

Arterial Duplex of Lower Limb

Purpose

This duplex ultrasound examination is used to assess the arteries of the lower limb from aorta to ankle to determine the location and severity of vascular disease (occlusive and aneurysmal).

The Vascular Lab will accept referrals from the Vascular Surgical Team and for the following appropriate reasons:-

- Plastic Surgery for imaging the crural vessels to help with skin flap formation.
- Transplant surgeons to assess iliac patency prior to kidney transplant.
- Cardiac surgery for assessment of iliac arteries for patient that may require cardiac access from the groin.
- Diabetic team for foot ulcers and absent foot pulses.

Common Indications

Indications for a lower limb arterial duplex ultrasound include:

- Intermittent claudication
- Ischaemia rest pain
- Gangrene
- Ulceration
- Follow-up imaging post-angioplasty/thrombolysis (+/- stent) or post-surgery (embolectomy, endarterectomy, bypass graft).
- Evaluation of aneurysm, pseudo aneurysm

Contraindications and limitations

There are very few contraindications for lower limb arterial duplex imaging; however the following limitations may affect the scan quality and completeness.

- Patient immobility – e.g. fixed flexion deformity, inability to move lower limb.
- Arterial calcification, particularly of the crural vessels
- Patient habitus and bowel gas may limit the successful imaging of the aorta and iliac vessels.
- Ulcers, casts, dressings, wounds etc. may affect the ability to image certain areas.

Patient positioning

The patient should remove lower limb clothing to expose the leg from the groin to the ankle. The examination is performed supine with the leg externally rotated; the patient's position may need to be altered to obtain adequate views of the popliteal artery.

Procedure

The examination can be of one limb or both depending in the patients symptoms. The scan should generally start at the level of the common femoral artery (CFA) and the arteries should be imaged from groin to the ankle. |

If triphasic waveforms were not obtained from the CFA, or there is an increased rise time/acceleration time, >100ms, (Oates, 2001), or there is clinical suspicion of aorto-iliac disease then the aorta, common iliac (CIA) and external iliac artery (EIA) should also be investigated.

Young patients and patients with distal occlusive disease may have triphasic flow in CFA in the presence of iliac disease (Sensier et al, 1998) and the iliac segments may need to be examined in this group of patient.

If there is disease in the CIA/EIA or CFA then the contralateral CFA +/- CIA and EIA should be accessed to determine patency for radiological access.

If both anterior tibial (AT) and posterior tibial (PT) vessels are patent it is not usually necessary to access the peroneal vessel as well.

Interpretation and grading of the disease

All segments should be imaged in order to determine the patency, stenosis, presence of disease and aneurismal dilatations with a view to producing a site-specific, representative map.

Velocities and phasicity of waveforms should be recorded at various points along the arterial tree, specifically CFA, profunda femoris (PFA) origin, superficial femoral (SFA) origin and distally, popliteal artery (PopA) distally, AT and PT distally. For areas of stenosis the highest velocity through the stenosis and the velocity approximately 2cm proximal to the stenosis should be recorded. Stenosis should be graded using the following velocities ratios:

Velocity Ratio	Diameter reduction
<2	0 – 49%
>2	50 – 74%
>4	75 – 99%
No flow detected	Occluded

Reporting of the results

The report should be recorded on an arterial duplex form. Flow velocities and the phasicity of the waveform, together with the location and degree of stenosis/occlusions should be recorded on the diagram. The length of occlusions and diameter of occluded vessels should also be included to help in treatment planning. The diameters of arteries if abnormal (larger or smaller than average diameters) should also be included.

The written report should describe the findings; giving site of and reasons for any sub-optimal areas of the scan, or vessels not imaged.

References

Oates, C: Cardiovascular Haemodynamics and Doppler Waveforms Explained. 2001 Greenwich Medical Media Ltd

Kohler TR, Nance DR, Cramer MM, Vandenburghe N, Strandness DE: Duplex scanning for diagnosis of aortoiliac and femoropopliteal disease. A prospective study. Circulation 76:1074-1080 (1987).

Sensier, Y, Bell, P, London, N, (1998) 'The ability of qualitative assessment of the common femoral doppler waveform to screen for significant aortoiliac disease.' European Journal of Vascular and Endovascular Surgery. 15(4): 357-64.

Resources

Society for Vascular Ultrasound Vascular Technology Professional Performance Guidelines Lower Limb Extremity Venous Duplex Evaluation 2011 www.svunet.org

American Institute of Ultrasound in Medicine Practice Guideline for the Performance of Peripheral Venous Ultrasound Examinations 2010 www.aium.org

Australasian Society for Ultrasound in Medicine Policies and Statements D20 Peripheral Venous Ultrasound 2007 www.asum.com.au

3-MONTH FEM-POP BYPASS
GRAFT

CFA: No significant atheroma noted, triphasic waveform.

PROFA: Patent proximally, triphasic waveform.

GRAFT:

Proximal anastomosis: Patent, triphasic waveform.

Graft body: 75% stenosis at the level of the distal thigh (prev. >50% Oct 2023).

Distal anastomosis: Elevated PSV consistent with 75% stenosis.

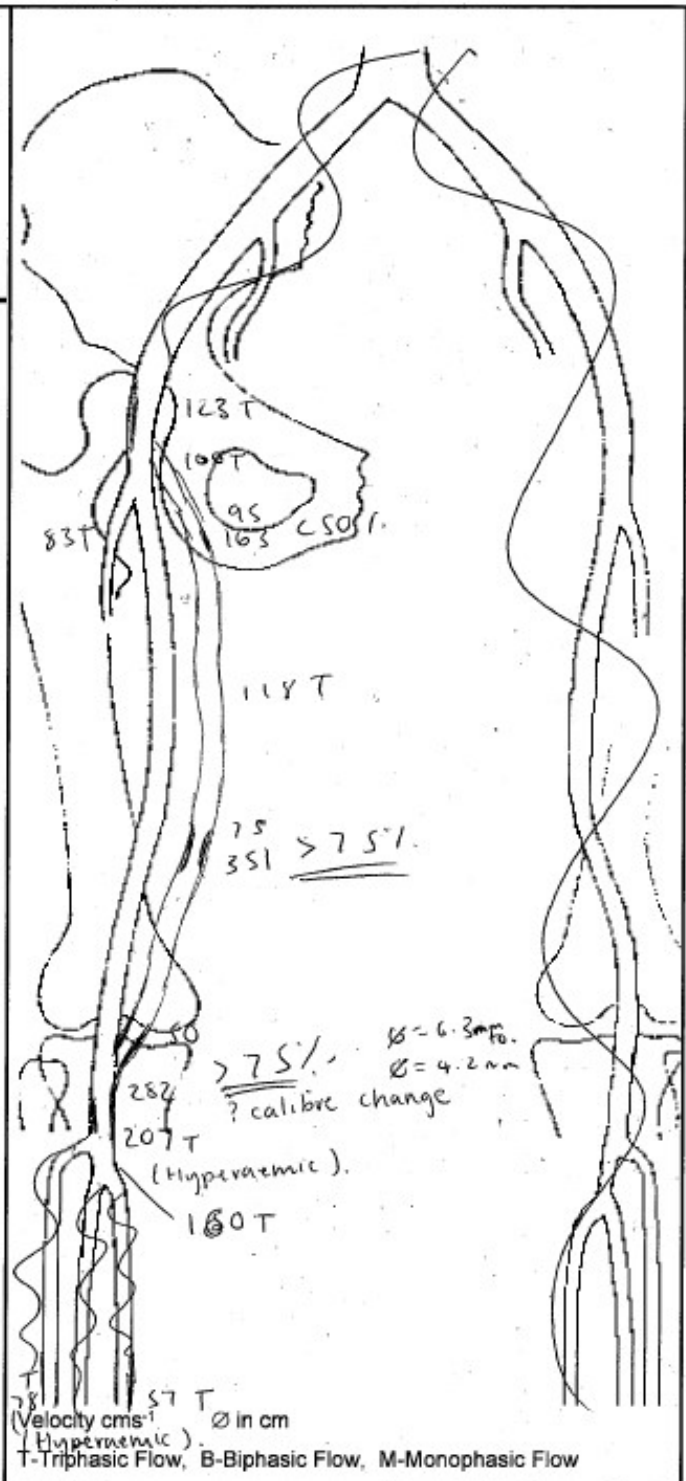
POPA + TPT: Patent, calcified atheroma noted (<50%) Triphasic, hyperaemic waveform.

Distal PTA: Patent, triphasic wave forms

Distal ATA: Patent, triphasic, hyperaemic waveform.

D. Arable informed of findings (Sfr) - to be reviewed in MDT.

A. Moley BSc



Consultant: DAS

Date: 07.12.2023

RIGHT LOWER LIMB ARTERIAL

CFA: mild atheroma noted, triphasic wave forms.

SFA: Calcified walls noted throughout resulting in ultrasound drop out. >50% stenosis in the mid vessel. Distal vessel patent where seen.

POPA, TPT, ATA + PTA: Patent where seen bi/triphasic wave forms.

LEFT LOWER LIMB ARTERIAL

CFA: mild atheroma noted, triphasic wave forms.

SFA: Calcified walls noted throughout. >75% stenosis proximally. >50% stenosis in the mid vessel. ? occluded segment in mid - distal vessel.

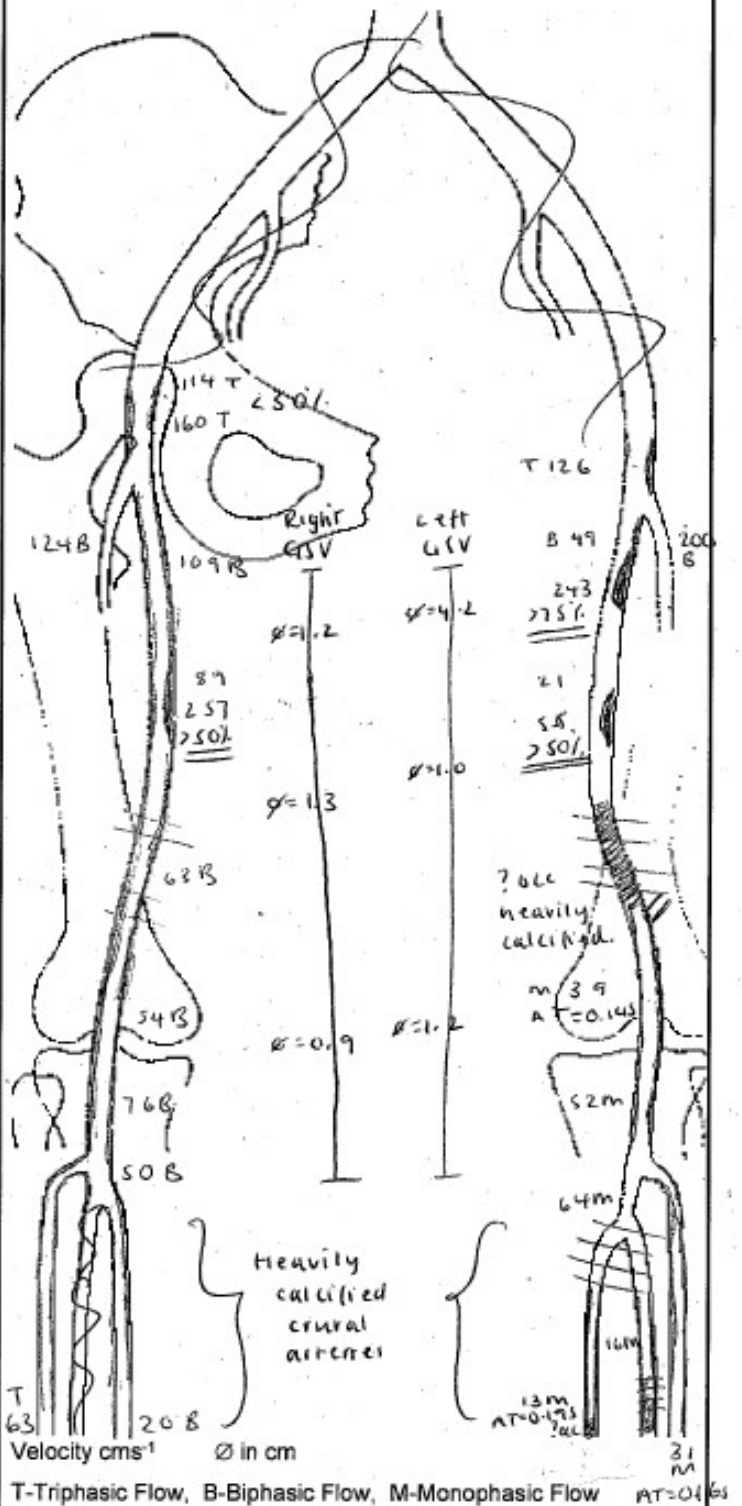
POPA + TPT: Patent, damped monophasic waveforms.

