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The Vascularization Pattern of the Colon and Surgical Decision in Esophageal Reconstruction with Colon. A Selective SMA and IMA Arteriographic Study

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Rezumat

Pattern-ul de vascularizație al colonului și decizia chirurgicală în reconstrucția esofagiană cu colon - studiu arteriografic selectiv al AMS și AMI

Introducere: Indiferent de tehnica reconstructivă, conceptele de fundamentare din reconstrucția viscerală au ca baza principală suportul vascular necesar pentru grefonul de substituție. Particularitățile vasculare individuale pot înclina sau chiar obliga chirurgul la o anumită opțiune către unul sau altul dintre procedee. De aceea, vascularizația este, fără îndoială, factorul care domină mobilizarea colonului pentru reconstrucția esofagiană.
Material și metodă: Studiul nostru arteriografic și-a propus o investigație asupra tiparului vascular al celor două surse principale ce participă prin vasele emergente la irigarea arterială a colonului: a. mezenterică superioară (AMS) respectiv a. mezenterică inferioară (AMI). Nu am avut în vedere selectarea pacienților după un anumit criteriu după cum nu am realizat nici o excludere dintr-un anumit considerent. Lotul de studiu a constat din 49 de pacienți care s-au prezentat în clinică pentru o tehnică reconstructivă, toți aparținând perioadei 2000-2010. În intervalul 1981-2012, au fost efectuate 187 de tehnici reconstructive pentru o indicație postcaustică. Din totalul de 49 de pacienți, 11 bolnavi suferiseră intervenții chirurgicale abdominale majore iar dintre aceștia, 5 cu tentative nereușite de reconstrucție.
Rezultate: Din cei 49 de pacienți la care s-a efectuat explorarea, arteriografia a evidențiat o situație favorabilă reconstrucției la 31 dintre aceştia. La ceilalți 18 pacienți au fost identificate anomalii ori distribuții atipice, 5 ale AMS respectiv 13 ale AMI. Decizia operatorie a fost ajustată la 22 de bolnavi. Un lucru important de semnalat dpdv predictiv asupra viscerul de mobilizat: nu am avut necroze de grefon la pacienții cu examinare arteriografică preoperatorie.
Concluzii: Dictate de necesitatea unei bune mobilizări, ligaturile arteriale trebuie adaptate şi modificate în funcție de particularitățile de distribuție vasculară, astfel încât să se mențină un flux sangvin suficient în arcada marginală până la nivelul secțiunilor colice şi, implicit, în arterele drepte din vecinătatea acestora.

Cuvinte cheie: reconstrucție esofagiană, grefon colic, suport vascular

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Abstract
Introduction: No matter the reconstructive technique, the fundamental concepts in visceral reconstruction have as

main grounds the mandatory vascular support for the graft replacement. Individual vascular particularities can influence or even oblige the surgeon to choose a certain procedure. This is why the vascularization is beyond doubt the dominant factor in mobilizing the colon for reconstruction.
Material and method: Our arteriographic study entails an investigation upon the vascularization pattern of the two main sources that participate in the arterial irrigation of the colon via the emerging vessels: superior mesenteric artery (SMA) and inferior mesenteric artery (IMA). We did not consider certain patients upon a specific criterion; also, we did not exclude any patients due to various reasons. We took into account 49 patients as study group, all of them having registered into the clinic for a reconstructive technique, throughout the years from 2000 to 2010. From 1981 to 2012 there have been 187 reconstructive techniques performed due to post caustic pathology. From a total of 49 patients, 11 had suffered major abdominal surgeries, 5 of which had had unsuccessful reconstructive attempts.
Results: Out of the 49 patients on whom we have performed the exploration, arteriography showed a favorable situation for reconstruction in 31 of them. In the other 18 patients anomalies or atypical distributions were identified, in 5 of the SMA and in 13 of the IMA, respectively. Operative decision was modified in 22 patients. One important thing to note from the point of view of the segment to be moved: we had no graft necrosis in patients with preoperative arteriographic examination.
Conclusions: Due to the need for good mobilization, arterial ligations should be adjusted and modified depending on the particular vascular distribution, to maintain a sufficient blood flow in the marginal artery, in order to reach the colic sections and the straight arteries near them.
Abbreviations: SMA – superior mesenteric artery; IMA – inferior mesenteric artery; ICa – ileocolic artery; RCa – right colic artery; MCa – middle colic artery; LCa – left colic artery; LC acc.a – left accessory colic artery (or middle left colic artery); ILCa – inferior left colic artery; S trunk – sigmoidian trunk; Sa – sigmoidian artery; SRa – superior rectal artery

Key words: esophageal reconstruction, colic graft, vascular support

Introduction

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Material and Method

Our arteriographic study entails an investigation upon the vascularization pattern of the two main sources that participate in the arterial irrigation of the colon via the emerging vessels: superior mesenteric artery (SMA) and inferior mesenteric artery (IMA). We did not consider certain patients upon a specific criterion; also, we did not exclude any patients due to various reasons. We took into account 49 patients as study group, all of them having registered into the clinic for a reconstructive technique, throughout the years from 2000 to 2010. From 1981 to 2012 there have been 187 reconstructive techniques performed due to post caustic pathology. From a total of 49 patients, 11 had suffered major abdominal surgeries, 5 of which had had unsuccessful reconstructive attempts.

The arteriography technique

The patients were admitted and watched for 24 hrs. The protocol entailed a blood test – a complete blood count and a coagulation profile – and an ECG exam. Sedation was mandatory (Dormicum), local thigh level anesthetic to mark the femoral artery was made with 1% Xiline, 10 ml and mandatory prophylactic antibiotherapy was also administered (Amoxiplus 1.2 g i.v. or equivalent).

