

Aortic graft infections: short and long term results of open AGI repair using bovine tailored pericardium graft replacement in correlation with a semi-quantitative PET/CT approach

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Two pending medical doctorates:
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no conflict of interests

Background

- Definition of VGEI infection difficult: MAGIC criteria.
- Incidence of VGEI aorto-iliac: approx. 1-6% of cohort.
 - possibly rising
- wide range of symptoms:
 - asymptomatic
 - enteric/bronchial fistula
 - emergency bleeding
- Surgical decision making difficult

9.2.3. Question 3: Did you think your physician provided enough information on the risks related to the VGEI?

Patients thought that they were not aware of the complexity and seriousness of the situation. The majority of patients did not anticipate the difficulties, the pain, or the tiredness induced by the procedures. They mentioned that they were not aware of the close follow up needed after re-intervention.

Table 5. The MAGIC classification ¹			
Criterion	Clinical/surgical	Radiology	Laboratory
Major	Pus (confirmed by microscopy) around graft or in aneurysm sac at surgery	Perigraft fluid on CT scan \geq 3 months after insertion	Organisms recovered from an explanted graft
	Open wound with exposed graft or communicating sinus	Perigraft gas on CT scan \geq 7 weeks after insertion	Organisms recovered from an intra-operative specimen
	Fistula development, e.g., aorto-enteric or aortobronchial	Increase in perigraft gas volume demonstrated on serial imaging	Organisms recovered from a percutaneous, radiologically guided aspirate of perigraft fluid
	Graft insertion in an infected site, e.g., fistula, mycotic aneurysm, or infected pseudo-aneurysm		
Minor	Localised clinical features of graft infection, e.g., erythema, warmth, swelling, purulent discharge, pain	Other, e.g., suspicious perigraft gas/fluid soft tissue inflammation; aneurysm expansion; pseudo-aneurysm formation: focal bowel wall thickening; discitis/osteomyelitis; suspicious metabolic activity on FDG-PET/CT; radiolabelled leukocyte uptake	Blood culture(s) positive and no apparent source except graft infection
	Fever $\geq 38^{\circ}\text{C}$ with graft infection as most likely cause		Abnormally elevated inflammatory markers with graft infection as most likely cause, e.g., erythrocyte sedimentation rate, C reactive protein, white cell count

Patients and Methods

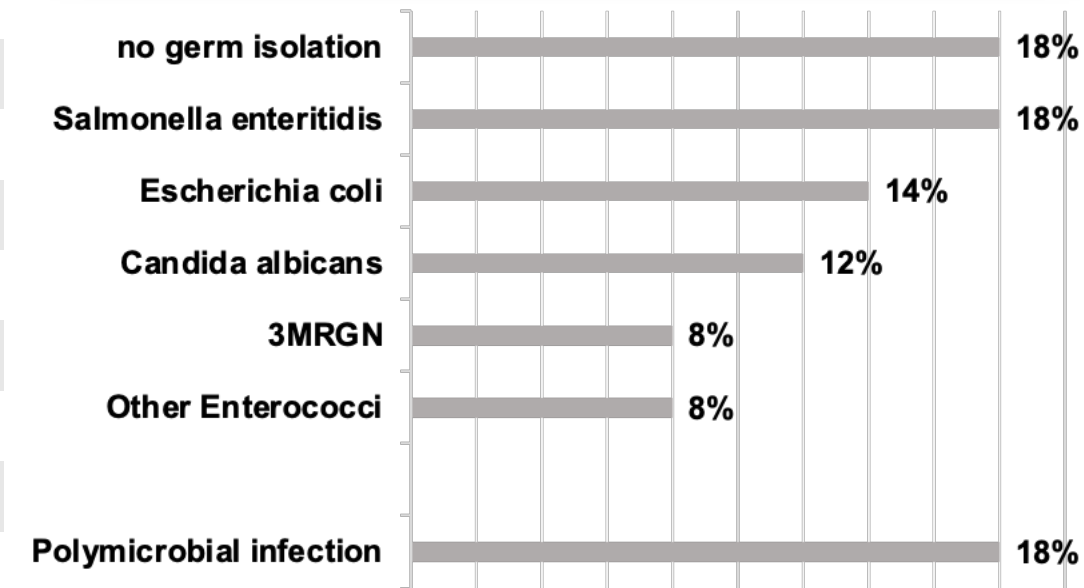
- Two center (tertiary referral) retrospective analysis: 1/2013 – 12/2021 (M) *and* 6/2016 – 12/2021 (DD)
- Prospective registration of all aortic graft infections (operative/*conservative*)
- Data extraction from electronic patient record:
 - preoperative status (fistula, initial operation, etc.)
 - infectious details/antibiotic regime, CDC classification Lyons Criteria;
 - procedure details: type of reconstruction, material, adjunct procedures (bowel reconstruction, etc.)
 - *follow-up*: outpatient check-up in 6 months intervals
- qualitative/quantitative analysis of PET/CT: SUVmax (aorta/graft, liver, mediastinic blood pool), visual grading scale
 - target/background ratio
 - target/liver ratio
- descriptive statistics, eventual univariate analysis
- **Primary endpoints** Mortality (in-hospital, 90 days, 1 year)
- **Secondary endpoints** Technical success, procedural and *follow-up* complications (bleeding, re-infection, etc.)
correlation of preoperative diagnostics with outcome and mortality

