Outpatient policies and procedures for patients with thoracic aortic disease

Policy and Procedure

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1. Background

Outpatient management of aortovascular patients at Liverpool Heart and Chest Hospital is in need of standardisation. With the appointment of a Senior Clinical lecturer in Aortovascular Medicine at LHCH, there has been a focus on our protocols and we have developed local guidance for this cohort of patients. This guidance sits within the structures of our integrated care system and so-called aortovascular hub (Figure 1).

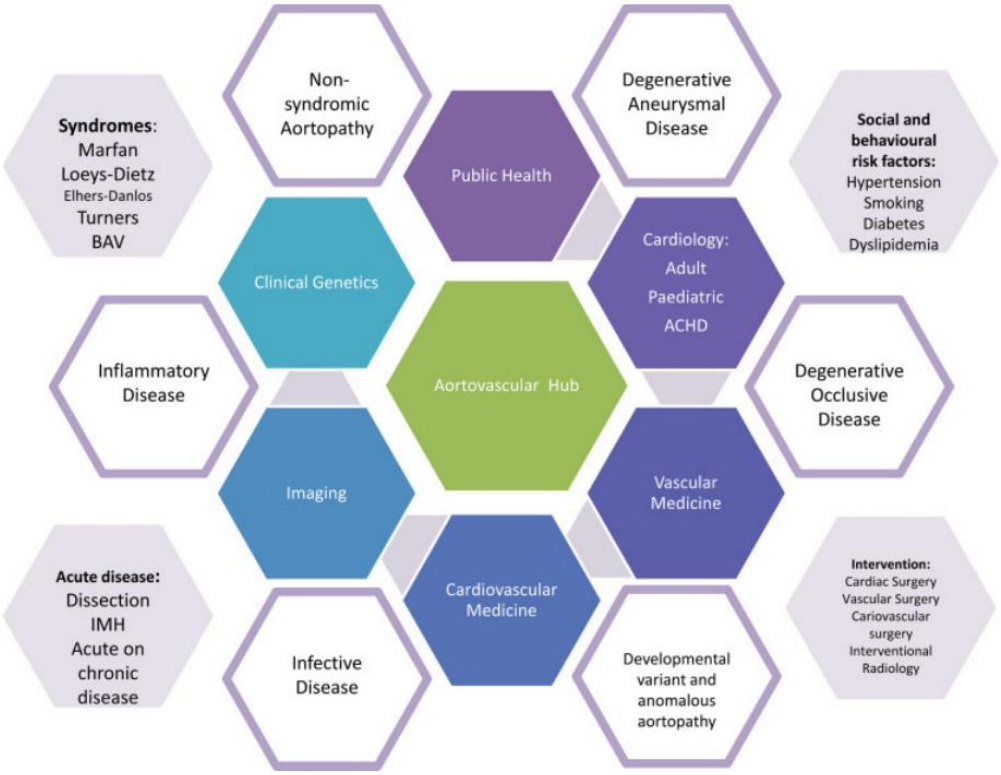


Fig. 1 The Aortovascular Hub.

We endorse the 2022 American Heart Association guidelines (Appendix) unless otherwise stated. Significant changes to size indications for surgery in the 2022 update presents capacity challenges to the organisation and therefore implementation of all recommendations will remain a staged process and subject to annual clinic review or patients.

2. Pathways and Protocols

All elective patients referred into the Trust come through the Access Team and are allocated to the clinical team through the OnBase system. Any e-mail or paper referrals through to the clinical team directly are redirected through to the Access Team. The bulk of referrals on OnBase are reviewed on a weekly rotational basis by each of the six aortic surgeons. The Vascular Surgeon Lead may have referrals directed to him/her. The Aortic Fellows have access to all OnBase lists and are expected to work up the patients with descending thoracic aortic (DTA) and thoracoabdominal aortic (TAAA) disease for LCS Clinic. The Aortic Advanced Nurse Practitioner (ANP) has their own OnBase for processing small aneurysms. The clinical team may allocate a patient to a specific clinic or cross refer to others within the OnBase to:

