, 38, 72-94}

In cases of celiac artery aneurysm, treatment is recommended regardless of size, if ruptured (in emergency) or symptomatic (in urgency).

Strong recommendation for (level of evidence 2-).

In cases of non-ruptured pseudoaneurysm of the celiac artery, treatment is recommended regardless of size, in patients with acceptable surgical risk.

Strong recommendation for (level of evidence 2-).

In cases of non-ruptured aneurysm of the celiac artery, treatment is recommended when size/diameter is greater than or equal to 2 cm, in patients with acceptable surgical risk.

Strong recommendation for (level of evidence 2+).

Consider treatment of non-ruptured celiac artery aneurysms less than 2 cm in size in cases of: non-atherosclerotic etiology, cases with documented rapid growth, patients in whom hepatic transplantation is planned.

Conditional recommendation for (level of evidence 3).

In cases of celiac artery aneurysm in pregnant women/women of childbearing age, treatment is suggested regardless of size for non-atherosclerotic aneurysms, cases with documented rapid growth, patients in whom hepatic transplantation is planned.

Good Practice Point (GPP) recommendation.

PICO 2.3.2 Clinical question

In patients with celiac artery aneurysm/pseudoaneurysm, with an indication for intervention, is endovascular treatment more suitable than open surgery to improve clinical success?

Recommendations^{9, 16, 72-77, 79-90, 93-104}

In patients with celiac artery aneurysm and favorable anatomy, the endovascular intervention is recommended as the first-choice treatment modality.

Strong recommendation for (level of evidence 2-).

In patients with indication for treatment of celiac artery aneurysm, revascularization (stenting, bypass or direct re-implant) is recommended over vessel occlusion (embolization or ligation).

Strong recommendation for (level of evidence 2-).

In patients with indication for endovascular revascularization, consider preserving the hepatic artery rather than the splenic artery, particularly when collateral circulation is not adequate.

Conditional recommendation for (level of evidence 3).

A preoperative selective angiography is suggested to verify adequate collateral circulation, particularly when vessel occlusion might be necessary.

Good Practice Point (GPP) recommendation.

Indications and treatment options: gastropancreaticoduodenal arteries aneurysms

PICO 2.4.1 Clinical question

In patients with aneurysms of the gastropancreaticoduodenal arteries, when is it justified to propose a surgical/endovascular treatment rather than medical therapy/follow-up alone to improve the outcomes?

Recommendation¹⁰⁵⁻¹⁰⁸

In case of asymptomatic gastropancreaticoduodenal aneurysm, the elective repair is recommended regardless of size.

Strong recommendation for (level of evidence 2++).

PICO 2.4.2 Clinical question

In patients with aneurysms of the gastropancreaticoduodenal arteries, which intervention/procedure is preferable in terms of outcomes?

Recommendations^{16, 105-109}

In patients with gastropancreaticoduodenal aneurysms, the endovascular approach is recommended, both in the elective and urgent settings, as the first-choice option in the presence of a favorable anatomy.

Strong recommendation for (level of evidence 2++).

In patients with a gastropancreaticoduodenal aneurysm associated with steno-occlusion of the coeliac artery, the revascularisation of the latter might not be considered.

Conditional recommendation against (level of evidence 3).

In patients with gastropancreaticoduodenal aneurysms and steno-occlusion of the coeliac artery with associated obstructive lesions of the superior and inferior mesenteric artery, the revascularisation of the coeliac artery is suggested.

Good Practice Point (GPP) recommendation.

PICO 2.4.3 Clinical question

In patients with pseudoaneurysms of the gastropancreaticoduodenal arteries, when is it justified to propose a surgical/endovascular treatment rather than medical therapy/follow-up alone to improve the outcomes?

Recommendations^{109, 110}

Emergency treatment is suggested in case of ruptured pseudoaneurysm of the gastroduodenal artery or pancreaticoduodenal arch associated with active bleeding.

Good Practice Point (GPP) recommendation.

Elective treatment is suggested as soon as possible in case of pseudoaneurysms of the gastroduodenal artery or the pancreaticoduodenal arch not associated with ongoing bleeding and regardless of the size of the pseudoaneurysm itself.

Good Practice Point (GPP) recommendation.

PICO 2.4.4 Clinical question

In patients with pseudoaneurysms of the gastropancreaticoduodenal arteries, which intervention/procedure is preferable in terms of outcomes?

Recommendations¹⁰⁹⁻¹¹⁶

It is suggested to choose the type of emergency treatment (open or endovascular) of ruptured pseudoaneurysms of

the gastroduodenal or pancreaticoduodenal artery based on clinical and anatomical evaluations, preferring endovascular solutions whenever possible.