Results

	Operative (n=42)	Conservative (n=17)
Men	81%	11%
Age (years; mean)	68 ±10a	78 ± 6a
Initial indication		
AAA/PAU	68%	100%
PAD	32%	-
Initial operation		
open repair	58%	55%
endograft	42%	45%
time to infection (median)	46 mo	48 mo
„early“ infection (< 3 months)	32%	27%
„late“ infection (> 3 months)	68%	73%
clinical presentation		
rate of fistula	18%	9%
emergency procedures	10%	-
B symptoms	60%	55%
SIRS/Sepsis	74%/26%	27%/9%

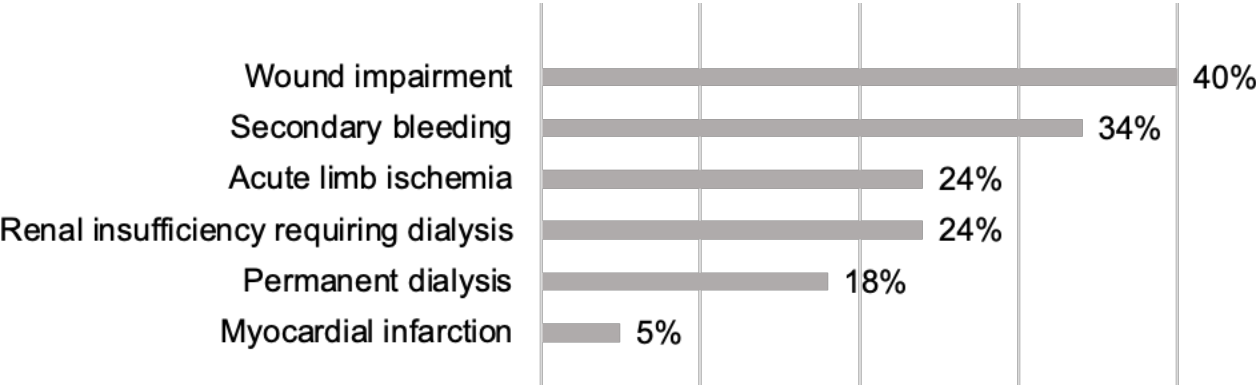
Table 5. The MAGIC classification¹

Criterion	Clinical/surgical	Radiology	Laboratory
Major			
	Pus (confirmed by microscopy) around graft or in aneurysm sac at surgery	Perigraft fluid on CT scan ≥ 3 months after insertion	Organisms recovered from an explanted graft
	Open wound with exposed graft or communicating sinus	Perigraft gas on CT scan ≥ 7 weeks after insertion	Organisms recovered from an intra-operative specimen
	Fistula development, e.g., aorto-enteric or aortobronchial	Increase in perigraft gas volume demonstrated on serial imaging	Organisms recovered from a percutaneous, radiologically guided aspirate of perigraft fluid
	Graft insertion in an infected site, e.g., fistula, mycotic aneurysm, or infected pseudo-aneurysm		
Minor			
	Localised clinical features of graft infection, e.g., erythema, warmth, swelling, purulent discharge, pain	Other, e.g., suspicious perigraft gas/fluid, soft tissue inflammation; aneurysm expansion; pseudo-aneurysm formation; focal bowel wall thickening; osteomyelitis; suspicious metabolic activity on FDG-PET/CT; radiolabelled leukocyte uptake	Blood culture(s) positive and no apparent source except graft infection
	Fever ≥38°C with graft infection as most likely cause		Abnormally elevated inflammatory markers with graft infection as most likely cause, e.g., erythrocyte sedimentation rate, C reactive protein, white cell count

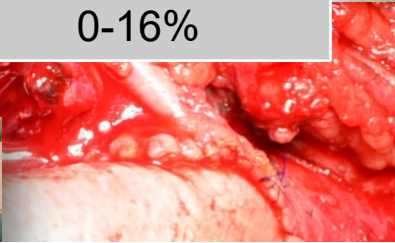


Results

- 100% bovine pericardium - tube/bifurcation 29%/71%
- bowel resection 18%
- renal cold perfusion/HLM 24%/10%
- Procedure time (mean) 8 ± 3h
- Time on ICU (mean) 8 ± 36d
- Time in-hospital (mean) 57 ± 55d
- postoperative course



Material	Re-infection rate
bovine pericardium	0-16%
deep femoral vein	0-6%
cryopreserved allografts	0-7%
Rifampicin-coated allografts	0-18%
Silver-coated allografts	0-16%



Recommendation 39

Recommendation 40

For patients with abdominal aortic vascular graft/endograft infection, cryopreserved allografts, silver coated grafts, rifampicin bonded polyester grafts, or bovine pericardium should be considered as alternative solutions.

Class	Level	References
IIa	C	Batt et al. (2018), ^{17,66}



Results

Mortality	Operative (n=42)	Conservative (n=17)
in-hospital	32%	18%
90 days	35%	27%
1 year	45%	45%
overall	47%	64%
Follow-up (median)	14 mo	12 mo

Material	late mortality	
bovine pericardium	?	
deep femoral vein	26.4%	(0-55) (367)
cryopreserved allografts	36.3%	(3-85) (934)
Rifampicin-coated allografts	22.3%	(0-40) (117)
Silver-coated allografts	17.1%	(0-27) (70)