A. Aortic Clinic

B. Aortic ANP Clinic (Small Aneurysm Clinic - New)

C. Aortic ANP Clinic (Small Aneurysm Clinic - Follow-up)

D. ABC Clinic – Vascular

E. LCS Clinic

F. Aortopathy Clinic

G. Cardiac Surgery

Or other clinics relevant to their care including:

A. Valve Clinic

B. Clinical Genetics Clinic

C. Hypertension Clinic

D. Marfan Clinic

E. ACHD Clinic

F. Other sub-speciality Cardiology or Cardiac Surgery Clinic

Patients may be discussed at a number of MDTs including:

A. Distal Aortic MDT

B. Proximal Aortic MDT

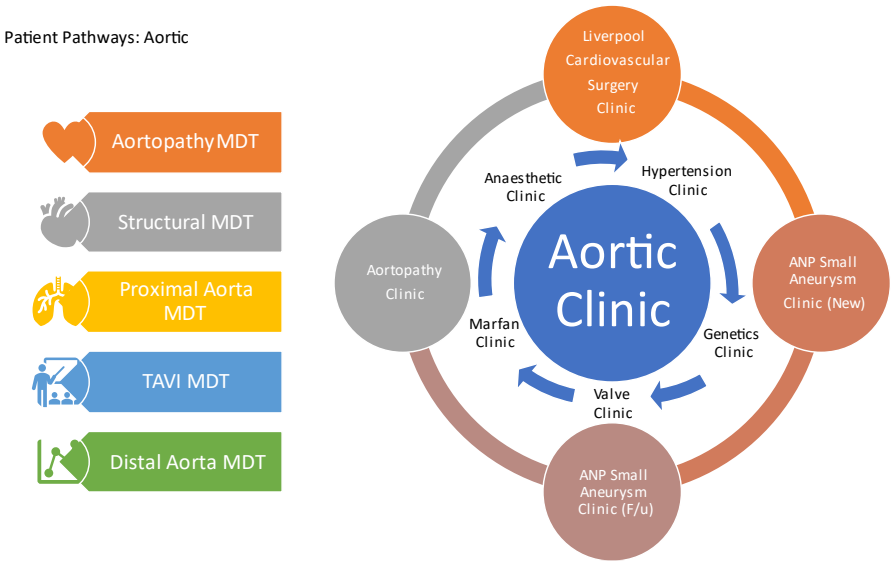
C. Structural MDT

D. Aortopathy MDT

E. TAVI MDT

F. ACHD MDT

G. Other (High Risk, Coronary, Endocarditis, Imaging etc)



3. Clinics

Clinics have been transformed by COVID-19 with a default for all follow-up patients to be reviewed via telephone call and only new patients to be reviewed face to face (F2F). Virtual patients with any issues are then brought in for F2F reviews. Total paper follow-up processes are currently being explored.

Generic advice on regular imaging is given in Section 5. In addition, sections below describe policies including:

a) Blood pressure
b) Risk factor management
c) Lifestyle
d) Exercise
e) Genetics
f) Mental health
g) Work, driving, flying

All new patients should receive a copy of the Aortic Booklet providing information on their condition and sign posting them to support.

Patients first seen in other clinics or under follow-up may be referred to the Aortic ANP for genetic testing.

No aortic patients should be allocated to the Follow-up Wating List (FOWL) or suspended pending results of investigations. All should receive a definitive follow-up date. At patient request, they may be allocated to PIFU (Patient Initiated Follow-up).

a. Aortic Clinic

Aortic Clinic is the original clinic through which all patients were channelled at the start of the service. With the original policy of not discharging any patients, this clinic became overly booked with poor experiences for the team and patients. As obvious sub-specialties arose, and the teams enlarged, patients were decanted into parallel

clinics (Liverpool Cardiovascular Services (LCS), Aortopathy, Small Aneurysm etc). The Aortic Clinic remains the busiest hub through which the majority of new aortic patients are reviewed. Principally the patients have aortic disease of the proximal segments including root and arch. The Clinic is attended by 1 consultant, 1 aortic fellow and 2 middle grade doctors. The clinic should be scrutinised prior to the day by Aortic Administrator and Aortic Fellow to ensure imaging and reports are in place (Appendix).

i. New

All new patients are F2F and should have available to view in clinic: CT whole aorta with contrast, echocardiography and imaging of the coronary vasculature. Ideally this should have been reviewed/arranged from the OnBase referral. New patients should have on arrival: ECG, CXR and BP measurements. PFTs are optional. Where indicated blood tests may be requested. Each patient should have an EPR entry with clinic outcome documented as well as a letter to referring doctor, patients GP and copied to patient. The clinic outcome should state which of the afore mentioned clinic to book follow-up into.