ATA: Patent along length.

PTA: Unable to visualize proximally, patent where seen until ? occluding distally.

PERON: Unable to visualize proximally. ? occluded distally.

GSV mapped bilaterally - small calibre.



A. M. M. B.

Consultant: SLK

Date: 14.12.2023

RIGHT LOWER LIMB

CFA: Patent, triphasic waveforms.

SFA: 2 focal >50% mid vessel stenoses.

PPA: Patent, biphasic.

NTA: poorly visualised. ? occluded in the prox-mid vessel.

PTA: appears occluded from origin. unable to visualise distally.

PERNA: Patent.

LEFT LOWER LIMB

CFA: Patent, triphasic

SFA: >50% mid vessel stenosis.

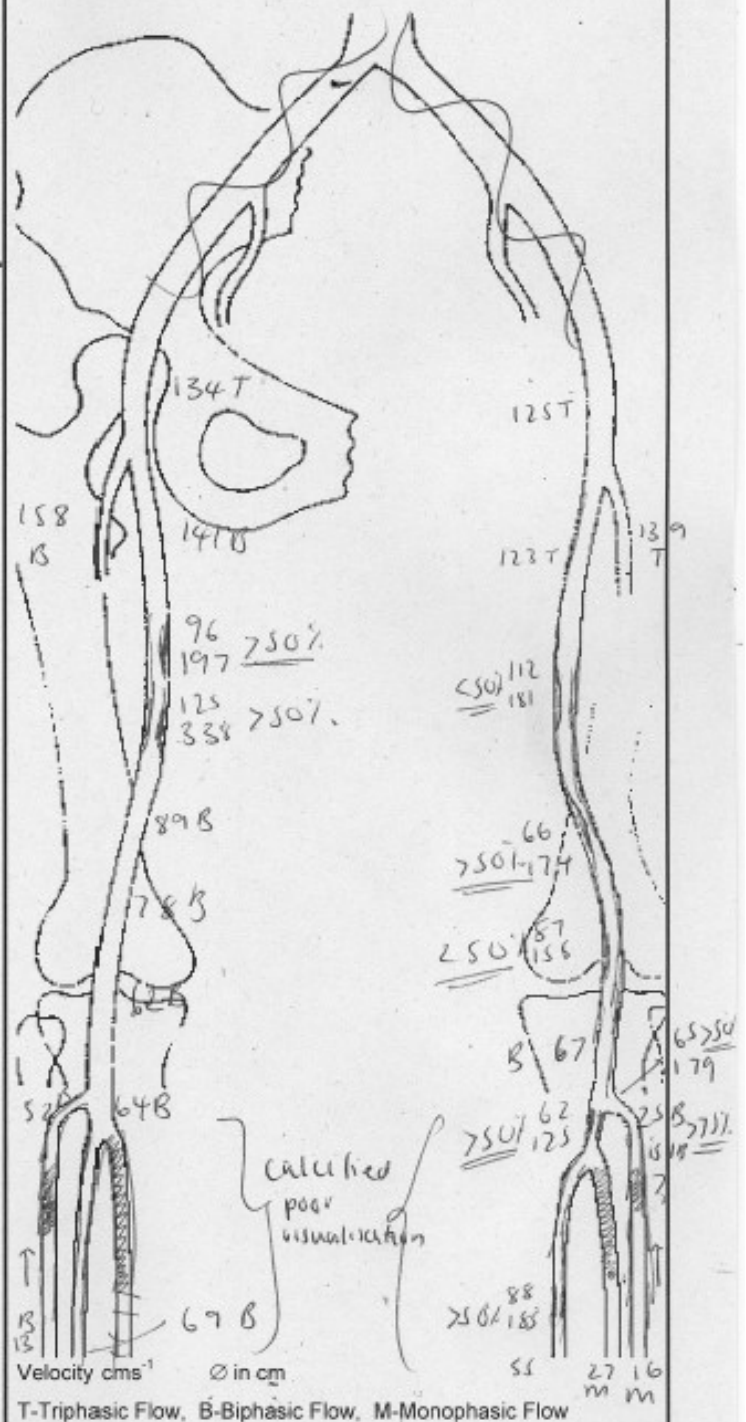
PPA: Patent, biphasic.

TPT: >50% stenosis.

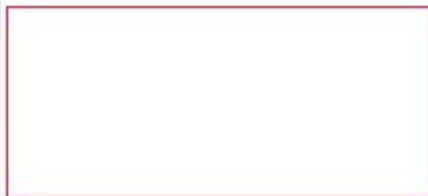
ATA: 1x >50% + 1x 75% stenosis proximally. ? prox-mid occlusion.

PTA: >50% distal stenosis.

PERNA: occluded from origin to mid vessel.



Amalsh



Consultant: DAS

Date: 27.11.2023

RIGHT FEM-MID ATA
GRAFT:

CFA: Triphasic waveforms,
parent ($\phi = 15\text{mm}$).

Graft

Proximal anastomosis: Elevated
PSV noted consistent with
> 50% stenosis however,
calibre change noted, $\phi = 15\text{mm}$
to $\phi = 3.9\text{mm}$.

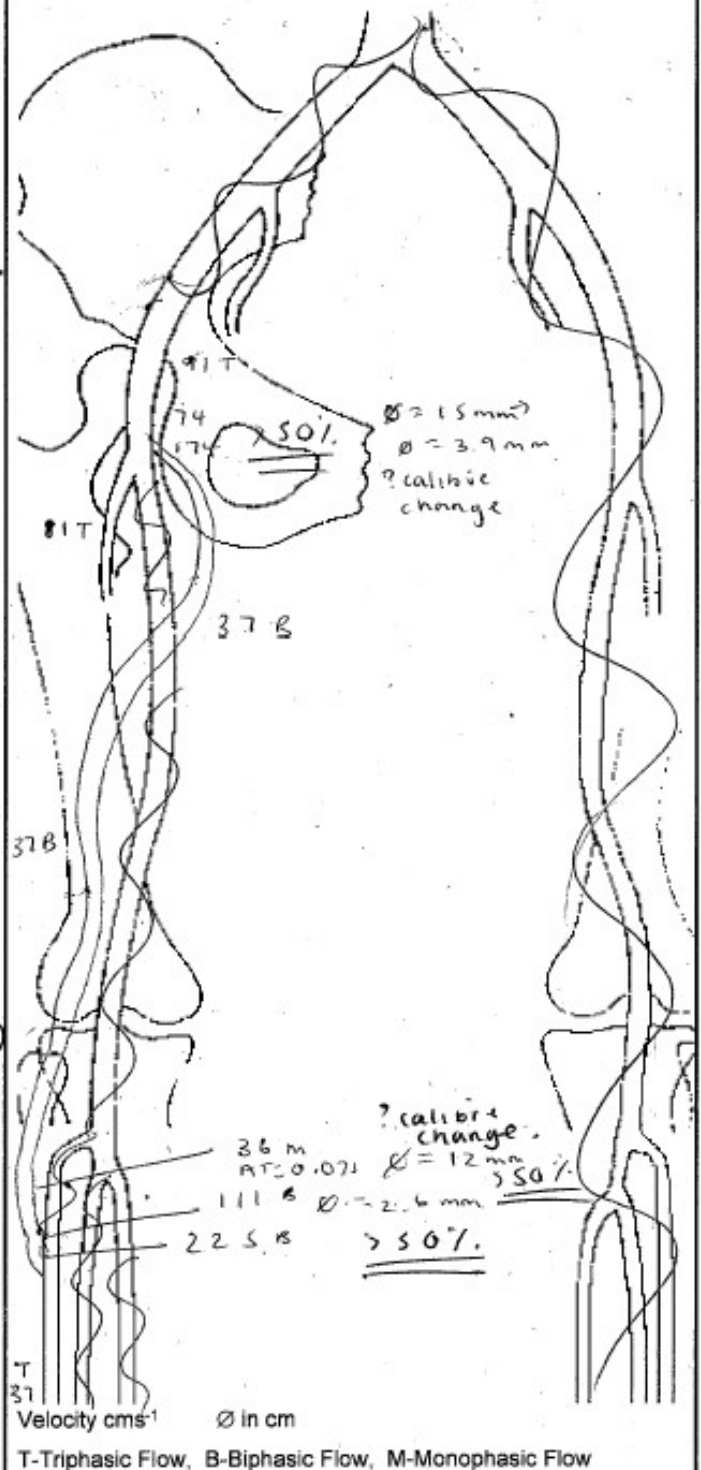
Graft body: Biphasic waveforms
throughout however, reduced
PSV noted ($< 40\text{cm/s}$).

Distal anastomosis: There are 2
areas of elevated PSV, the
first appears to be due to
calibre change ($12\text{mm} \rightarrow 2.6\text{mm}$).
The 2nd may be due to atheroma
consistent with a > 50% stenosis.

ATA: Patent from the mid-
distal vessel.

Pl. reviewed by D. Avadbe (SpR) to
be discussed at MDT.

A. Moly B.



Consultant: SLK

Date: 01.12.2023

RIGHT LOWER LIMB ARTERIAL

Aorta: Patent, normal and uniform calibre. Biphasic waveforms.

LTA: Patent, pulsatile monophasic waveforms.