As contrasting enhancement, ULTRAVIST, 50 ml sol inj iopromid 0.499 g/m - 1.3 ml/kg body was used, injected progressively via a dosing pump. The average investigation time, from laying the patient on the investigation table and until leaving the radiology unit was of approximately 80 minutes. The patients were monitored in the postoperative unit in order to avoid the occurrence of a hematoma at vascular approach level. We did not have any incidents with the arteriographic examination regarding the medical act itself or the possible appearance of morbidity. This investigation was possible in all the patients tested, therefore no paraclinical failure.

Results

The right colon – arteriographic study

Even though the classical description (1,2) establishes a trident distribution from the SMA: the right angle colic artery, the right colic artery and the ileocolic artery, we have encountered a common celio-mesenteric triangle. Even though the occurrence of a celio-mesenteric triangle (3-5) is rare, we have encountered one case in our group of 49 investigated cases.

The number of the colic arteries varies usually between two (6-9) or three main branches (10-14) and in most cases it depends on the identification of the right colic artery (*Fig. 1*). In our cases we have found the following distributions:

a. Three colic arteries, ICa, RCa, CMa, all of them with origin directly from the SMA (17%);
b. Three colic arteries, out of which the CMa and the ICa with origin from the SMA and the RCa parted as a branch from the ICa (39%) – *Fig. 2A*;
c. Three colic arteries, out of which the CMa and the ICa with origin from the SMA and the RCa parted as a branch of the CMa trunk (10%) - *Fig. 2B*;

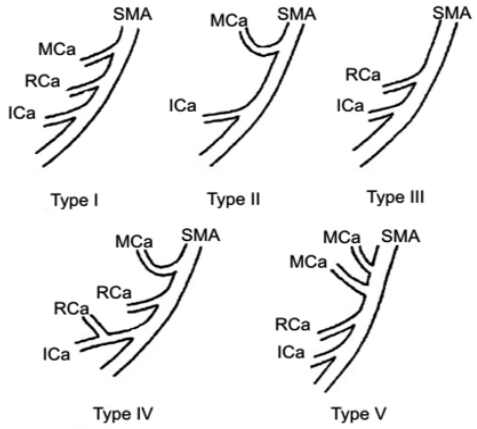

Figure 1. *Schematic layout of colonic vascularisation – straight branches – with origin in SMA*

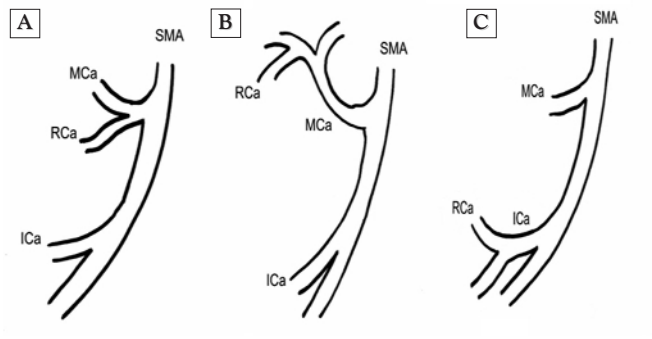

Figure 2. *The main variations of vascular pattern of the right colon: (**A**) MCa, ICa origin in SMA, RCa branch of ICa (39%); (**B**) MCa, ICa origin in SMA, RCa branch of MCa (10%); (**C**) MCa, ICa origin in SMA, RCa from right branch of MCa (22%)*

d. Three colic arteries, out of which the CMa and the ICa with origin from the SMA and the RCa parted as a branch from the right part of the CMa (22%) - *Fig. 2C*;
e. Two colic arteries, the ICa and the CMa, with origin from the SMA (11%);
f. Four colic arteries, the ICa, the RCa, the CMa and an extra right colic artery, classified and catalogued under the name of medium right colic artery (MRCa - 1%). The origin of the MRCa was from the ICa.

We did not identify any adjunct colic arteries; but, if we take into account a possible origin from the auxiliary blood vessel arches, we can report one such case.

We have constantly found the ICa to be bigger or at least as big as the CMa (in over 80% of the cases), the average vascular diameter identified being of 3.24±0.72 mm (extremes 1.99-4.73). Generally we have found it having the origin in the SMA, somewhere between the second and the sixth ileal artery, or, as a more fixed landmark, at the level of the L3 vertebra and in exceptional cases at the level of L4. Normally there are two terminal branches – the ascendant colic branch (named Kopsch or Versari) and the descendant ileal branch (Paturet) – and in some cases a third branch, the right colic branch, which is inconstant. We have only found one case in which the ascendant branch ramifies and spreads through a descendant caecal oriented branch as well. Aside from this typical terminal distribution, we have also identified few other possibilities: a three-split of the ICa trunk, a grouped multi-ramified distribution (Cabanie's "in delta"– *Fig. 3*), composed of two arterial groups that spread through two or more small calibre branches, etc. or even an actual lack of the ICa vascular trunk – *Fig. 4*.

The RCa has a big versatility regarding its origin, topography and termination, with an extremely variable calibre. The average calibre we measured was of 2.49±0.59 mm, with extremes from 1.54 to 3.39 mm. In cases where we discovered the RCa (50% from the patients), we identified the following situations regarding the origin:

a. A branch from the ICa, as the most frequent case (49%). Even though it is a rather frequently described case for the RCa to emerge from a common trunk with the ICa, we have only identified one such situation – *Fig. 5*, for the rest of our cases the RCa being an apparent branch of the ICa – *Fig. 6*;
b. A branch from the SMA (28%) – *Fig. 7*, with origin close to the ICa emerging point, in most cases;
c. A branch from the CMa (23%) or from its right branch – *Fig. 8*.