Patients may require special tests, further assessments including anaesthetic and further outpatient reviews.

All patients listed for surgery should be directed to the clinic nurses for preoperative investigations, swabs and treatments as per hospital policies. Ideally all preoperative patients should be assessed in the CNP clinics prior to admission.

Any patients requiring genetic screening should be referred to the Aortic ANP Clinic.

ii. Follow-up

All follow-up patients are Virtual (Telephone) and should have available for the consultation, their imaging with reports. If any issues are discovered, then a F2F consultation should be arranged.

iii. Post operative

All follow-up post operative patients are Virtual (Telephone) but a low threshold should be had for a F2F meeting.

NOTE: Patients may require referral for genetic screening within ANP Clinics (Appendix). The clinic outcome forms should state which of the afore mentioned clinics to book follow-up into.

b. Liverpool Cardiovascular Surgery (LCS) Clinic

Liverpool Cardiovascular Surgery (LCS) is a collaboration between LHCH and LiVES from LUHFT. Essentially this includes independent vascular surgery lists at LHCH and joint MDTs and Clinics. A vascular surgeon (L1) is allocated on a weekly basis to cover these roles as well as ward patients (Appendix). The clinic focuses on new and follow-up patients with DTA and TAAA disease. Within the clinic are representatives from vascular surgery, cardiac surgery, anaesthesia and aortovascular medicine. Patients are assessed for open, endovascular or best medical management.

i. New

All new patients are seen F2F. Patients are often extra-regional and enhanced scrutiny of referrals and clinic should ensure all relevant imaging (CT whole aorta, echocardiography, coronary assessment). In addition, patients should have CXR, ECG and PFTs on arrival. Blood tests may be requested where indicated. The Aortic ANP ensures a range of fitness tests including:

a) Hand grip test
b) Frailty scoring
c) Cognition measure

Each patient should have an EPR entry with clinic outcome documented as well as a letter to referring doctor, patients GP and copied to patient.

Patients may require special tests, further assessments and further outpatient reviews.

All patients listed for surgery should be directed to the clinic nurses for preoperative investigations, swabs and treatments as per hospital policies. Ideally all preoperative patients should be assessed in the CNP clinics prior to admission.

Any patients requiring genetic screening should be referred to the Aortic ANP Clinic.

ii. Follow-up

All follow-up patients are Virtual (Telephone) and should have available for the consultation, their imaging with reports. If any issues are discovered, then a F2F consultation should be arranged.

iii. Post operative

All follow-up post operative patients are Virtual (Telephone) but a low threshold should be had for a F2F meeting.

NOTE: Patients may require referral for genetic screening within ANP Clinics

c. Aortopathy Clinic

The aortopathy clinic is a multidisciplinary clinic led by an aortovascular physician and including also a cardiac surgeon, a geneticist and cardiologist with competence in imaging.

In the clinic patients with confirmed or suspected syndromic aortopathy and familial cases of non-syndromic aortopathies, approaching surgical threshold, have access. New visits as well as follow up of patients managed medically are assessed. The management of patients in the aortopathy clinic follows a stepwise approach including;

1) Identification of the syndromic pattern and associated genetic variant
2) Identification at physical examination of associated syndromic feature
3) Assessment of the aortic aneurysm through imaging test which should be available at the time of the visit (CT, MRI, echocardiogram)
4) Planning of the management specific for the syndromic pattern and genetic variant identified. Imaging surveillance scheduled according to underlying disease
5) Medical therapy optimization with strict control of Blood pressure. Prescription of any additional beneficial medication (i.e. statins)
6) Discussion of life style change and genetic counselling for siblings

i. New

All new patients are F2F and should have available to view in clinic: CT whole aorta with contrast, echocardiography and imaging of the coronary vasculature. Ideally this should have been reviewed/arranged from the OnBase referral. New patients should have on arrival: ECG, CXR and BP measurements. PFTs are optional. Where indicated blood tests may be requested. Each patient should have an EPR entry with clinic outcome documented as well as a letter to referring doctor, patients GP and copied to patient.