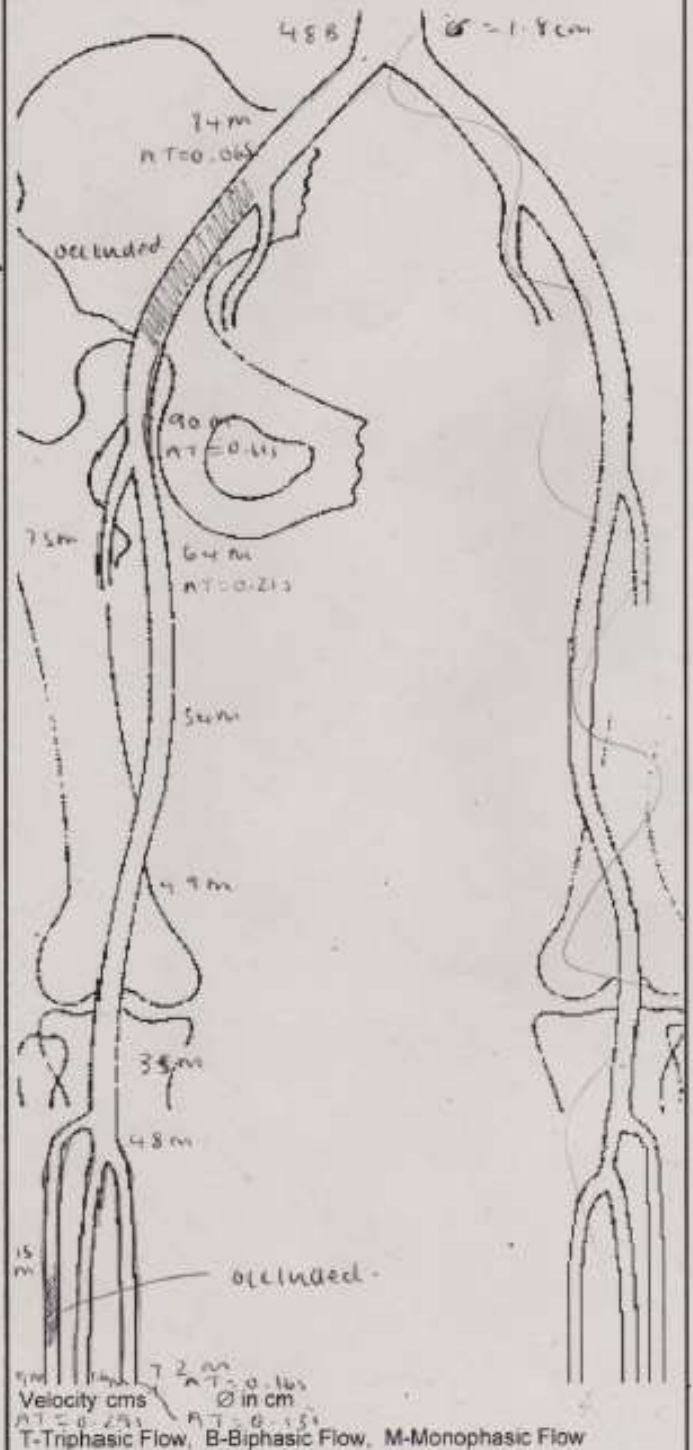
EIA: occluded throughout.

CPA: Flow reforms proximally, mild atheroma on the posterior wall. Damped monophasic waveforms.

SFA - TPT: Patent, damped monophasic waveforms.

PTA/PEROA: Patent, damped monophasic waveforms distally.

ATA: mid-distal vessel occlusion.



A. DAWSON-BROWN

T-Triphasic Flow, B-Biphasic Flow, M-Monophasic Flow

Consultant: SLK

Date: 11.12.2023.

RIGHT LOWER LIMB- DISTAL FEM-DISTAL POP GRAFT

CFA- MID SFA: Patent with no significant atheroma noted, triphasic waveforms throughout.

GRAFT: Arises from the distal SFA. Patent with no significant atheroma noted, triphasic waveforms throughout.

ATA and PTA: Patent distally with no significant atheroma noted, triphasic waveforms.

LEFT LOWER LIMB DISTAL FEM-DISTAL POP GRAFT

CFA-MID SFA: Patent with no significant atheroma noted, triphasic waveforms throughout.

GRAFT:

Proximal anastomosis: Elevated PSV noted, consistent with a >75% stenosis however, no obvious atheroma demonstrated ?due to calibre change, diameter decreasing from 12mm to 5.9mm.

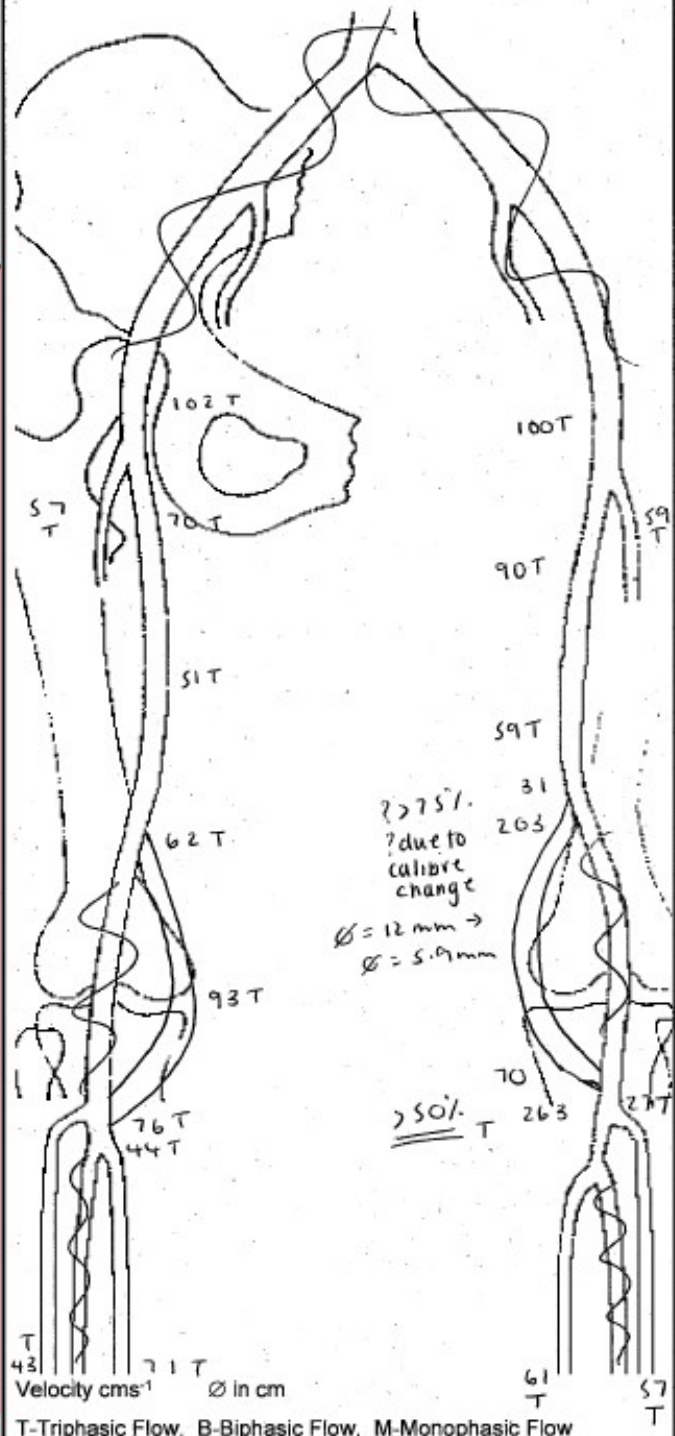
Graft body: Patent, triphasic waveforms.

Distal anastomosis: Difficult to clearly visualise due to vessel depth and angulation however, elevated PSV noted, consistent with a >50% stenosis, colour filling defects noted suggestive of atheroma present.

ATA and PTA: Patent distally with no significant atheroma noted, triphasic waveforms.

Pt. discussed with A.Duncan (vascular consultant) before patient left the vascular lab.

?follow up ?intervals



A. Malyk

Consultant: TMB

Date: 28.11.2023

RIGHT FEM - MID ATA
BYPASS GRAFT.

(FA: >50% stenosis
in the mid vessel. ?dissection
in the distal vessel.

GRAFT:

Appears patent for a short
segment proximally, via a
narrow channel before
occluding until the distal
anastomosis.

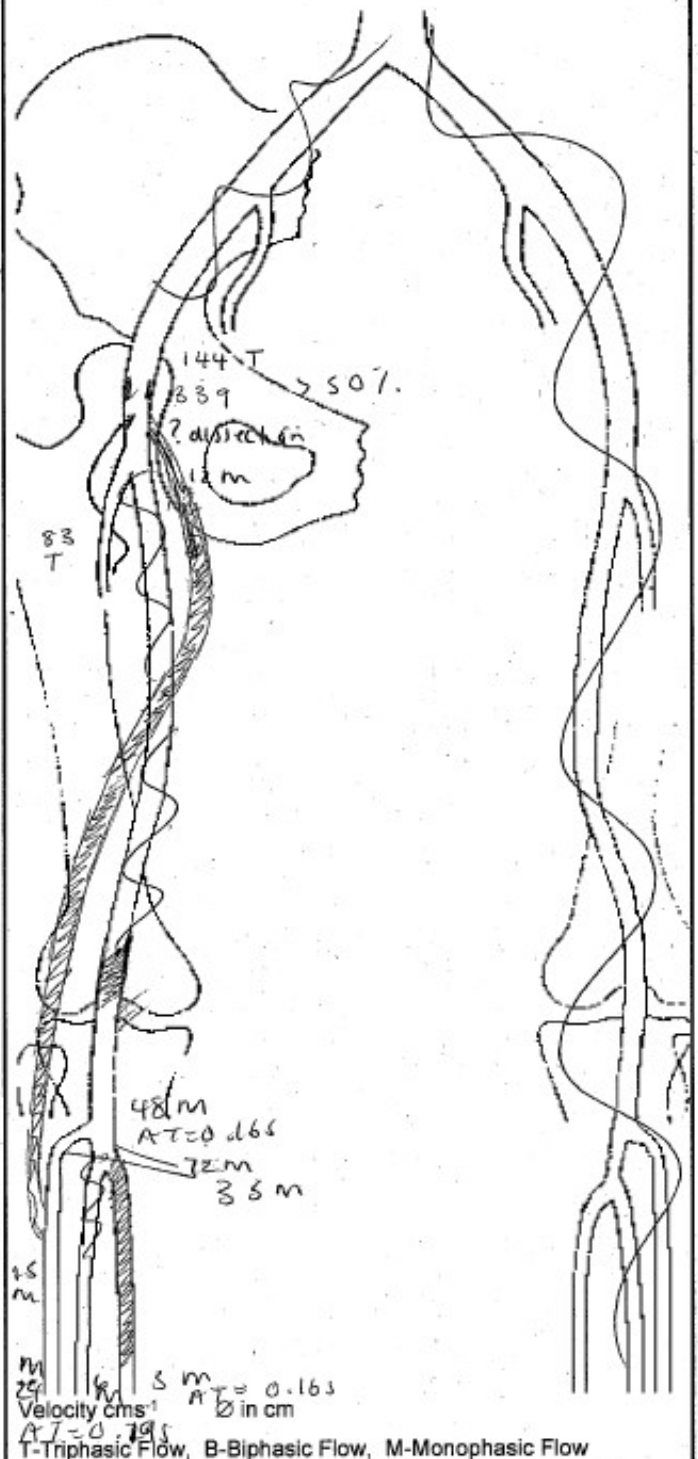
ATA: Patent throughout its
length (filled via POPA,
via collateral).

PTA: Patent distally, appears
occluded from origin.

PERVA: Not visualised
proximally, reduced monophasic
waveforms in the mid -
distal vessel.