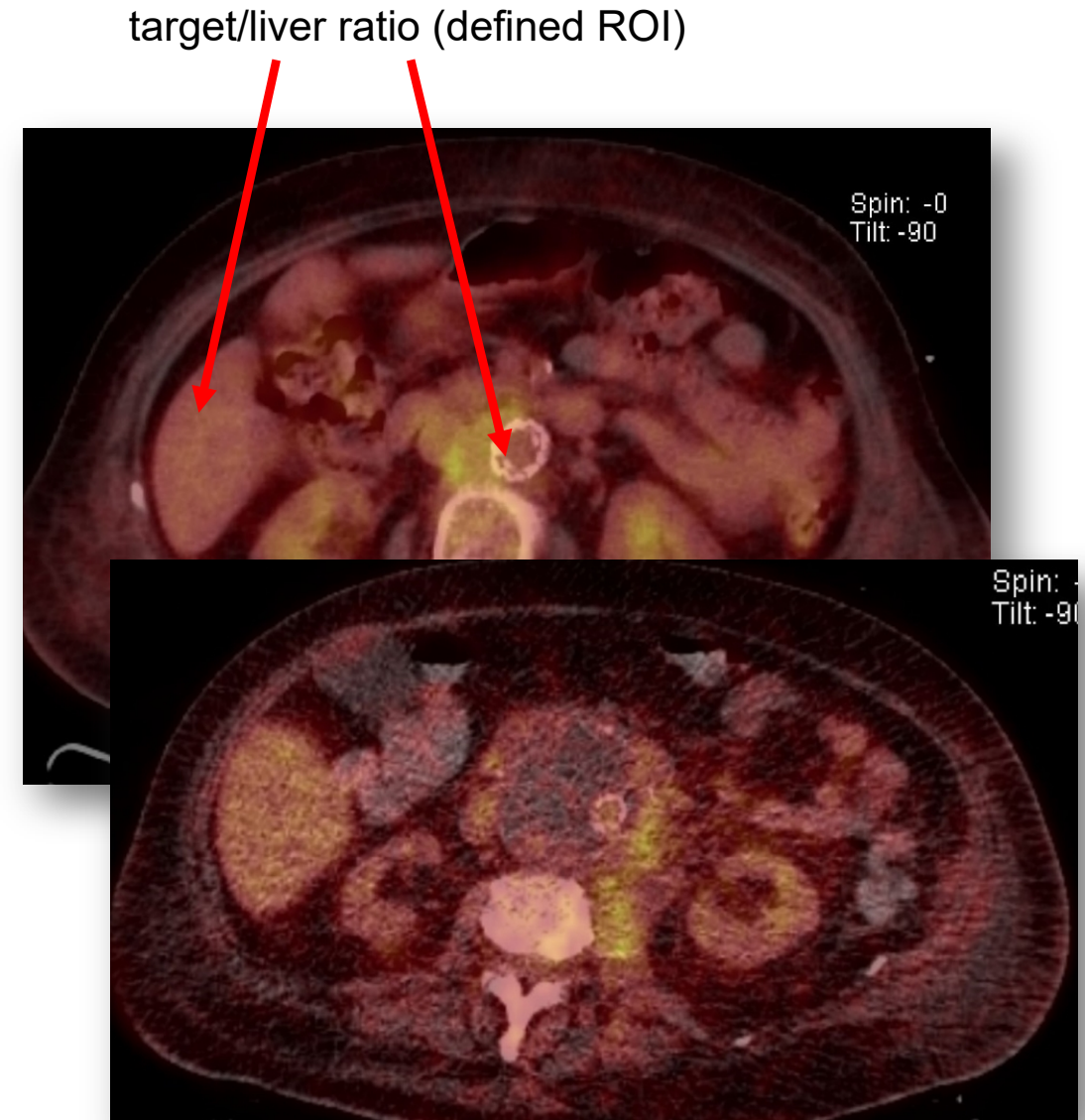
Recommendation 38		
For fit patients with an abdominal aortic vascular graft/ endograft infection, complete excision of all graft material and infected tissue is recommended for definitive treatment.		
Class	Level	References
I	B	Batt <i>et al.</i> (2018), ¹⁷ O'Connor <i>et al.</i> (2006) ¹⁸⁰

Results

- PET/CT available (21 operative, 13 conservative)
- Control group (cancer + EVAR – **no AGI**): 19

- AGI 4.1 ± 2.3
 - EVAR but no AGI. 1.2 ± 0.4
- $p < 0.001$

- AGI: surv > 6 mo 3.6 ± 1.8
 - AGI: surv < 6 mo 4.3 ± 2.5
- $p < 0.18$



Conclusion

- Bovine Pericardium physician made grafts are a technically feasible and reliable in situ reconstruction option.
- Procedures are time and resource intensive.
- Complication and re-intervention rates are high.
- Short- and midterm mortality are high in this specific patient cohort regardless of surgical treatment.
- Material for in situ reconstruction might not be the question at stake.
- Quantitative PET/CT analysis can well discriminate between AGI and no AGI.
- Additional value is yet to be determined.

Thank you very much for your attention !!!