Good Practice Point (GPP) recommendation.

It is suggested to choose the type of elective treatment (open or endovascular) of pseudoaneurysms of the gastroduodenal or pancreaticoduodenal artery based on clinical, anatomical, multidisciplinary, and logistic evaluations.

Good Practice Point (GPP) recommendation.

Indications and treatment options: hepatic artery aneurysms

PICO 2.5.1 Clinical question

In patients with aneurysms/pseudoaneurysms of the hepatic artery, when is it justified to propose a surgical/endovascular treatment rather than medical therapy/follow-up alone to improve the outcomes?

Recommendations^{33, 38, 76, 98, 117-122}

Emergency treatment is recommended in case of ruptured hepatic artery aneurysms/pseudoaneurysms. In case of symptomatic hepatic artery aneurysms, treatment is recommended in an urgent setting regardless of size.

Strong recommendation for (level of evidence 2+).

It is recommended to treat hepatic artery pseudoaneurysms as soon as possible, due to high rupture rates and mortality risk.

Strong recommendation for (level of evidence 2+).

Consider treatment in case of asymptomatic patients with hepatic artery aneurysms greater than 2 cm in diameter or demonstrated high increasing rates (0.5 cm/year), taking into account patients' comorbidities and life expectancy.

Conditional recommendation for (level of evidence 2-).

Consider treatment of hepatic artery aneurysms with diameters inferior to 2 cm in case of aneurysms of non-atherosclerotic origin or patients suffering from systemic pathology as vasculitis or collagen diseases, given a higher propensity for rupture.

Conditional recommendation for (level of evidence 2+).

PICO 2.5.2 Clinical question

In patients with an aneurysm/pseudoaneurysm of the hepatic artery, which intervention/procedure is preferable in terms of outcomes?

Recommendation^{16, 123}

Consider an endovascular-first approach in patients with hepatic artery aneurysms/pseudoaneurysms if anatomically feasible (e.g., the presence of anatomic conditions that allow the procedure and/or the possibility of maintaining arterial circulation to the liver).

Conditional recommendation for (level of evidence 2+).

PICO 2.5.3 Clinical question

In patients with extra-hepatic aneurysms/pseudoaneurysms suitable for repair, is it preferable to maintain hepatic arterial circulation over endovascular vessel ligation/closure to avoid hepatic necrosis?

Recommendation^{16, 123-126}

In patients with extra-hepatic aneurysm/pseudoaneurysm, consider preserving hepatic arterial circulation rather than vessel ligation/endovascular occlusion to avoid hepatic necrosis.

Conditional recommendation for (level of evidence 2++).

PICO 2.5.4 Clinical question

In patients with intra-hepatic aneurysms/pseudoaneurysms suitable for repair, is it preferable the endovascular treatment over surgical lobe resection to preserve hepatic function?

Recommendations^{16, 127}

In patients with intra-hepatic aneurysms/pseudoaneurysms consider the endovascular embolization of the affected arterial branch.

Conditional recommendation for (level of evidence 2++).

Consider lobe surgical resection in patients with giant intra-hepatic aneurysms/pseudoaneurysms (involving a whole segment or lobe), in order to avoid possible hepatic necrosis secondary to an endovascular approach.

Conditional recommendation for (level of evidence 2++).

Indications and treatment options: mesenteric arteries aneurysms

PICO 2.6.1 Clinical question

In patients with a mesenteric artery aneurysm/pseudoaneurysm, when is it justified to propose surgical/endovascular treatment compared to medical therapy/follow-up alone to improve the outcomes?

Recommendations¹²⁸⁻¹³⁴

Treatment is recommended for asymptomatic true mesenteric artery aneurysms with a diameter greater than 20 mm.

Strong recommendation for (level of evidence 2+).

Treatment is recommended in an urgent setting for symptomatic true mesenteric artery aneurysms, and in an emergent setting for ruptured true mesenteric artery aneurysms.

Strong recommendation for (level of evidence 2+).

Treatment is recommended regardless of size in case of mycotic and dissecting mesenteric artery aneurysms, as well as pseudoaneurysms.

Strong recommendation for (level of evidence 2+).

PICO 2.6.2 Clinical question

In patients with a mesenteric artery aneurysm/pseudoaneurysm, which intervention/procedure is preferable in terms of outcomes?

Recommendations^{16, 92, 127, 130, 131, 134-143}

When technically feasible, the endovascular intervention is indicated rather than open surgery.

Strong recommendation for (level of evidence 2++).

It is suggested to leave the choice of the specific endovascular technique (bare stent and covered stent, embolization with coils, or combination of both) to be adopted to the discretion of the operator.