Discharge from surveillance.
Pl. to have follow-up out patient
appointment in 2-months -
(Reviewed by Spr + TMB).

A. Moly R



HOPKINSON

Consultant: SLK

Date: 14.12.2023

* Technically challenging assessment due to heavily calcified vessel throughout *

RIGHT LOWER LIMB
ARTERIAL

Aorta: Patent, $\phi = 1.6$ cm

CIA: $>50\%$ stenosis proximally

EIA: Patent, pulsatile monophasic waveform.

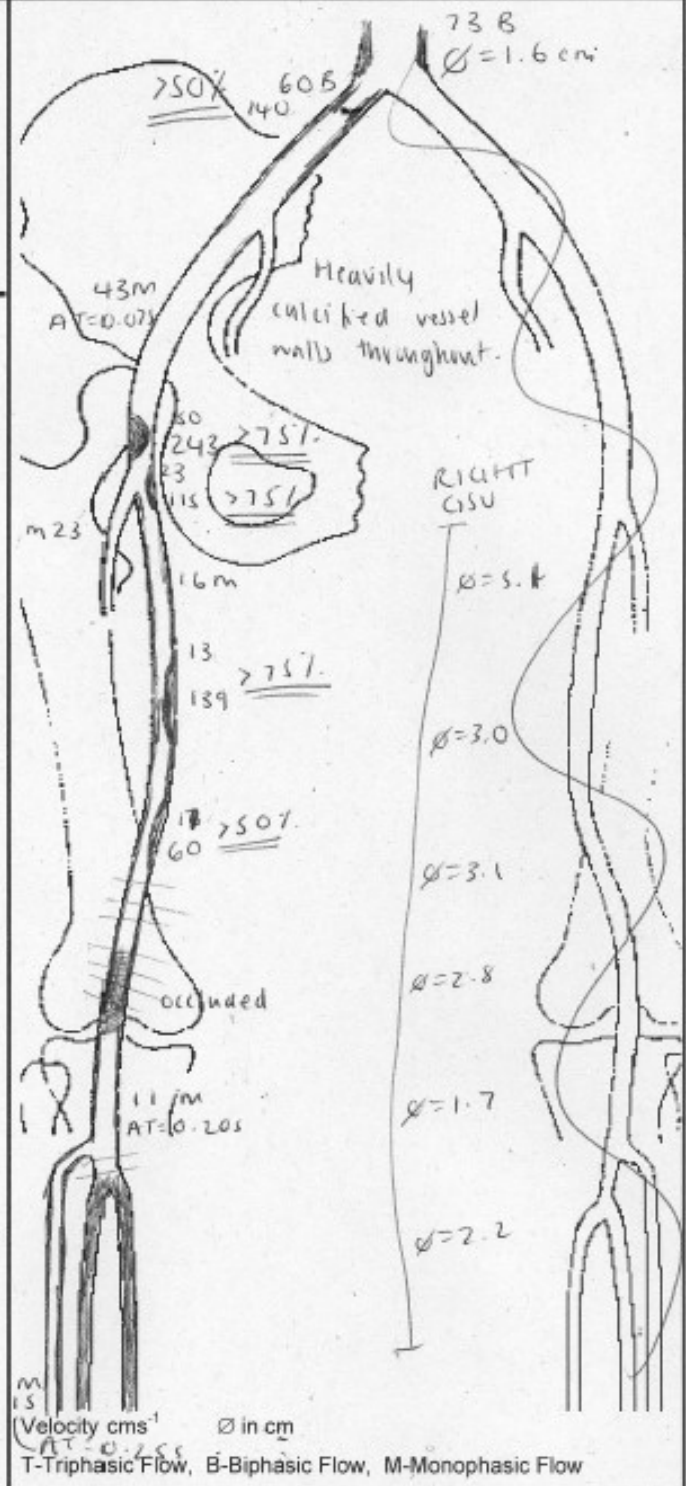
CFA: 77.5% stenosis.

SFA: 77.5% origin stenosis
 $>75\%$ mid vessel stenosis
 $>50\%$ distal vessel stenosis

POPA: poorly visualised proximally
however appears occluded.
Patent distally.

ATH: Patent throughout

PIA + PEROA: Appear
occluded throughout
(unable to visualise TPT?
occluded).



A. M. R.

Consultant: TAB

Date: 06.12.2027

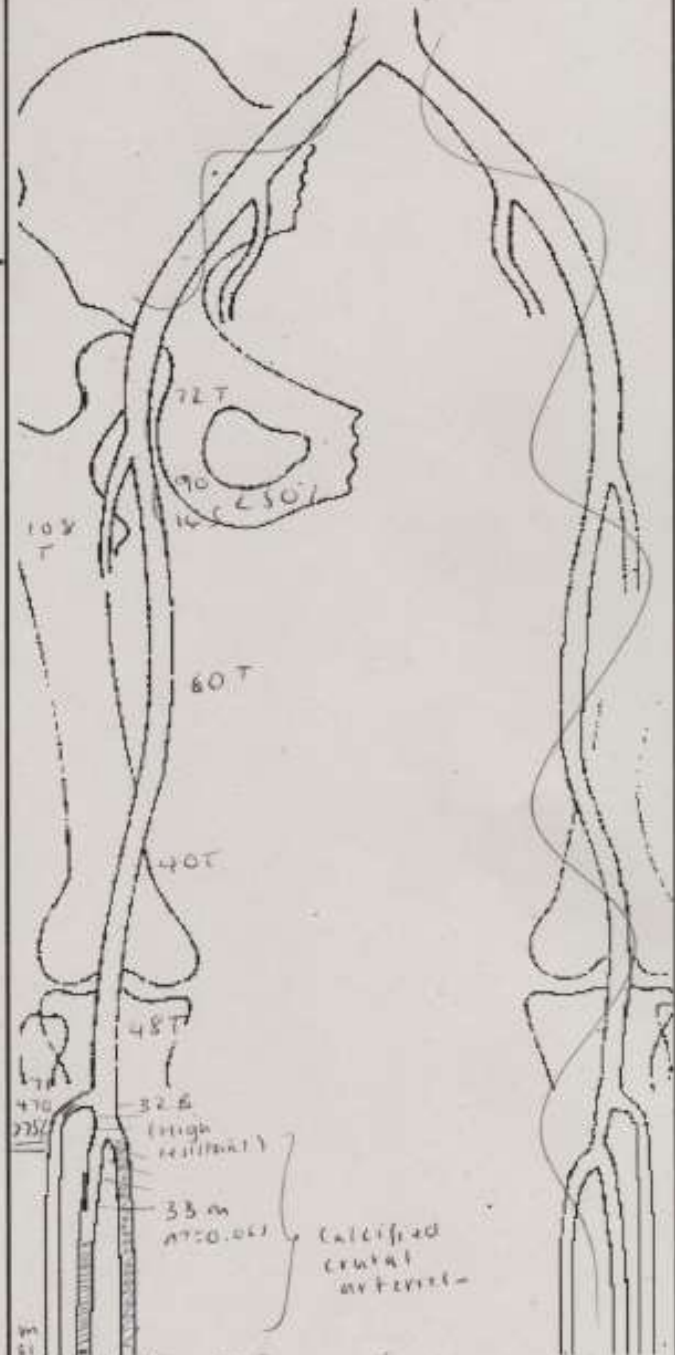
RIGHT LOWER LIMB
ARTERIAL

CFA - prox TPT: Patent +
mild atheroma in the
CFA + prox SFA (LSO1)
Tri-phasic waveforms.

ATA: >75% stenosis
proximally

PTA: Appears occluded
along its length

PERUN: Appears occluded
in the mid - distal vessel



Velocity cm/s

Ø in cm

T-Triphasic Flow, B-Biphasic Flow, M-Monophasic Flow

A. M. P.

Consultant: SLC

Date: 14.12.2023

RIGHT LOWER LIMB ARTERIAL

CFA: Patent, mild atheroma, triphasic waveforms.

Proximal POFA: Patent, biphasic waveforms.

SFA: Patent, calcified vessel walls, biphasic waveforms.

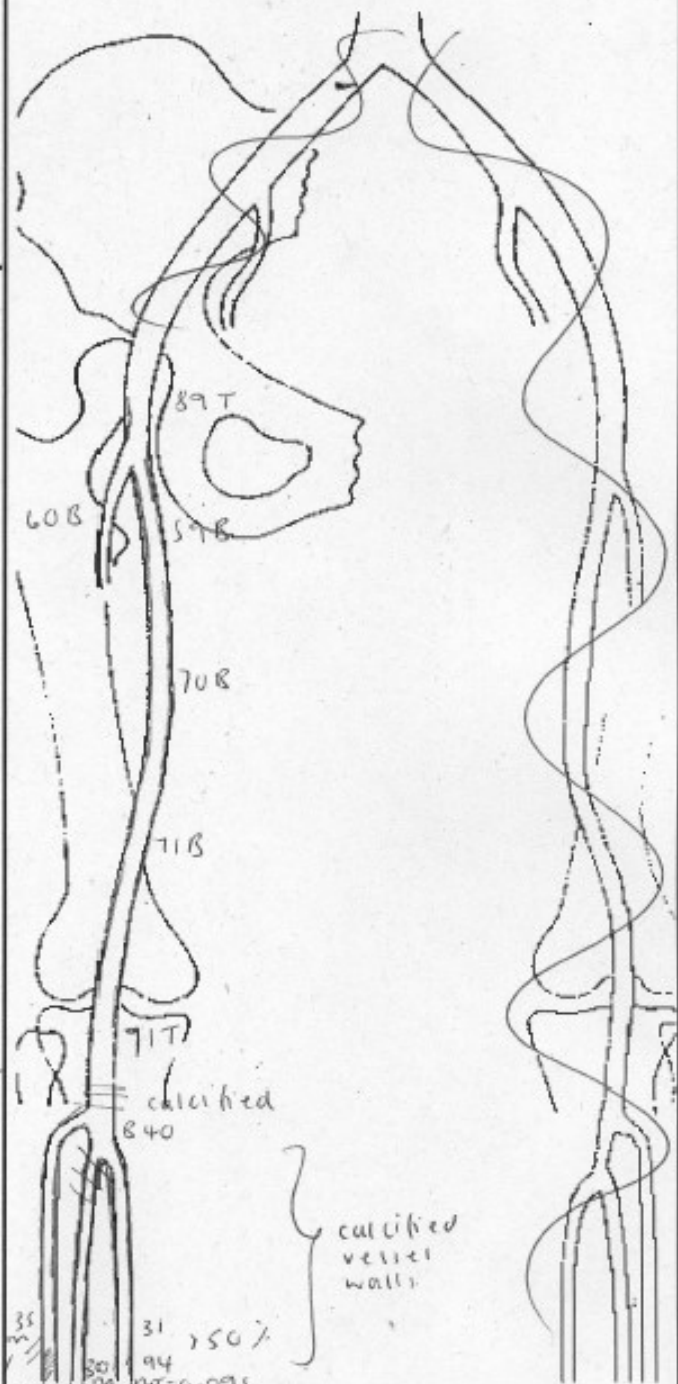
POFA: Patent where seen, calcified vessel walls, triphasic waveforms.

TFT: Patent, biphasic waveforms.

ATA: Appears occluded at the level of the ankle.