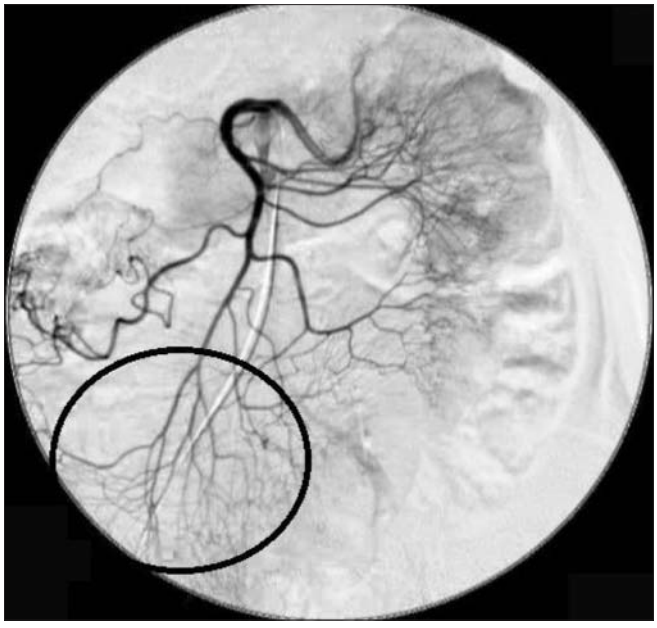

Figure 3. *ICa – with a particular "delta" distribution (Cabanie). Note here an RMCa*

The RCa termination knows the same variability, usually its terminal bifurcation being made through an ascendant branch and a descendant one, with arch aspects. We did not identify the termination via multiple branches, cases in which the arch type connections with over and underlying territories are missing.

It was exceptional for us to encounter the MRCa, in only one case, as it is extremely invariable regarding both existence

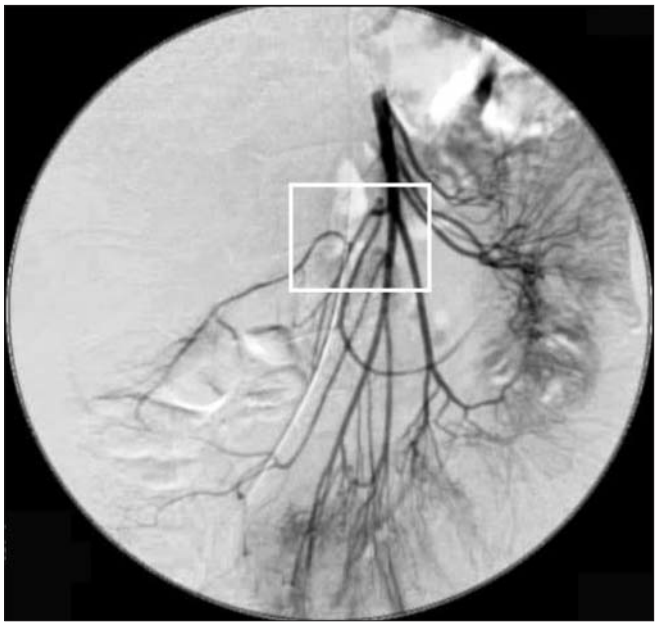

Figure 4. *Note absence of ICa - colic & ileal branches straight from SMA*

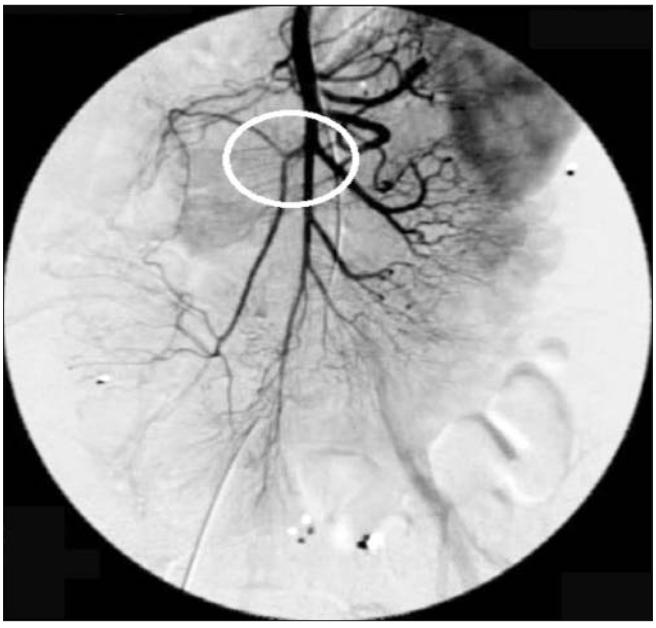

Figure 5. *RCa – common trunk with Ica (image from our clinic collection)*

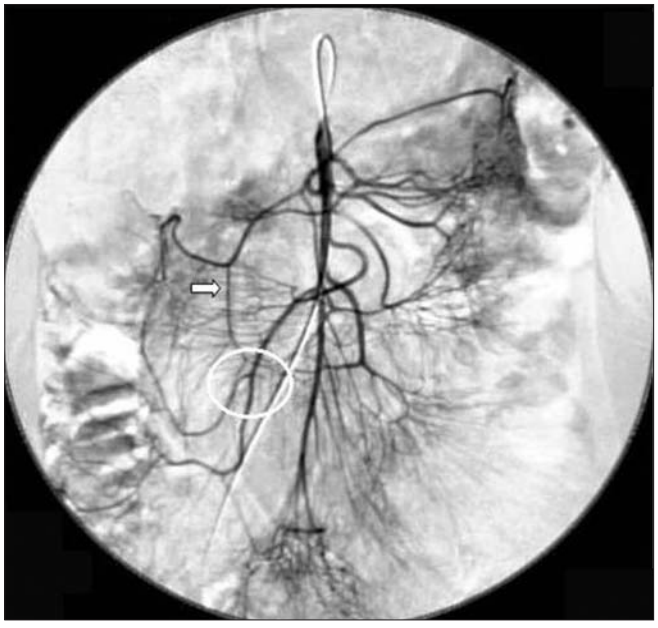

Figure 6. *RCa – branch of ICa. Secondary vascular arcade in addition to marginal*