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Acknowledgement

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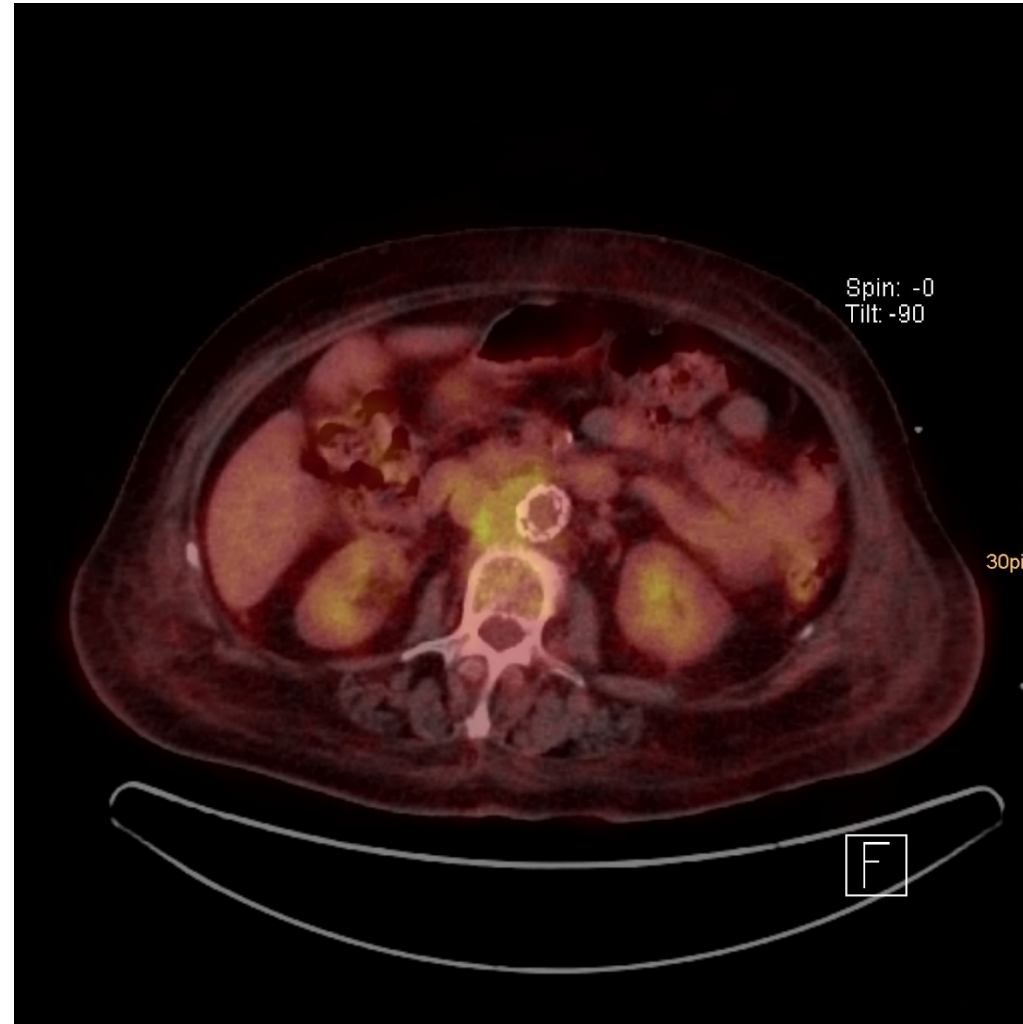