PTA: No obvious atheroma seen however, limited view due to calcified walls. Elevated PSV consistent with a >50% distal stenosis.

PERON: Patent where seen, pulsatile monophasic waveforms.



Velocity cms

AT=0.021

T-Triphasic Flow, B-Biphasic Flow, M-Monophasic Flow

Analysis



Date: 02.12.2023

RIGHT LOWER LIMB
ARTERIAL

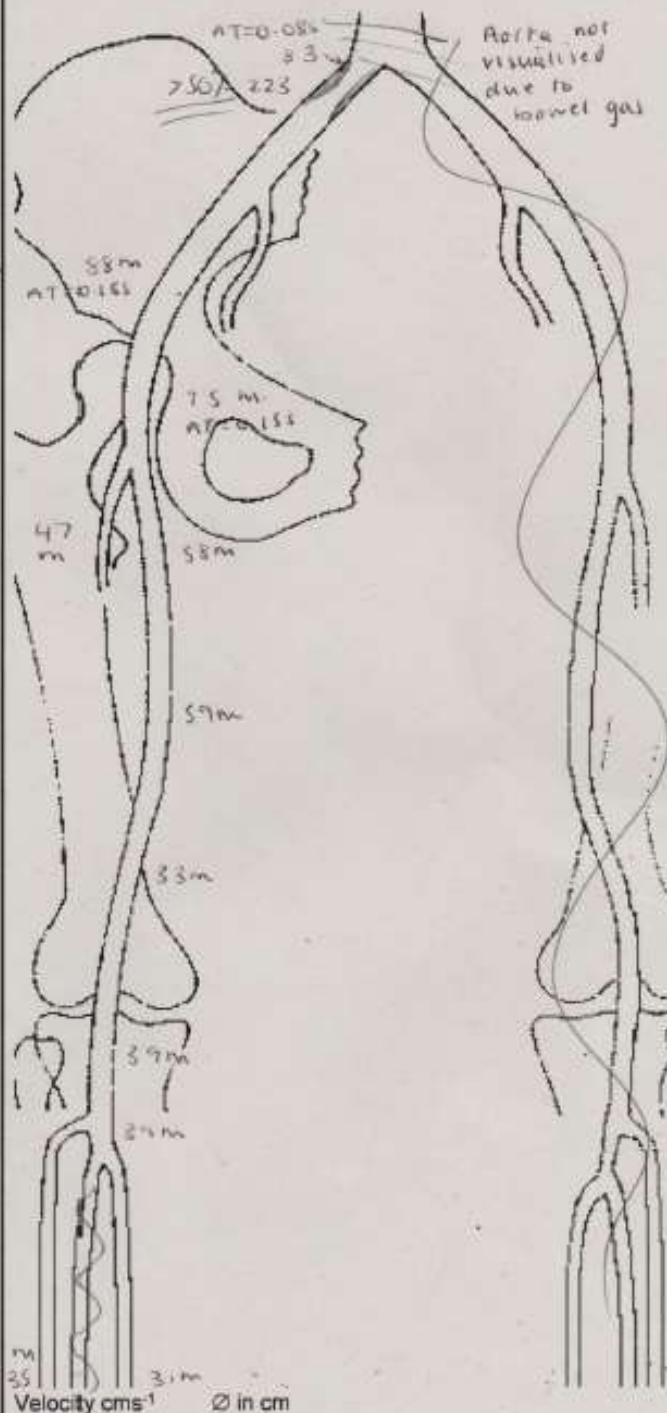
Aorta: Not visualised
due to overlying bowel gas.

CCA: > 50% proximal
stenosis.

EIA, CFA, proximal PEPA,
SFA, POPA, TPT, ATA +
PTA: Patent; no significant
arterial disease seen.
Damped monophasic waveforms

SUMMARY

> 50% proximal CCA stenosis.



Amalya

Consultant: JMS

Date: 08.12.2023

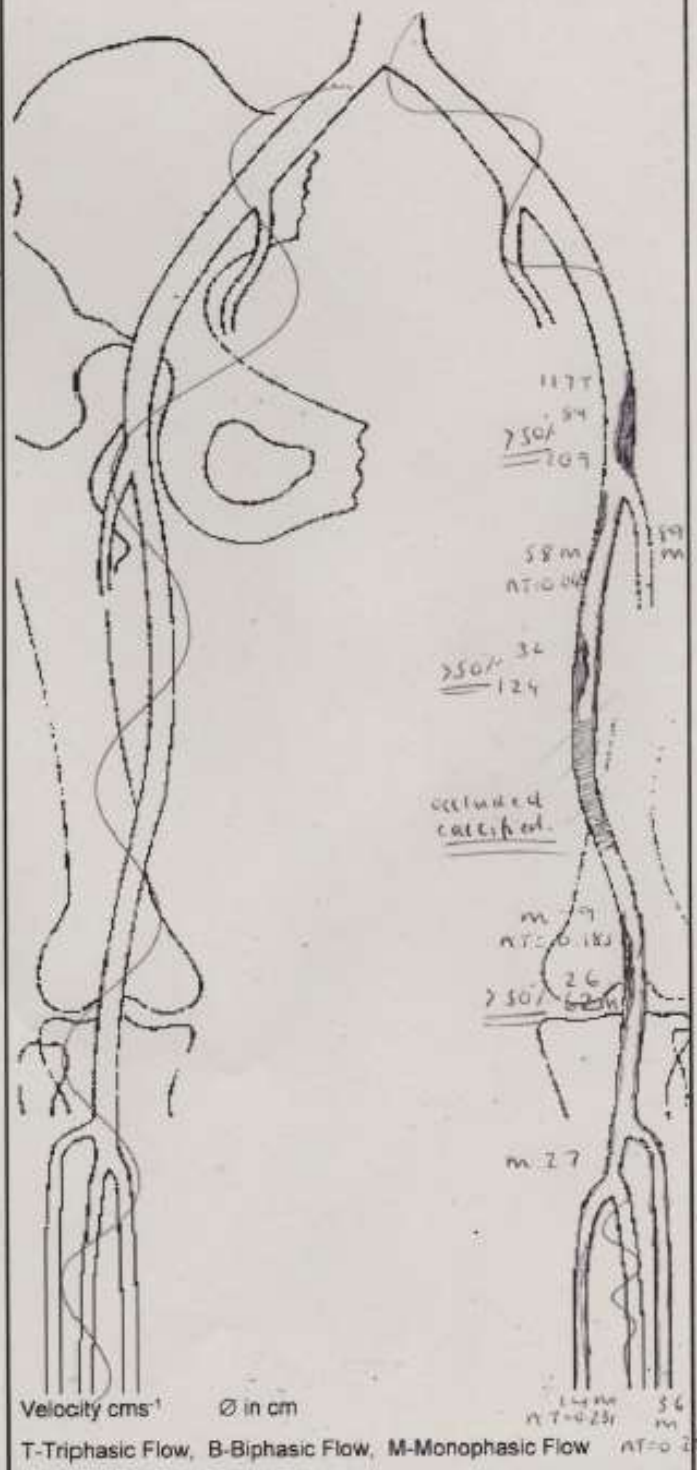
LEFT LOWER LIMB
ARTERIAL

CFR: 750% stenosis.
PROPR: Patent proximally,
monophasic waveforms.

SDR: 750% stenosis in
the mid vessel before
app occluding. Flow
reforms distally.

POPR: 750% mid vessel
stenosis.

TPTs, ATN + PTA: Patent
where seen, damped
monophasic waveforms.



Consultant: SLK

Date: 14.12.2023

LEFT LOWER LIMB ARTERIAL

CFR = mid SFA: patent,
triphasic wave form.

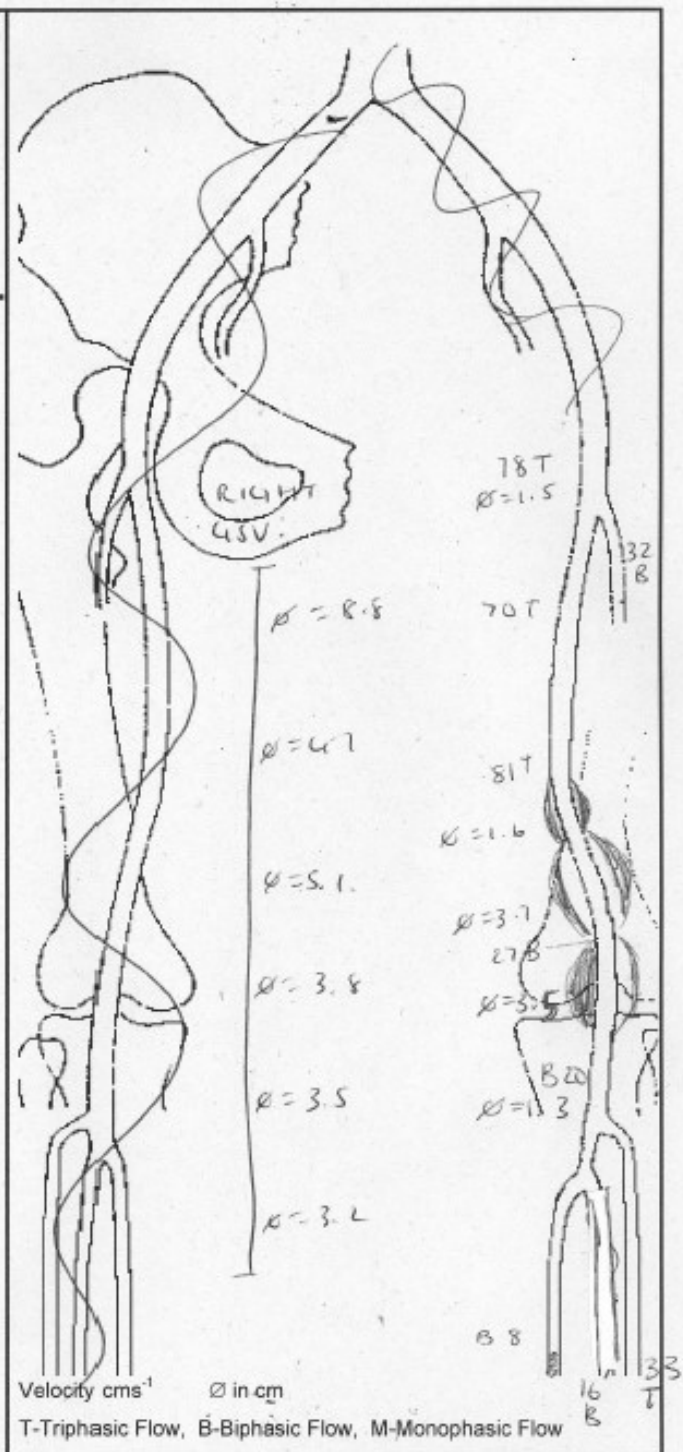
mid SFA: Dilated, measuring
 $\phi = 1.6$ cm in diameter.

Distal SFA: Aneurysmal,
patent, thrombus noted,
 $\phi = 3.7$ cm in diameter.

POPA: Aneurysmal, patent,
thrombus noted, $\phi = 3.5$ cm
in diameter.

ATA + PERON: Patent.

PTN: occluded distally
(chronic).



Aorta: Aneurysmal, measuring a maximum diameter of 3.4cm.

CIA + EIA: Patient where seen, triphasic waveforms.

CEAC: Patient, mild atherosclerosis
on posterior wall.