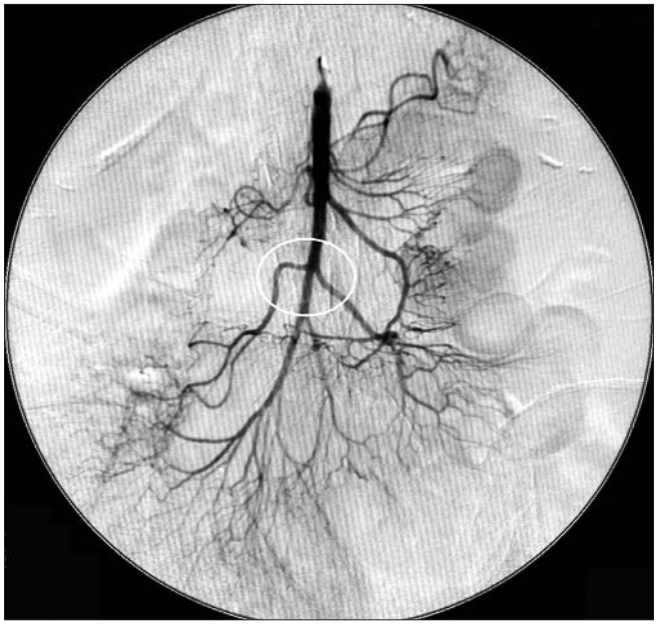

Figure 7. *Origin of RCa straight from SMA, right before origin of Ica*

and origin – the auxiliary colic branch of Hovelacque (15), Testut and Latarjet (16).

We encountered the CMa in over 97% of cases. The determined average arterial calibre was of 2,88±0,36 mm, with extremes from 2.18 to 3.54 mm. The identified origin level of the CMa was little variable, thus we have found it in most cases somewhere in the near vicinity of the duodenal-pancreatic artery, as a first branch of the SMA, similar to the forming level of the first jejunal artery; the exceptions were represented by one case of a common trunk with the RCa (*Fig. 8*), and with the ICa respectively (*Fig. 9*). We have currently identified two terminal branches. The first is a right branch that follows the colic edge towards the right flexure and that forms an anastomosis with the ascendant branch of the ICa or of the RCa. The second is represented by a very constant left branch that most of the times forms a paracolic marginal artery that will connect to the ascendant branch of the LCa. Furthermore, we even noticed, in very rare cases for that matter, the halving of the marginal artery through auxiliary branches (*Fig. 10*), having sometimes even an important calibre, forming secondary arches that contribute to sustaining and facilitating the colic perfusion (it is on this

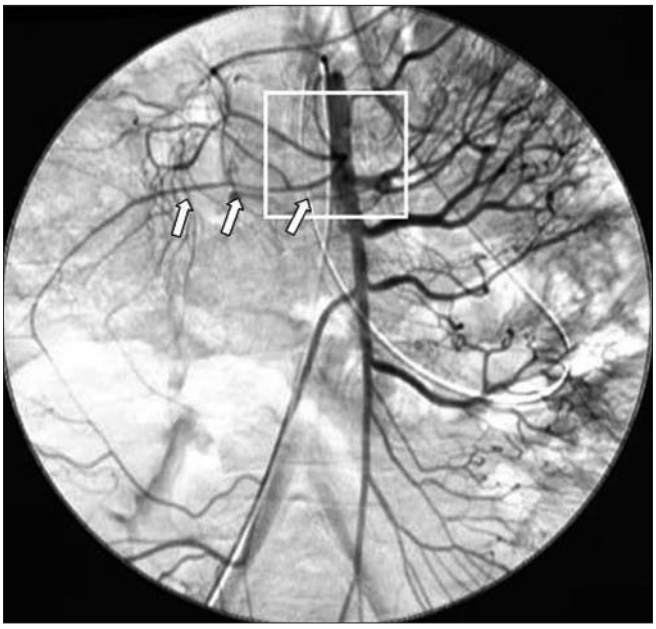

Figure 8. *Origin of RCa from a common trunk with MCa*

Figure 9. *A single colic artery – origin of ICa and Mca*

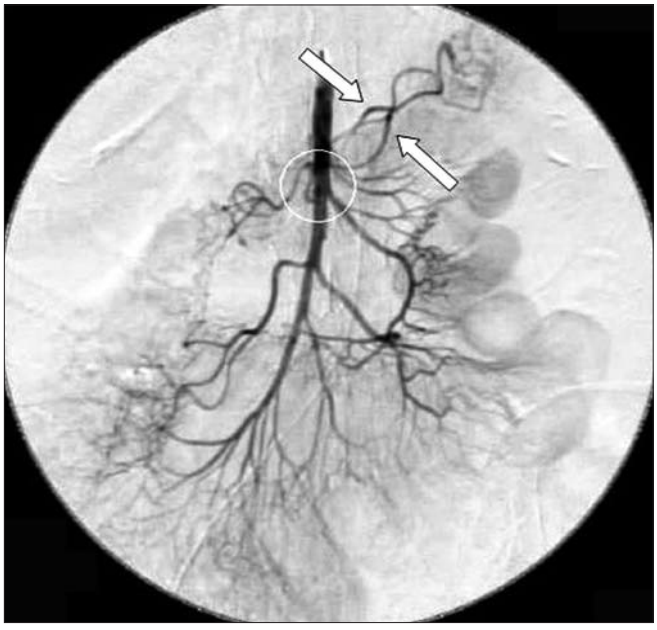

Figure 10. *MCa with doubled branches, especially on left branch*

Figure 11. *A "bridge" type branch between terminal branches of Mca*

behaviour that the left transverse colon with a medium colic pedicle reconstruction technique is based on).

We identified in one of our patients a so-called auxiliary CMa that creates a connection between the two terminal branches of the CMa, the so-called "bridge branches" (17) and this is the equivalent of a II degree secondary arch – *Fig. 11*. We have encountered another interesting case in one of our patients in which the CMa is not formed by emerging from the SMA, and the colic artery detaches straight from the aortic artery, connecting to the maginal artery of the transverse colon – *Fig. 12*.