Good Practice Point (GPP) recommendation.

It is suggested to consider the use of flow-diverter stents to treat mesenteric artery aneurysms in selected cases.

Good Practice Point (GPP) recommendation.

Open surgery is suggested in case of unfavorable anatomy or failure of endovascular treatment.

Good Practice Point (GPP) recommendation.

In case of open surgery, consider intervention strategies that maintain the patency of the superior mesenteric artery and its branches (graft, bypass, etc.) rather than its ligation.

Conditional recommendation for (level of evidence 3).

Open surgery is suggested in case of mycotic mesenteric artery aneurysms.

Good Practice Point (GPP) recommendation.

Indications and treatment options: jejunal, ileal and colic arteries aneurysms

PICO 2.7.1 Clinical question

In a patient with an aneurysm/pseudoaneurysm of the jejunal, ileal or colic artery, when is surgical/endovascular

treatment indicated *versus* medical therapy or watchful waiting to improve outcome?

Recommendation¹⁴⁴⁻¹⁴⁹

In the patient with aneurysm/pseudoaneurysm of the jejunal, ileal and colic arteries, it is suggested to propose a surgical/endovascular treatment in case of: all cases of colic aneurysms (ruptured, symptomatic and asymptomatic); jejunal or ileal aneurysms if ruptured or symptomatic or with a maximum diameter greater than 2 cm.

Good Practice Point (GPP) recommendation.

PICO 2.7.2 Clinical question

In a patient with an aneurysm/pseudoaneurysm of the jejunal, ileal or colic artery, which intervention/procedure is preferable in terms of outcome?

Recommendation^{144, 146}

In patient with aneurysm/pseudoaneurysm of the jejunal, ileal or colic artery, an endovascular procedure is preferable to the surgical one both in election and in urgency/emergency setting, due to lower invasiveness and fewer immediate complications.

Good Practice Point (GPP) recommendation.

Indications and treatment options: isolated hypogastric artery aneurysms

PICO 2.8.1 Clinical question

In patients with an isolated hypogastric artery aneurysm, when the endovascular/surgical treatment strategy is justifiable, instead of the conservative management/follow-up, to improve the outcomes?

Recommendations¹⁵⁰⁻¹⁷¹

Consider elective surgical/endovascular repair in those patients with asymptomatic isolated hypogastric artery aneurysms and acceptable surgical risk and life expectancy when the diameter is equal to or greater than 3 cm, or in case of demonstrated rapid growth.

Conditional recommendation for (level of evidence 3).

Emergency treatment is suggested in case of ruptured isolated hypogastric artery aneurysms.

Good Practice Point (GPP) recommendation.

Consider emergency treatment in case of symptomatic isolated hypogastric artery aneurysms.

Conditional recommendation for (level of evidence 3).

PICO 2.8.2 Clinical question

Which is the type of intervention/procedure to be preferred for patients with isolated hypogastric artery aneurysms?

Recommendation^{153, 156, 157, 168, 169, 171}

In case of isolated hypogastric artery aneurysm, when it is feasible, the endovascular repair is recommended in both elective and urgent settings as the first option because of its early and mid-term outcomes.

Strong recommendation for (level of evidence 2++).

Medical therapy and follow-up**PICO 3.1 Clinical question**

In patients with visceral or renal artery aneurysms who underwent corrective open/endovascular treatment, is CT angiography/magnetic resonance angiography superior to Doppler ultrasound (DUS) for follow-up surveillance?

Recommendations

In patients who underwent endovascular visceral and/or renal artery aneurysms treatment, it is suggested to perform a control CT angiography within 3 months and subsequently at 12 months from surgery, in order to identify possible endoleaks or sac volume increase that might lead to aneurysm rupture. If no complications develop at 12 months, it is suggested to extend follow-up time interval to 24-36 months.

Good Practice Point (GPP) recommendation.

In patients who underwent open surgical treatment for visceral and/or renal artery aneurysms, it is suggested to perform a control CT angiography within 3 months and subsequently at 12 months from surgery. If no complications develop at 12 months, no further diagnostic exams are deemed necessary.

Good Practice Point (GPP) recommendation.

In order to limit ionizing radiation exposure and iodinated contrast medium use in young patients and in patients with renal insufficiency (grade II-III), it is suggested to evaluate the use of alternative imaging methods, such as Magnetic Resonance angiography, DUS, Contrast-enhanced Ultrasound. In selected cases, non-contrast CT might be used to monitor aneurysm diameters.

Good Practice Point (GPP) recommendation.