SEM: appears occluded in the mid - distal vessel.

POPA, TET, ATA + PTA: Parent
where seen, dumped
monophasic wave forms.

ECG: $> 75\%$ stenosis, poorly visualised due to bowel gas but elevated PRV consistent with $> 75\%$ stenosis + damped monophasic waveform distal to this.

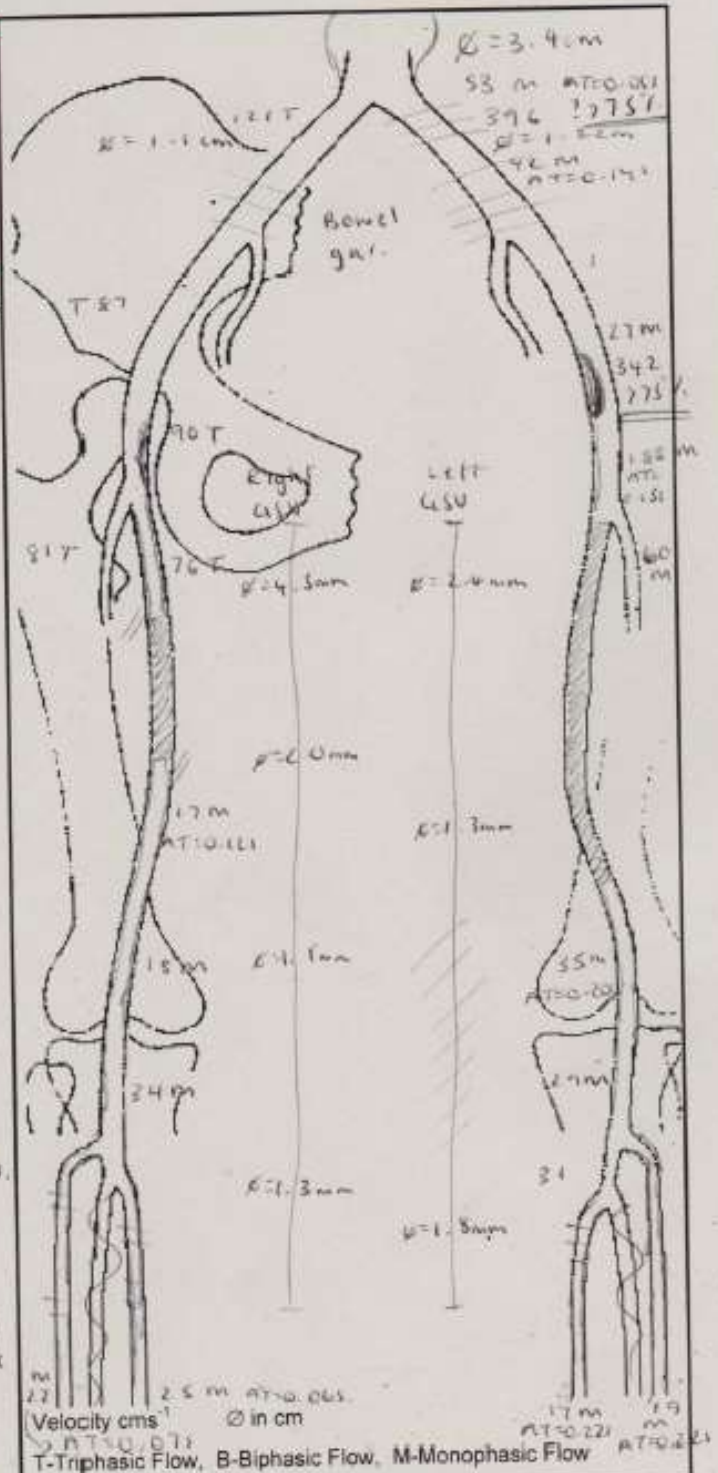
$E(A) > 757$ memorized distally

ECG: Patient: mild atherosclerosis,
turbulent, monophasic waveform.

SFA: derived from origin to distal vessel. Pargat at adductor canal.

POPA, TPT, ATM + PTA: Patient
never seen; dumped mono-phasic
wave form.

Bilateral GSV mapped.



A Water-Bone

Consultant: SLK

Date: 10.11.2023

RIGHT LOWER LIMB ARTERIAL

*Treadmill test not performed as unable to pick up right DP and PTA.

Aorta: Not visualised due to overlying bowel gas.

CIA: Elevated PSV noted proximally ?non-visualised significant stenosis.

EIA: Patent where seen with damped monophasic waveforms.

CFA: >50% stenosis.

PROFA: Patent proximally.

SFA: Patent with diffuse atheroma noted in the proximal vessel before occluding.

Flow reforms via a collateral distally.

POPA & TPT: Patent throughout, damped monophasic waveforms.

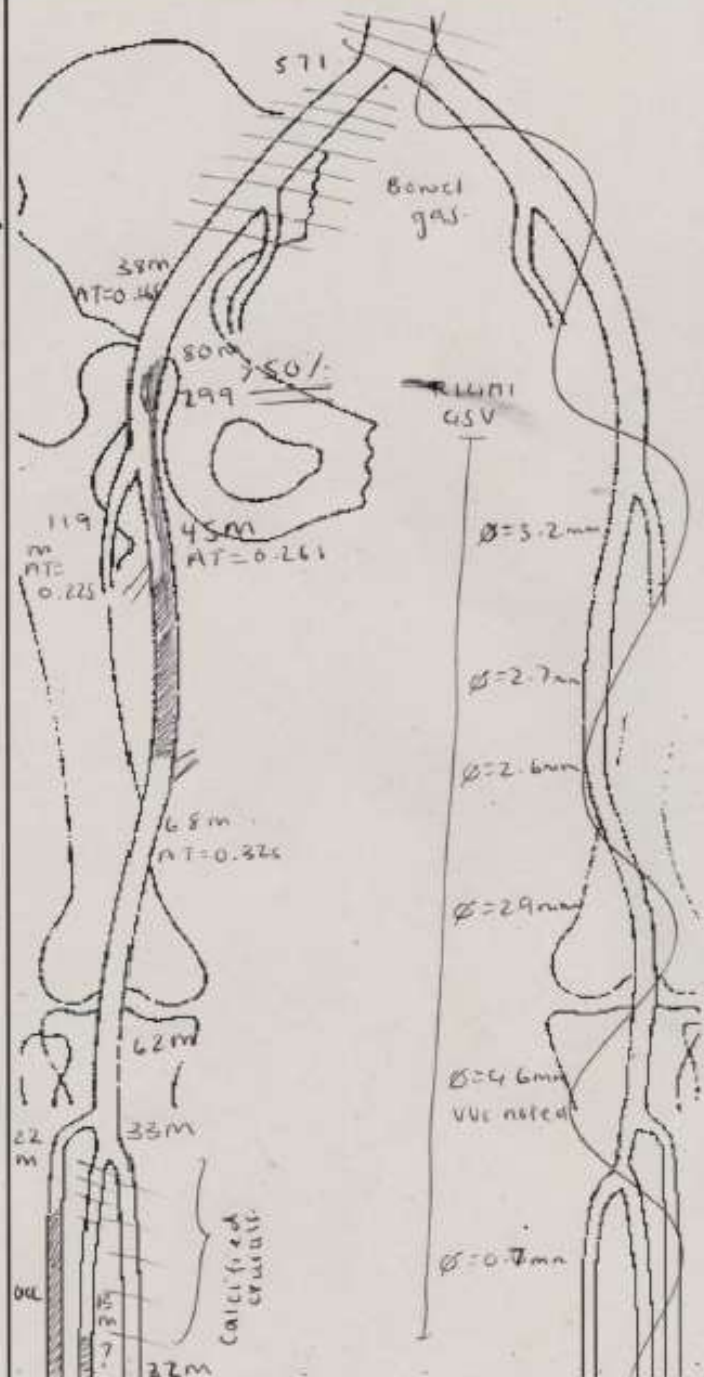
ATA: Patent proximally. Appears to occlude in the mid vessel to the ankle.

PTA: Calcified vessel walls resulting in intermittent filling throughout. Patent where seen, damped monophasic waveforms distally.

PEROA: Unable to visualise the proximal vessel due to calcification. Patent in the mid vessel, damped monophasic waveforms.

Appears to occlude distally.

Right GSV mapped, diameters on diagram.



A. Morley-Brown

[Signature]

Velocity cms⁻¹ Ø in cm

T-Triphasic Flow, B-Biphasic Flow, M-Monophasic Flow

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Nottingham University Hospital
NG7 2UH

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**Nottingham
Vascular Centre**

Vascular Services for Nottinghamshire and the East Midlands



Abdominal Aortic Aneurysm Assessment

Name:		Date:	13/11/2023
DOB:		Vascular Consultant	AOD
NHS No.		Reason for exam	surveillance scan
Hospital No.			

Proximal Aorta AP diameter (cm):	1.2		
Maximum AP Abdominal Aorta diameter (cm):	4.8	Maximum Transverse Abdominal Aorta diameter (cm):	5.2
Previous max diameter (cm)	4.8X5.2		
Right Common Iliac diameter (cm):	1.7	Left Common Iliac diameter (cm):	1.6
Scan comments	No significant change in maximum AAA diameter. Follow up in 3 months.		

The above named patient attended for an ultrasound scan of their abdominal aortic aneurysm

The scan has shown that the maximum diameter of the abdominal aorta is 4.8x5.2 cm.

The patient has been notified of the outcome of the screening test and has been informed they will be invited to attend a further surveillance appointment in 3 months' time.

If you have any queries regarding this result, please contact the vascular lab at the above address.

The Vascular Laboratory

Department of Vascular and Endovascular Surgery

Duplex Aneurysm Assessment

Patient Name:		Date:	13.12.2023
Hospital Number:		Consultant:	CMC
Date of Birth:			

Abdominal Aorta

Proximal AP diameter (cm):	1.2		
Maximum AP diameter (cm):	1.5	Transverse diameter (cm):	1.5
Previous max. diameter (cm):			
Below renal vessels?	YES / NO		

Iliac Arteries

Right CIA (cm):	1.0	Left CIA (cm):	0.8
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Peripheral Arteries

Right CFA (cm):	0.8	Left CFA (cm):	0.7
Right Popliteal A. (cm):		Left Popliteal A. (cm):	

Comments:	No evidence of AAM demonstrated on today's assessment
Signature:	Amel R

Date: 18.12.2023

CROSSOVER GRAFT + Rt Arterial

Aorta: Patent, mildly ectatic, calcified.

Left CIA: >75% stenosis proximally.

Left CIA: Patent heavily calcified walls.

CROSSOVER GRAFT: Appears occluded.

RIGHT LOWER LIMB

Right CFA: Appears occluded.

SFA: Appears occluded proximally. Patent in mid to distal vessel via a narrow channel.