The left colon – arteriographic study

We suggest a systematization that would help the surgical use:

- type I - distribution through two IMA terminal branches, just one left colic a. and the recto-sigmoid trunk - *Fig. 13*;
- type II - three split of the IMA (Debierre's trident):
  a) three branches of the IMA, namely the left colic a. (LCa), the sigmoid trunk, superior rectal a. (SRa);
  b) one trunk from which all three arteries split as a trident;

Figure 12. *MCa with origin straight from aorta*

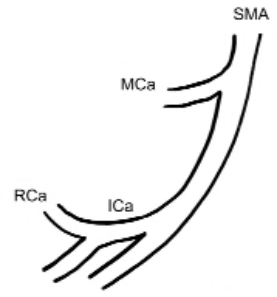

Figure 13. *Schematic layout of IMA distribution, type I*

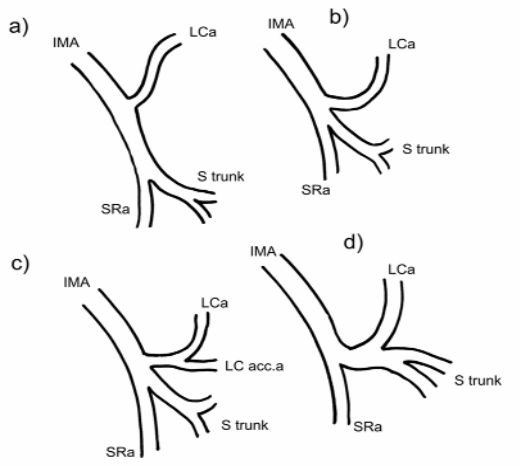

Figure 14. *Schematic layout of IMA trifurcation – types II a,b,c,d*

c) a colic trunk from which the LCa detaches and, eventually, the medium left colic a. (MLCa) as well, or the inferior left colic a. (ILCa), and the sigmoid a. and the SRa are separate branches,
d) a trunk that splits in two forming the LCa and the sigmoid artery (colo-sigmoid trunk) and the SRa is a separate branch – *Fig. 14*.

The arteriographic study we have conducted statistically showed all the patterns of vascular distribution previously classified (*Fig. 15-18*) and, unlike other studies, the most frequent vascular model we have encountered was type II, subtype d (approx 70%) in which the LCa and the sigmoid a. form from the IMA through a common trunk.

In our study group we have encountered the LCa in every patient, with various origins, dispositions and distributions. From a topometry point of view, in most cases the artery originated at L4 vertebra level, eventually L3, usually detached from the IMA at approx 3-5 cm after the IMA emerges from the aorta (from a common trunk with the sigmoids in 70% of the cases, as we already mentioned) and more rarely presented another version (ex straight from the aorta). The calibre of the arterial trunk varied between 1.81-3.3 mm, with an average dimension of 2.3 mm, as for length, the measured average was of 16.8 cm.

In our study we have identified several versions of LCa termination:

a) The "classic" type, with a split of the LCa in two branches (93%) close to the left colic angle: an ascendant branch (called the left superior colic a. or Riolan's (18) "big" colic a.) and a descendant branch (medium left colic a.). The ascendant branch is the most consistent one and we have found it to always participate in the anastomosis with the left branch of th CMa, while the descendant branch is more gracile, descends along the left colon until it anastomoses with the ascendant branch of the first sigmoid a. (or of the ILCa) and forms what Mondor (19) named "the marginal artery of the left colon".
b) The lack of a terminal split of the LCa (3%), which we have only seen once – *Fig. 19*, situation in which the artery continued its ascension and anastomosed directly with the left branch of the CMa. In specialized literature (20) they describe this type as being much more frequent than what we have met;
c) We have encountered halvings of the LCa at the level of the left colic flexure when the arterial arch was placed at a distance from the enteric margin.

The LMCa (approx 50% from patients), comes from the LCa or from a common trunk with the other sigmoids, a situation which we have also met. We did not have any cases in which the LMCa had a different origin. Regarding the calibre of the LMCa, this was quite modest, not going over 1.8 mm and the termination of the artery was made, in all of the cases, through two branches that anastomose in an arch with the over - and the underlying ones (*Fig. 20*). We did not encounter any cases different from this disposition.

The ILCa is not a constant vessel. We can only report one patient in our statistics with a ILCa originating from a common trunk with the LCa.

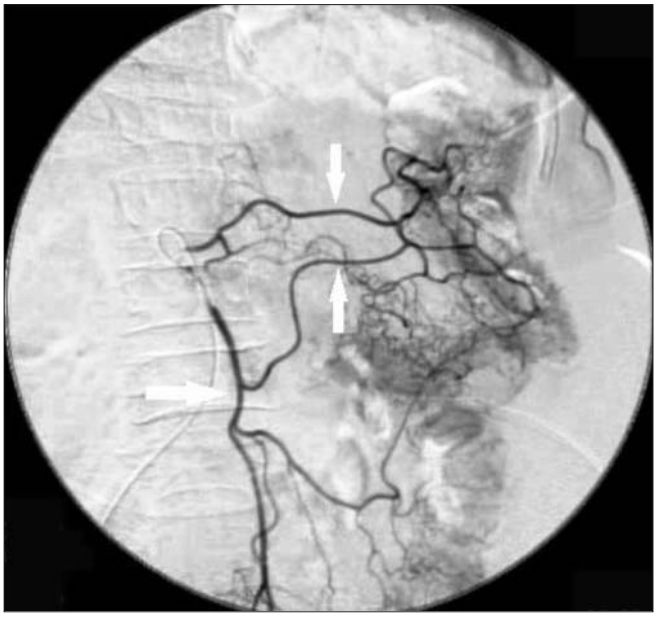

Figure 15. *IMA bifurcation type I: LCa and trunk of SRa and sigmoid arteries*

Figure 16. *IMA bifurcation type IIa: LCa + trunk of sigmoid arteries and SRa*

Figure 17. *IMA distribution type IIb – LCa in a single trunk, sigmoid arteries and SRa*

Figure 18. *IMA distribution type IId – colic-sigmoid trunk + SRa*

The sigmoid a. did not have an explicit purpose in this study except for, probably, the first sigmoid a. The main reason was the fact that the supplementary length offered by the sigmoid is rarely used in the reconstruction with left and transverse colon. In our patients, we have only encountered the versions with the first sigmoid a. originating from the LCa or directly from the IMA, in approximately equal proportions. With an important calibre, around 2-3 mm, the Sa currently ramifies terminally in two branches that would participate in the marginal artery.