**Department of Nuclear
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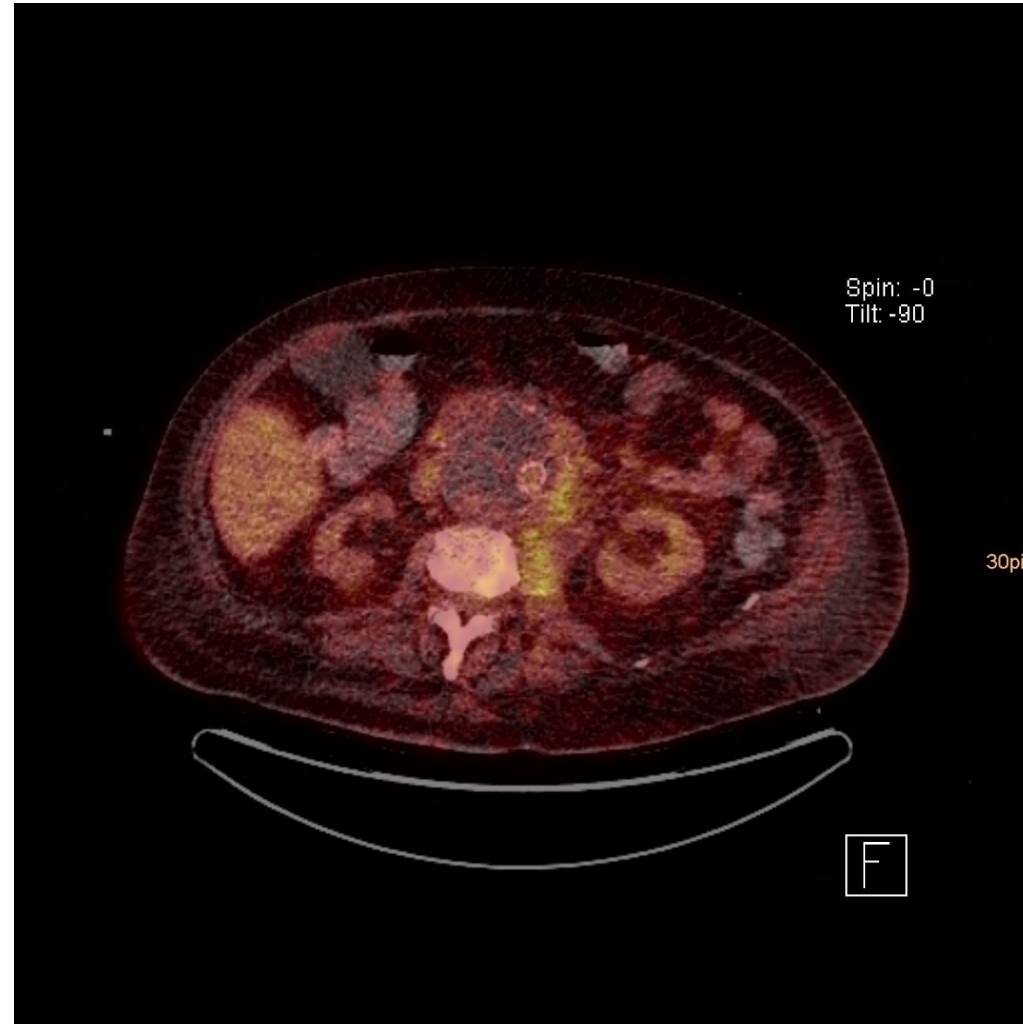
- J Kotzerke