PICO 3.2 Clinical question

In patients with visceral or renal artery aneurysms who did not undergo corrective treatment, is CT angiogra-

phy/magnetic resonance angiography superior to Doppler ultrasound (DUS) for aneurysm dimensions surveillance?

Recommendations

In patients with untreated visceral and/or renal artery aneurysms, ultrasound surveillance at 12 months is suggested. If the aneurysm is not adequately assessable through ultrasound, CT angiography/Magnetic Resonance angiography is suggested. In case of demonstrated volumetric stability over time, surveillance at 24-36 months is suggested.

Good Practice Point (GPP) recommendation.

In order to limit ionizing radiation exposure and iodinated contrast medium use in young patients and in patients with renal insufficiency (grade II-III), it is suggested to evaluate the use of alternative imaging methods, such as magnetic resonance angiography, DUS, Contrast-enhanced ultrasound. In selected cases, non-contrast CT might be used to monitor aneurysm diameters.

Good Practice Point (GPP) recommendation.

PICO 3.3 Clinical question

In patients with visceral or renal artery aneurysms who did not undergo corrective treatment, is home medical therapy optimization indicated, compared to no therapy, to improve outcomes?

Recommendations¹⁷²⁻¹⁷⁴

In patients with untreated visceral and/or renal artery aneurysms of atherosclerotic nature, it is suggested to treat modifiable risk factors and optimize medical therapy in accordance with current guidelines on atherosclerosis.

Good Practice Point (GPP) recommendation.

In patients with untreated visceral and/or renal artery aneurysms of non-atherosclerotic non-inflammatory nature (degenerative, connective tissue disorders or congenital diseases), it is suggested to optimize antihypertensive therapy and stop smoking.

Good Practice Point (GPP) recommendation.

In patients with untreated visceral and/or renal artery aneurysms associated with connective tissue disorders, it is suggested to consider antiplatelet therapy.

Good Practice Point (GPP) recommendation.

In patients with an untreated visceral and/or renal artery inflammatory aneurysm, it is suggested the use of steroids and/or immunosuppressants to control inflammatory processes.

Good Practice Point (GPP) recommendation.

PICO 3.4 Clinical question

In patients with visceral or renal artery aneurysms who underwent corrective open/endovascular treatment, is home medical therapy optimization indicated, compared to no therapy, to improve outcomes?

Recommendations¹⁷²⁻¹⁷⁴

In patients who underwent open surgical or endovascular treatment of visceral and/or renal artery aneurysms of atherosclerotic nature, it is suggested to treat modifiable risk factors and optimize medical therapy in accordance with current guidelines on atherosclerosis.

Good Practice Point (GPP) recommendation.

In patients who underwent open surgical or endovascular treatment of visceral and/or renal artery aneurysms of non-atherosclerotic non-inflammatory nature (degenerative, connective tissue disorders or congenital diseases), it is suggested to optimize antihypertensive therapy and stop smoking.

Good Practice Point (GPP) recommendation.

In patients who underwent endovascular treatment of non-atherosclerotic non-inflammatory visceral and/or renal artery aneurysms, it is suggested to evaluate the use of short- or long-term antiplatelet therapy according to the type of device used.

Good Practice Point (GPP) recommendation.

In patients who underwent open surgical or endovascular treatment of visceral and/or renal artery aneurysms associated with connective tissue disorders, it is suggested to consider antiplatelet therapy.

Good Practice Point (GPP) recommendation.

In patients who underwent open surgical or endovascular treatment of visceral and/or renal artery inflammatory aneurysms, it is suggested the use of steroids and/or immunosuppressants to control inflammatory processes.

Good Practice Point (GPP) recommendation.

Discussion

Visceral artery aneurysms represent a relatively rare although clinically relevant pathology, with an incidence in the general population of up to 2%; they present in 22% of cases as clinical emergencies and 8.5% result in death.⁸⁰ We found no RCTs evaluating clinical questions relative to this pathological condition, therefore the present Guidelines rely mostly on case-series, observational studies, and systematic reviews with or without meta-analysis of outcomes. Consequently, the panel did not give a high

strength to most of the proposed recommendations, due to the generally low impact of the level of available evidence.

The accurate process of literature screening and selection made it possible to give 79 recommendations for the management of visceral and renal artery aneurysm disease.

Starting from the diagnosis, it is clear the superiority of CT angiography compared to DUS in terms of accuracy and anatomical characterization for procedural planning, even because the location of the aneurysm/pseudoaneurysm and a hostile abdomen make it often difficult to give appropriate measurements and details. Along with the latter diagnostic tools, it is important as well to mention the possible utilization of magnetic resonance imaging in case of young or chronic kidney disease patients.