The marginal artery

The main characteristic that customizes the colonic vascularization is the presence of the marginal artery (equivalent with the Drummond marginal artery or with the paracolic artery).

In none of our cases have we found a missing initial arch [as others have: Sonneland (21), Michels (22), Steward (23)] even though the French authors notify that such vascular pattern could be missing in case of a "bouquet" type of distribution [H. Cabanie (24,25)]. Plus, though we have never encountered a

Figure 19. *Arteriographic layout of IMA. Note absence of specific bifurcation of LCa (single branch) and anastomosis with left branch of MCa*

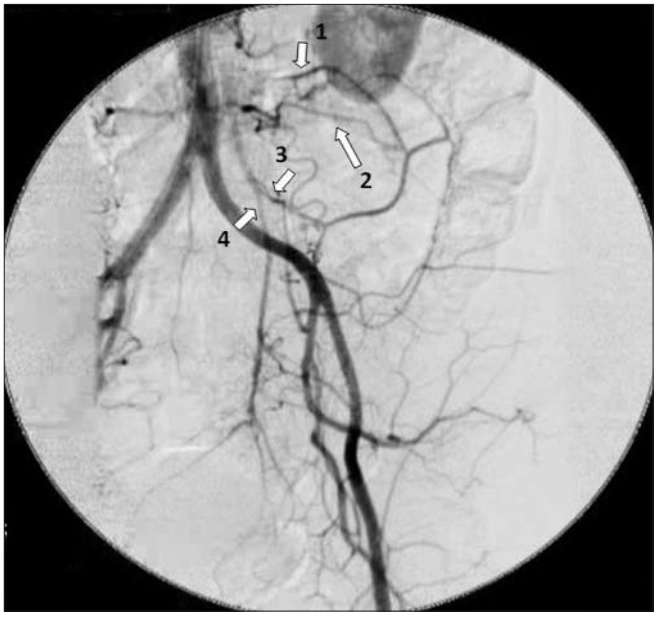

Figure 20. *Arteriographic layout of IMA. Note LCa (1), LMCa (2), sigmoid trunk (3), SRa (4)*

missing right arch, even in a previously presented "bouquet" type of distribution (*Fig. 3*), this can occur in a ratio of 1/13 [Rudler (26)] or even of 1/8 [Mialaret (27). We have mostly found the right arch to be in the proximity of the colic wall, this probably also being the reason why we rarely meet a halving of the arch (II or III degree arch). This presence also explains the inexistence of the avascular zones at the level of the ascending colon, even with an interrupted artery. We only came across the latter – an interrupted artery – in literature, it is described as an unfavorable situation for ileocolic reconstruction.

At ⅓ hepatic level we have encountered only one type of distribution with all our patients: the Drummond juxtacolic marginal artery composed from the right branch of the CMa with a descendant rightward trajectory that anastomoses with the ascendant branch of the ICa or the RCa. Arteriographic, for the left ⅓ of the transverse colon, we have noticed the artery is composed from the anastomosis of the ascendant branch of the LCa and the left branch of the CMa or, when the medium colic is missing, of the RCa.

We have also discovered a particular area at the level of the right colic angle and similarly also at the level of the left one, where, due to the fact that the artery is spaced from the colon, the rather frequent halving of the primary arch can be noticed. The result will be the forming of a series of angular arches – *Fig. 21* – that describe alternative perfusion ways – "bridge branches" (Bertocchi).

The anastomosis (the Haller Riolan arch) is constant, unique, with a convenient calibre. The interruption of the marginal artery in the area of the left flexure of the colon through the connection of the left branch of the CMa with the ascendant branch of the LCa (anastomosis magna Halleri) is known as the Griffith's critical point and was noticed in three cases (*Fig. 22*).

As for the rest, along the left colon, the descendant branch of the LCa will anastomose with the ascendant branch of the first sigmoid a. (or from the ILCa) and will form what Mondor (19) called "the marginal artery of the left colon". With our gathered data, we cannot confirm any other sensitive levels from the point of view of the continuity of the marginal artery (ex Südeck critical point), as we also cannot report any exceptional situations, as would be the absence of the Riolan arch (noticed by Merckel and Lockart-Mummery) or the

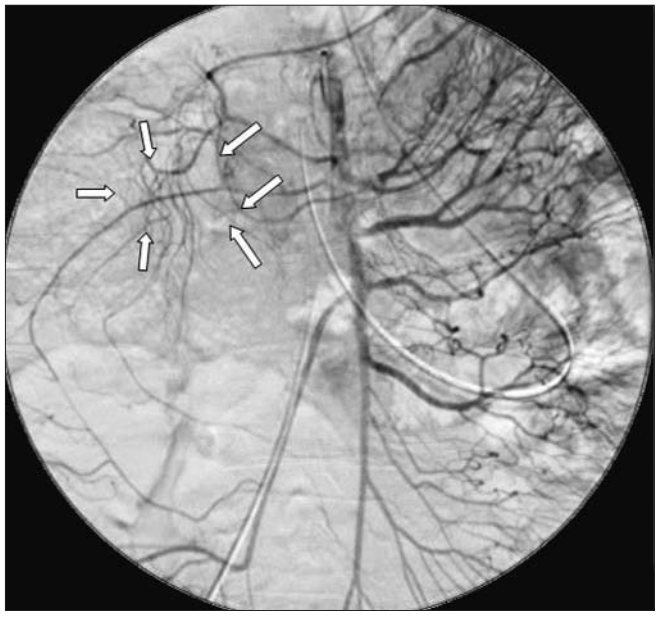

Figure 21. *Arteriographic layout de SMA. Note secondary paracolic vascular arcades between ICa and MCa*