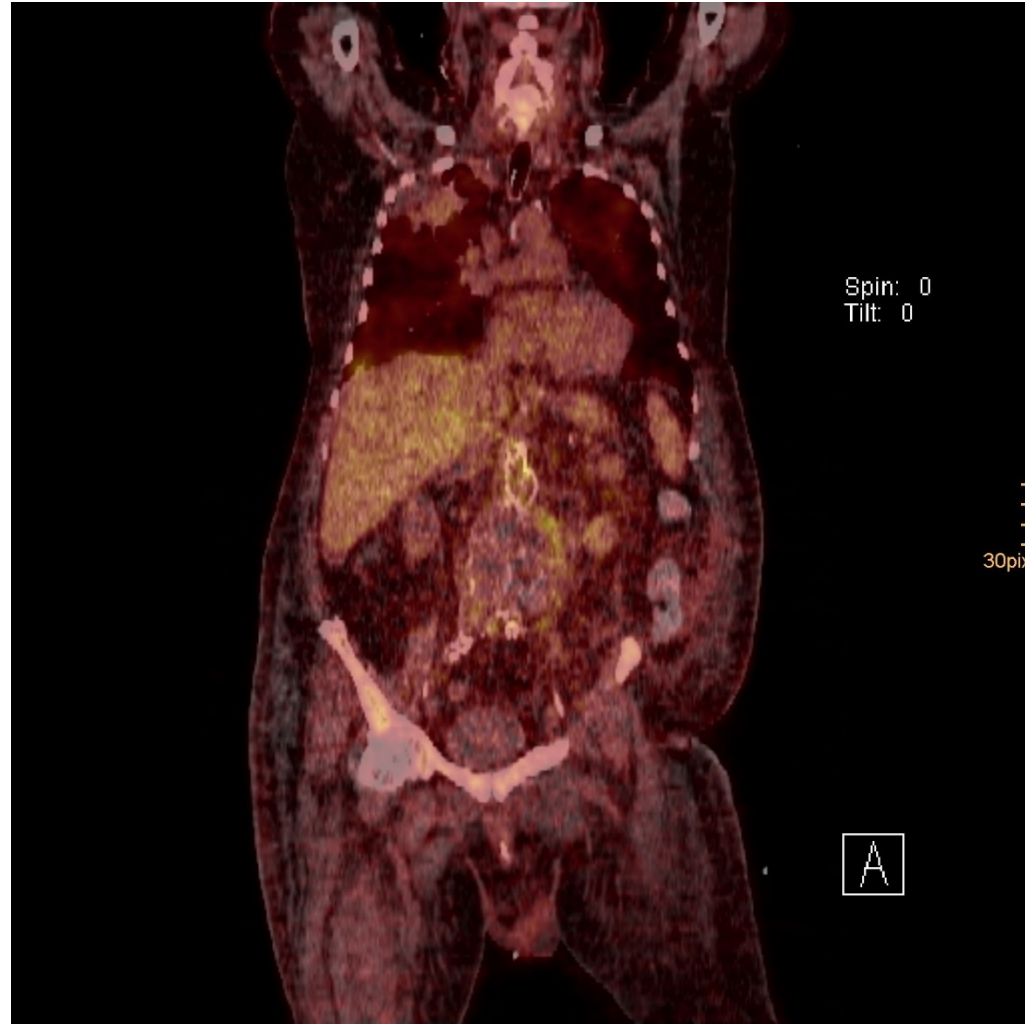
**Division of Vascular and
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- C Reeps
- S Wolk
- S Ludwig
- **J Kröger**