It is not rare that a visceral aneurysm presents with concomitant aneurysmatic manifestations elsewhere in the body (4-44% other visceral arteries, 3-27% thoraco-abdominal aorta and iliac arteries, 3-4% intracranial arteries),⁵⁷ even if there is currently no evidence in performing additional imaging studies but an accurate examination of images of the already scanned area. It is otherwise important to perform further screening tests, such as for fibromuscular dysplasia, to assess for underlying conditions which could be the reason for aneurysm manifestation.

Going to the indications, the panel performed separate analyses for each intra-abdominal major arterial district.

The threshold for renal artery aneurysms elective treatment has been set at 3 cm, which is in line with the Society for Vascular Surgery (SVS) Guidelines.³⁹ Current evidence demonstrates that there is no convenience in treating renal aneurysms between 2 and 3 cm because of the slow-growing natural history (0.06 to 0.6 mm per year) and not demonstrated risk of rupture under these dimensions.¹⁷

As concerning aneurysms of the splenic artery, the threshold for elective treatment has been set at 3 cm, which is in line with the SVS Guidelines,³⁹ and slightly higher than the ≥ 25 mm generically proposed by the European Society of Vascular Surgery (ESVS) for all asymptomatic true aneurysms of the visceral arteries;¹⁷⁵ in addition, the panel expressed a conditional recommendation for treatment of splenic artery aneurysms between 2 and 3 cm, reserving surveillance for patients with a low life expectancy or significant comorbidities and demonstrated stability of aneurysm dimensions over time.

The threshold for aneurysm treatment in case of celiac artery, hepatic artery, mesenteric arteries, jejunal and ileal arteries has been set at 2 cm, while colic and gastropancreaticoduodenal arteries aneurysms are recommended to be treated regardless of size. The latter recommendations

agree with the SVS Guidelines,³⁹ except for the mesenteric arteries (regardless of size for the superior mesenteric artery; no specific guideline for the inferior mesenteric artery); the differences between our indications and the SVS ones could lay to the fact that new evidence^{128, 129} arose in the last couple of years after SVS Guidelines publication, which we were able to include in our analyses.

Since it represents another important and crucial intra-abdominal artery and we did not focus on it in previously published Italian Guidelines dealing with aorto-iliac aneurysm disease,⁶ our Guidelines gave recommendations for isolated hypogastric artery aneurysms as well. The treatment threshold has been set at 3 cm, and it has been lowered compared to European ESVS Guidelines on the topic (3.5 cm),¹⁷⁶ according to recently published outcomes of a meta-analysis specifically looking at just isolated hypogastric artery aneurysms.¹⁷¹

Lastly, in accordance with International Guidelines,^{39, 175} the panel agreed on the treatment regardless of dimensions in case of symptomatic, ruptured and rapidly increasing aneurysms, as well as all pseudoaneurysms; it is still debatable whether and at which dimensions it is convenient to treat women of childbearing age, and since the evidence is still not clear the panel suggested to consider treatment under dimensional threshold in case of demonstrated rapid growth.

Referring to treatment options, it emerged that the treatment of all aneurysms of the visceral and renal arteries is essentially achievable, with satisfactory results, both through endovascular solutions and open surgery; the preference between the two must take into account the anatomical feasibility for an endovascular intervention and patients' fitness for open surgery, as well as logistic and multidisciplinary considerations which might direct the treatment strategy.

However, in view of the less invasiveness and fewer complications, endovascular solutions have been confirmed to be the preferred method for the treatment of these aneurysms, and for the same reasons the panel suggested an endovascular-first approach for most of the intra-abdominal arterial districts being addressed.

Concluding the management pathway of visceral and renal artery aneurysm disease, the recommendations suggested for the follow-up and medical therapy of patients both treated (surgically or endovascularly) and not treated (aneurysm surveillance only) were all Good Practice Points (GPP) formulated after panel discussion, since authors were not able to find adequate quality literature on the topic.

Conclusions

These Guidelines are intended to outline the correct management of patients affected by visceral and renal artery disease, according to the most recent and reliable indications provided by the current Literature, selected following strict methodological criteria of scientific research and selection. This review highlighted the need for additional studies in this field, with a more relevant methodology, to address questions which are still open.

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Conflicts of interest

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Authors' contributions

Carlo Pratesi, Davide Esposito, Massimiliano Orso, and Maurizio Cariatì have given substantial contributions to the conception and the design of the manuscript; all authors contributed to acquisition, analysis and interpretation of the data. All authors have participated to drafting the manuscript, Carlo Pratesi and Maurizio Cariatì revised it critically. All authors read and approved the final version of the manuscript.

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History

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Supplementary data

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