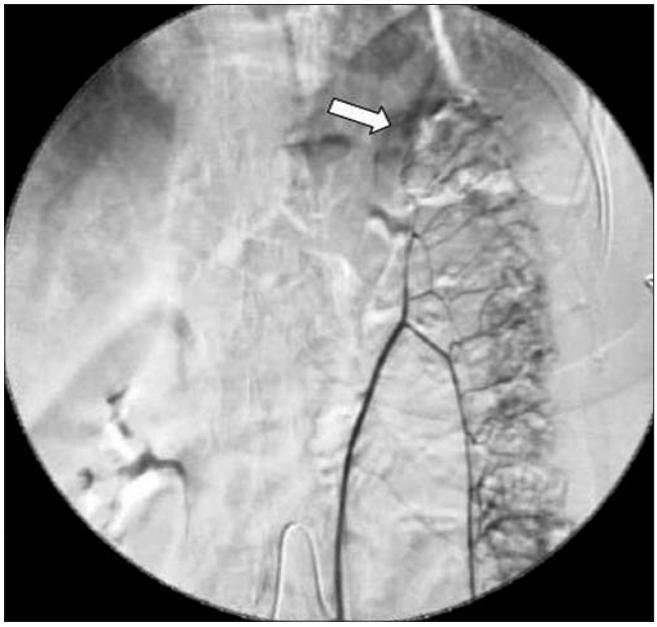

Figure 22. *Arteriographic layout IMA. Note a Griffith point, with interruption of the arcade*

vascular insufficiency of the artery due to its reduced calibre (Steward, Garcia).

Regarding the outcome and the therapeutic decision post-arteriography, we can draw a few conclusions. From the 49 patients who were examined, the arteriography has showed situations in favor of reconstruction for 31. For the remaining 18 patients, we have identified abnormalities or atypical distributions, 5 of which of the SMA and 13 of the IMA. The surgical decision was adjusted for 22 of the patients. From a prediction point of view regarding the viscera to be mobilized, it is important to notice that we had no graft necrosis in patients submitted to arteriographic examination before surgery.

Conclusions

Right colon – arteriographic study

Based on our arteriographic study and some other similar studies, there are many conclusions to be drawn regarding the disposition of the right colon arteries (a colic topographic classification from an embryologic point of view):

The variation of the vascular poles of the right colon and of ¾ from the transverse, the so-called Ist degree arteries or main arteries, is the only constant element in all the vasculo-anatomic and arteriographic studies.

Even though the classic description establishes a trident disposition derived from the SMA: the right angle colic artery, the right colic artery and the ileocolic artery, there can also be a common celio-mesenteric trunk (in this case, the vascular anomaly did not influence the reconstructive decision as the Orsoni technique was preferred). Most often you can identify two colic arteries originating from the SMA and a right colic artery (RCa) emerging from the medium colic artery or from the right branch of the ileocolic artery. But if the left colon cannot be used due to various reasons, then the Roith technique can also be performed, most often due to the substantial modification in distribution of the vascular poles originating from the SMA.

It is duly noted that the ICa and the CMa have been the most constant vessels of the right colon identified arteriographically. We did not encounter nor found in any other studies the version in which the ICa is missing and the vascularization is sustained only by the CMa and the RCa. Even the CMa is present in all of our cases, although we have found studies that note its absence (21,28) or it having abnormal origins.

The most versatile variable artery was the RCa, both as existence and as distribution. If we have observed its presence in 50% of our cases, other studies (11,29) have this percentage as varying from 11 - 75% and regarding its absence, the percentages are quite notable with some authors (30). The most variable existence is reported for the MRCa. We have only encountered it in one patient, originating from the ICa.

The terminal distribution of the colic vessels has a rather similar pattern: the RCa and the CMa split into two branches at a variable distance from the visceral margin, participating in forming the Haller marginal arcade, while the ICa forks particularly for the colon in one branch that anastomoses with the descendant branch of the RCa and one with a branch that comes directly from the SMA.

The ICa is an important arterial branch, relatively constant.

The RCa has a large versatility regarding its origin, topography and termination. The RCa termination has a surgical impact upon the reconstructive technique. When the RCa detaches from the ICa, its terminal split is realized juxta-cecal through an ascendant branch with a wider calibre and a minor descendant one. On the one hand, when the RCa detaches from the SMA, the vessel divides somewhere between the colic flexure and cecum in two branches with arch aspect, and that would form the connection between the ICa infused territory and the CMa one. If the origin is from the CMa trunk, the split will form two calibre branches that arch connect with the ICa and respectively with the CMa, being thus convenient for possibly performing an ileocolic graft. On the other hand, when the origin is from the right branch of the CMa, the calibre is gracile and the artery is poorly competent. Its termination through numerous branches, when the arch type connections with the over and underlying territories are also missing, turns the reconstruction into a hazardous attempt.

We have met the CMa in over 97% of the cases and, given the statistical values of other studies (85 – 95%), we can state that it is a constant artery (17,31,32), that constitutes the main vascular pole of the Riolan intermesenteric artery.

The left colon – arteriographic study

The LCa is the most constant of the left colon vessels and it constitutes the main vascularization source of the ⅓ left transverse colon, splenic flexure, and descendant colon. From

a surgical point of view, between the LCa bifurcation branches and the margin of the colon, there is a determined triangular area that grows bigger as the split of the vessels is made at a closer distance to the origin trunk. We have identified less secondary arches as the bifurcation was closer to the colon, and often even their complete absence; the reciprocity also applies. In this latter case, between the bifurcation branches, connecting branches appear that have a parallel trajectory to the colon ["bridge vessel" (11,33,34)]. The effect is that of "weakening" the blood flow in the marginal artery, especially in the case of an accidental sectioning of a by-pass branch;

With regards to the MLCa, when it exists, we have noticed that whenever the LCa had a considerable length then the MLCa was also present, possibly as a supplementary source of vascular substitute. The ILCa is not constant.