- DD zusätzlich

40 Patienten: 10xTEVAR, 18x ABIL/F, 12xEVAR
 27x Aneurysma, 13x pAVK
 19x Fistel
 21x PET/CT
 5x Perikard, 20x Sibler, 10xVFS

et. Gek. Mula

defined ROI

(forget to background → no too very overlaid zone) → Supplement

forget to line ratio (line differ color codes)

workbooks each

Patient	Aorta			Isokontouring Aorta	Leberuptake			Med. Blutpool/TBR			Focality uptake	VSG
	SUVmax	min	MittW	MittW	SUVmax	min	MittW	SUVmax	min	MittW	description	
1.	16,3	0,1	1,8	4,3	2,7	1,4	2,0	2,2	1,3	1,8	Semizirkumferent, Aortenwand, cutane Fistel, multisegmental, inhomogen	4
2.1.	11,6	0,4	3,0	4,2	3,1	1,6	2,5	2,9	1,1	1,8	Semizirkumferent, Aortenwand, multisegmental, inhomogen	4
2.2.	13	0,3	2,8	4,3	3,6	1,6	2,6	2,9	1	1,8	Semizirkumferent, Aortenwand, multisegmental, inhomogen	4
2.3.	4,5	0,5	4	3	8,3	4,3	6,4	2,5	1,3	1,9	Semizirkumferent, Aortenwand, multisegmental, inhomogen	3
2.4.	4,9	0,5	2	3,1	9	2,8	5,4	1,6	0,6	1	Semizirkumferent, Aortenwand, multisegmental, inhomogen	3
3.1.	20,5	0,7	3,6	5	3,6	1,7	2,8	3,3	1,7	2,5	AMS-Stent, intraluminal, fokal, homogen	4
3.2.	12,6	1	4,5	5,3	4,4	2,3	3,1	3,4	1,9	2,5	AMS-Stent, intraluminal, fokal, homogen	4
4.1.	7,9	0,3	1,8	4	4,9	2,2	3,3	3,3	1,8	2,3	Zirkumferent, Aortenwand, homogen	3
4.2.	9,1	0,3	2,7	4,2	4,6	1,8	3	2,9	1,2	2,1	Zirkumferent, Aortenwand, homogen	4
4.3.	4,6	0,2	2	3	2,9	1,5	2,2	2,2	1,4	1,9	Zirkumferent, Aortenwand, homogen	4
4.4.	11	0,3	3	3,9	3,6	1,4	2,6	3,8	1,5	2,3	Zirkumferent, Aortenwand, homogen	4