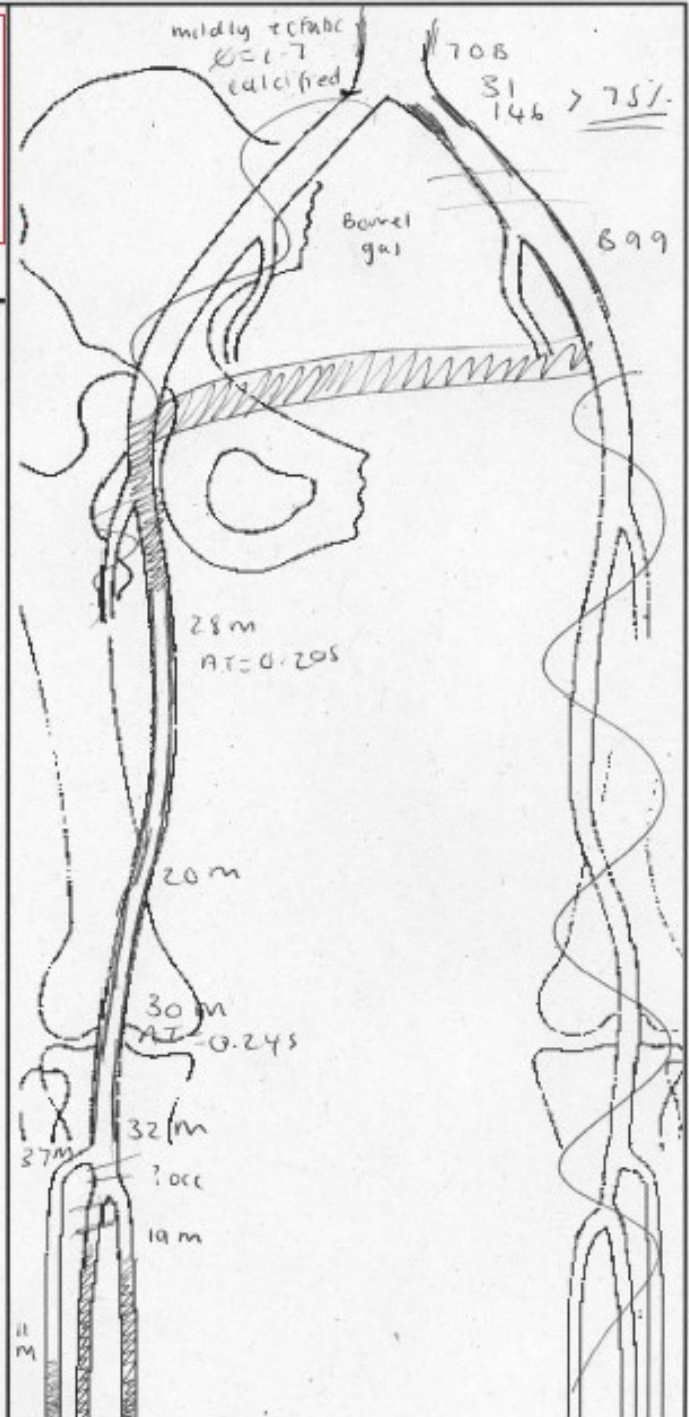
POPA: Patent, mild atheroma.

TFT: Not visualised 3cc

PTA: Appears occluded in mid - distal vessel

ATN: Appears occluded distally.

PERON: Appears occluded throughout.



Velocity cms⁻¹ Ø in cm

T-Triphasic Flow, B-Biphasic Flow, M-Monophasic Flow

UPIN: 1912/2023



Condition: SLR

Date: 14.12.2023

RIGHT LOWER LIMB ARTERIAL

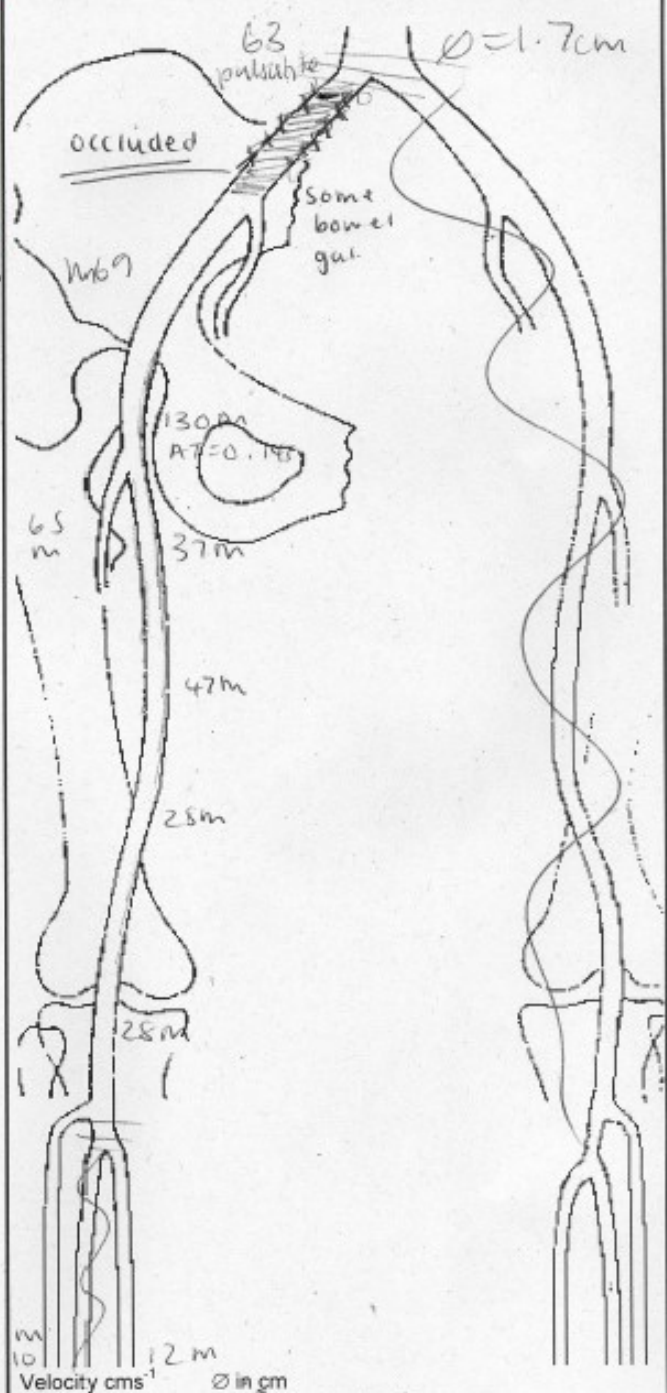
Aorta: Patent, pulsatile wave forms.

CIN: Appears occluded.

EIA, CFA, SFA, POPA,

ATA + PTA: Patent.

where seen, no significant atheroma. Damped monophasic wave forms.



T-Triphasic Flow, B-Biphasic Flow, M-Monophasic Flow

A. Wong

Date: 13.12.2022 CML

RIGHT LOWER LIMB ARTERIAL

CEA: Patent, mild atheroma, triphasic waveforms.

SFA: Patent where seen, pulsatile, monophasic waveforms.

POPA: $>75\%$ stenosis in the mid vessel.

TFT: heavily calcified but appears occluded.

ATN: Appears patent where seen.

PTA + PEEON: Appears occluded throughout length.

LEFT LOWER LIMB ARTERIAL

CEA: Patent, mild atheroma, triphasic waveforms.

SFA: 3 focal $>50\%$ stenoses demonstrated.

POPA: $>50\%$ proximal stenosis.

Appears occluded distally.

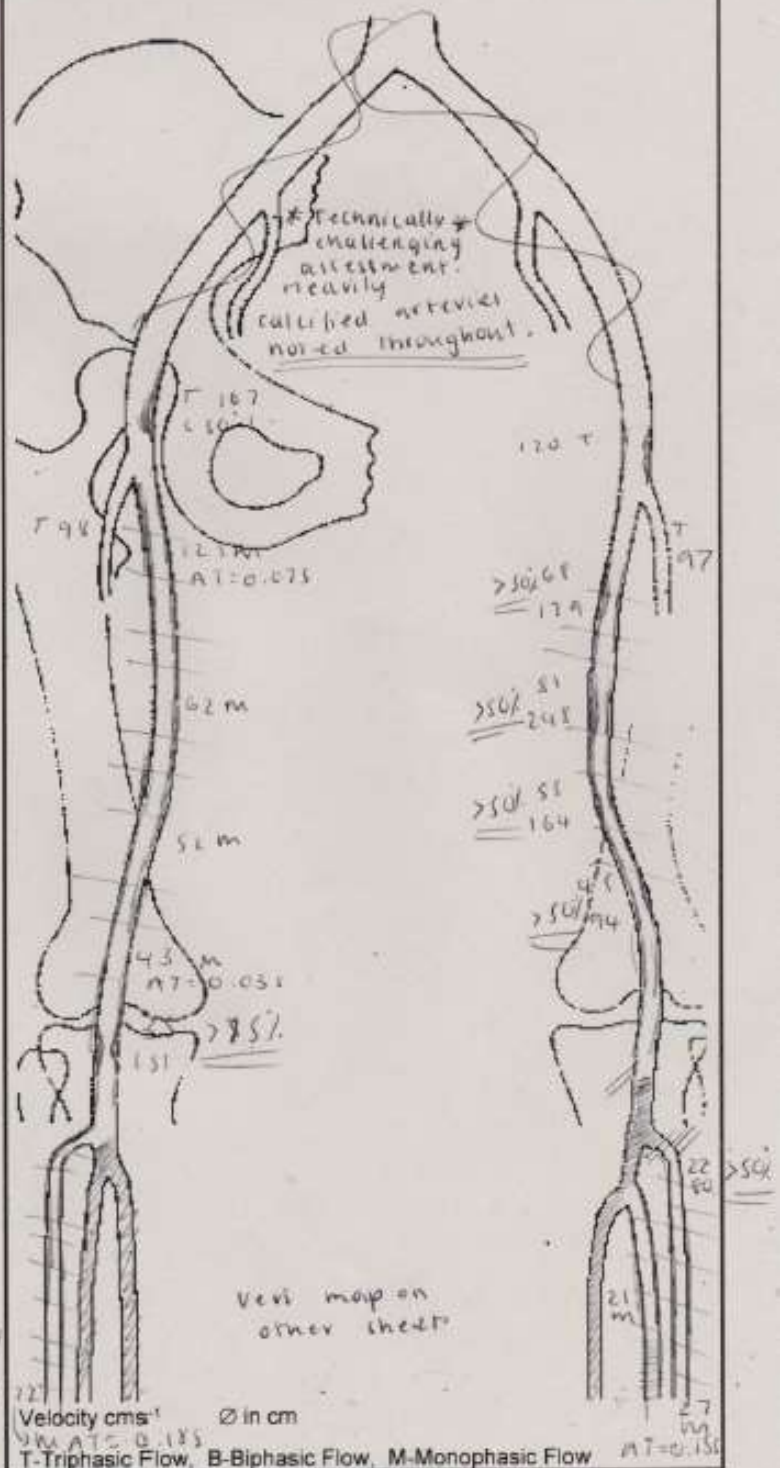
TFT: Appears occluded.

ATN: $>50\%$ stenosis proximally, intermittent filling throughout, patent where seen.

PTN: Appears occluded throughout.

PEEON: not visualised proximally.

Appears occluded distally.