A constant presence of the Sa can be noted, but with great variability regarding the distribution type and the arch forming.

The marginal artery – arteriographic study

From our study and others with the same profile (35,36), there is one thing that is clear: the great variability of the paracolic arches in terms of amplitude, number and shape. While taking the decision for reconstruction, all the colic arches must be analyzed (ascendant, transverse, descendant-sigmoid) from the point of view of the forming modality, distribution and inter-arch connectivity in order to decide upon the colic segment that would be most technically suited. We did not encounter any branching type terminal distribution.

At the level of the right colon and ⅓ of the liver there is almost always a juxtacolic marginal artery formed from the right branch of the CMa with a descendant rightward trajectory that anastomoses with the ascendant branch of the ICa or RCa. The consequence is a simple one – right colon graft availability through a Roith technique. Whenever we identify a vascular pattern with multiple terminal arteries that disappear in the colic wall without forming an arch, we must consider it an ineligible case for this procedure.

On the left side the situation is a bit more nuanced. Aside from the disposition that is considered typical (37), there are some options that, even though exceptional, oblige to the initial identification of the CMa origin, followed by the separate sectioning as close to the origin as possible of the IMA branches that are destined for the left colon. The existence of a CMa branch strictly destined for the left angle or of (2-3) auxiliary medium colic arteries with different origins, one of which possibly originating directly from the IMA, creates difficulties in weighing their importance in the colon vascularization and raises question marks for the perfusion of the colic graft. If technically possible in such a case, the accessory vessel must be preserved as a secondary pedicle (38). Whenever we presumed a critical point in the connection between the SMA and the IMA through the colonic bifurcation branches we have tried to preserve any pedicle in the proximity of the main one in order to increase the vascular flow – *Fig. 23* a and b. Also, identifying a discontinuity in the marginal artery, anywhere between the CMa and the first sigmoid, renders the left reconstruction improper.

Of course, in a retrospective view, there is a series of shortcomings described for the method: rather expensive and inaccessible performance equipment, a pretentious and laborious technique. These are reasons due to which the indication for a selective SMA and IMA arteriographic exam must be weighed attentively and recommended with parsimony (39). At this moment, such exam is mandatory in

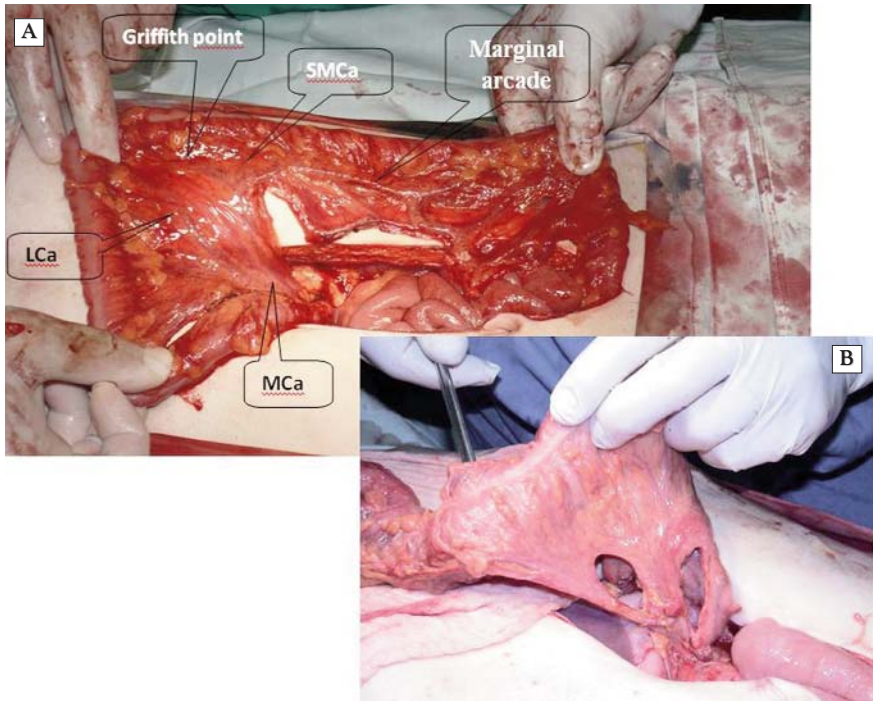

Figure 23. *Intraoperatory images (images from our clinic collection). (**A**) Vascular origins and margi al arcade are highlighted. (**B**) Preserving of a secondary artery from left superior colic artery*

two well shaped situations: for patients with prior major abdominal surgeries and who surely have mobilizations or pedicle ligatures (ex. prior reconstructive failures), or with diagnostic purpose for those who are believed to have a possible pathological involvement of the major vessels, in order to exclude them from a possible reconstructive attempt (ex. aorta a. aneurism, severe atherosclerosis, etc).

Also, we have extended the use of the arteriographic technique to the nourishing pedicle, for the precocious post surgical period. The technique is absolutely new in Romania, being exceptionally used in the western world (40). The main indication was a consequence of the difficult post-surgery evolution of patients with a "critical graft and in the case of which such a behavior was thought to be a consequence of a hypoperfusion with ischemic character.

Finally, for the performing surgeon, the conclusion is an obvious one: the vascular factor represents the essential element for any reconstructive technique as it conditions stretching the visceral material and, together with other factors, the safety of the sutures. Conditioned by the necessity of a good mobilization, the arterial ligatures must be adapted and modified according to the vascular distribution particularities, so that a sufficient blood flow can be maintained in the marginal artery up to the level of the colic sections and, implicitly, in the right arteries from their proximity.

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