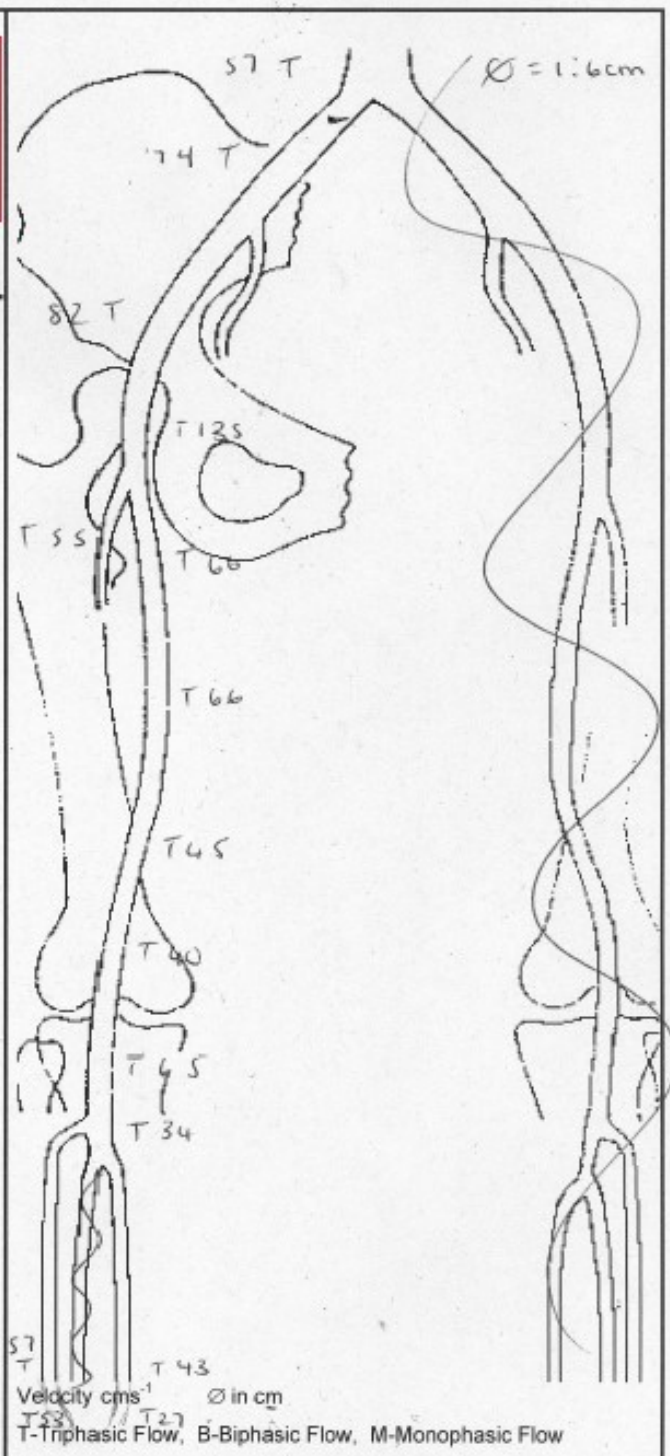
Amey Rini

Date: 18.12.2023

Aorta: Normal + "uniform calibre".

CIA, EIA, CFA, SFA,
POFA, TPT, ATA + PTA:
Parent, no significant
arterial disease demonstrated,
triphasic wave forms.

ABPI: normal resting ABPI
at 1.2.



Consultant: TAB

Date: 08.12.2023

LEFT LOWER LIMB
ARTERIAL

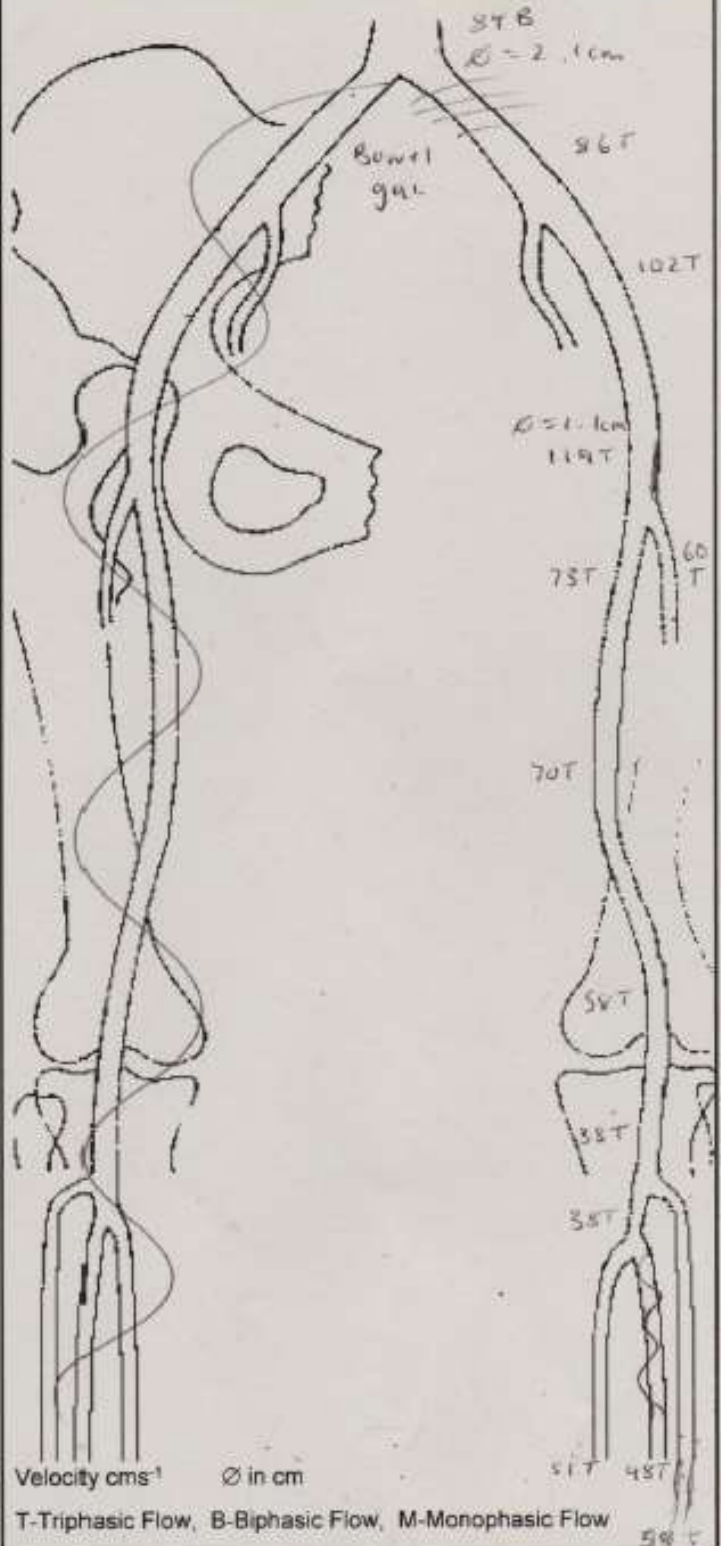
Aorta - distal EIA:
Patent where seen,
triphasic waveforms.

CFA: mild atheroma on
posterior wall (C50-1),
triphasic waveforms.

PROFA (proximal), SFA, POFA,
TFT, ATA + PTN: Patent
triphasic waveforms.

DF: Patent, triphasic
waveforms.

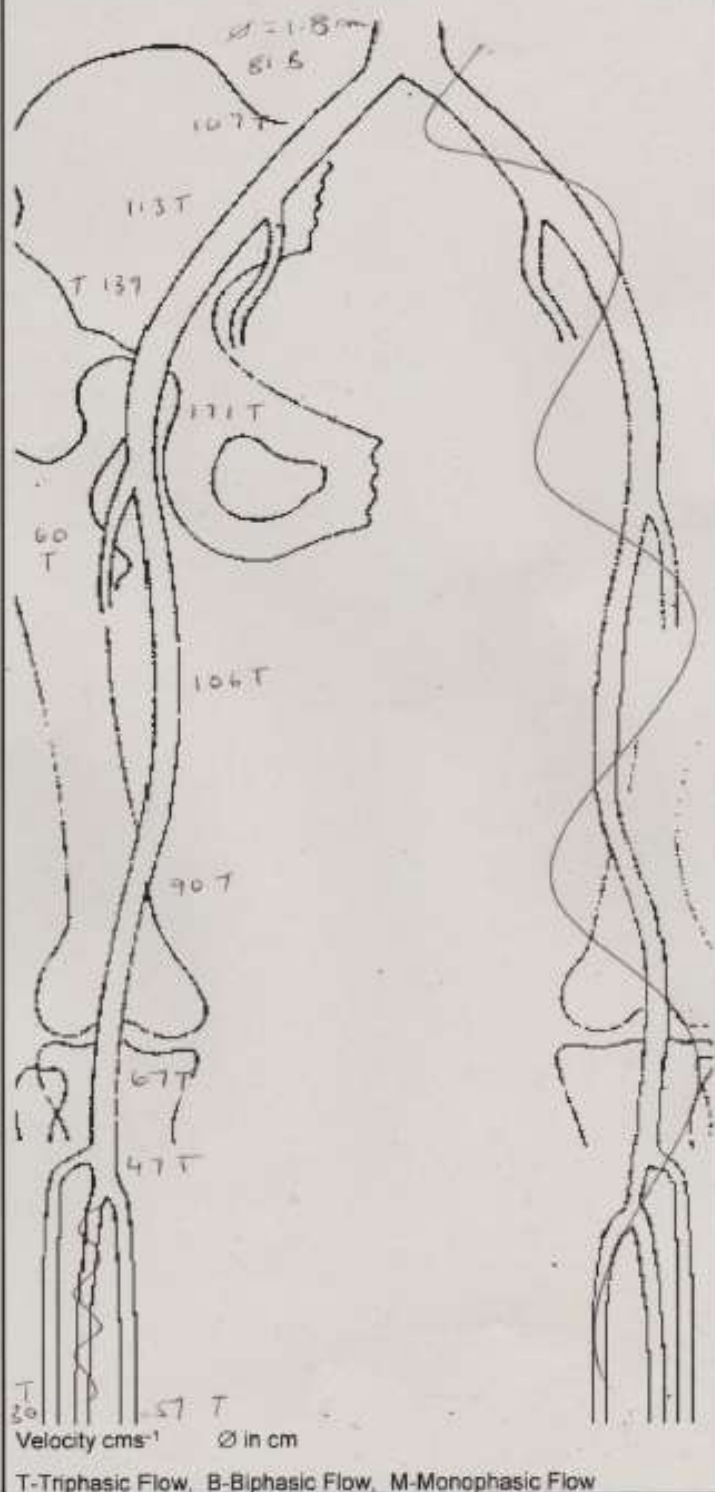
Difficult to clearly assess
pedal vessels - however,
where seen digital
arteries appear patent,
triphasic / biphasic waveforms.



Date: 13-12-2023 CML

RIGHT LOWER LIMB ARTERIAL

Aorta, CIA, EIA,
IFA, proximal PEUA,
SFA, POPA, TPT, ATA
+ PTA are patent with
no significant arterial
disease demonstrated.
Triphasic wave forms
throughout.



Date: 14.12.2023

LEFT LOWER LIMB
ARTERIAL

CFA: Patent, Miphrate
- wavy form. mild atheroma
on posterior wall.

SFA: >50% stenosis in
med vessel,

Popn: Patient, biphasic wave form.

TPT: Patient, emphasis
wave form.

ATA: Poorly visualised throughout, patent where seen but unable to exclude significant disease.

PTA: appears occluded in
proximal to distal vessel.
patent at the ankle.

PEROA: Patent, where seen.
biphasic wave forms.