Patients may require special tests, further assessments including anaesthetic and further outpatient reviews.

All patients listed for surgery should be directed to the clinic nurses for preoperative investigations, swabs and treatments as per hospital policies. Ideally all preoperative patients should be assessed in the CNP clinics prior to admission.

Any patients requiring genetic screening should be referred to the Aortic ANP Clinic (Appendix).

ii. Follow-up

All follow-up patients are Virtual (Telephone) and should have available for the consultation, their imaging with reports. If any issues are discovered, then a F2F consultation should be arranged.

iii. Post operative

All follow-up post operative patients are Virtual (Telephone) but a low threshold should be had for a F2F meeting.

d) Small Aneurysm (New and Follow-up)

Patients with small aneurysms have been referred at an increasing rate over the last five years with more patients undergoing CT scans with the incidental findings of aortic pathology. Following the start of the Healthy Lung Project, referrals were at such a rate as to impact the functioning of the Aortic Clinic. To address these pressures an ANP led Small Aneurysm (New) clinic was established as well as Small Aneurysm (Follow-up) clinic.

Inclusion, onward referrals and cautions:
Non-syndromic patients with thoracic aortic aneurysm up to 50 mm dimension.

Patients will be referred on to relevant aortic clinics if found to:

a. Have significant concurrent disease (valvular, coronary etc)
b. Have syndromic disease
c. Have non-syndromic disease with aggressive genetic aetiology (MYLK, MYH-11 etc) or variants of uncertain significance (VUS)

d. Chronic aortic dissection
e. Thoracoabdominal disease
f. Significant disease corrected for BSA

Patients will be followed up with caution if:

a. Previous aortic surgery
b. Anxiety related to aorta as an indication for surgery below guidelines
c. Other

i. New

All new patients are F2F and should have available to view in clinic: CT whole aorta with contrast, echocardiography and imaging of the coronary vasculature. Ideally this should have been reviewed/arranged from the OnBase referral. New patients should have on arrival: ECG, CXR and BP measurements. PFTs are optional. Where indicated blood tests may be requested. Each patient should have an EPR entry with clinic outcome documented as well as a letter to referring doctor, patients GP and copied to patient.

Patients may require special tests, further assessments including anaesthetic and further outpatient reviews.

All patients listed for surgery should be directed to the clinic nurses for preoperative investigations, swabs and treatments as per hospital policies. Ideally all preoperative patients should be assessed in the CNP clinics prior to admission.
Any patients requiring genetic screening should be referred to the Aortic ANP Clinic.

ii. Genetic counselling and testing

The NHS guidelines (Appendix) for genetic testing have the potential to overburden genetic services.

Genetic test:

1) All patients with 1st or 2nd degree relative with thoracic aortic aneurysm and/or syndromic features
2) patients with TAA ≥ 38 mm diagnosed under 50 years old with no family history and no syndromic features
3) patients with TAA≥ 38 mm diagnosed under 60 years with no classical risk factors, no family history, non-syndromic features.

LHCH policy for genetics (Appendix)

The Aortic ANP is able to offer counselling and testing as required. Patients with positive findings are referred on to genetic counsellors or clinical geneticist.

ii. Follow-up

All patients referred at the first clinical consultation to the surveillance clinic will be reviewed by first telephone call with relevant imaging and reports.

e.ABC -*Vascular* clinic (ABC-*V*)

The ABC – *Vascular* Clinic is a “Beta phase” initiative. The Clinic is attended by the Senior Lecturer and Honorary Consultant in Aortovascular Medicine as well as research staff. The goal of the ABC – *Vascular* clinic is to trial, within the context of research and innovation, optimal management and follow up of patients with aortic disease. The Clinic will focus on patients with non-syndromic thoracic aortic aneurysms, with size below the threshold for current indication to surgery. The cohort will be similar to patients seen in the Small Aneurysm ANP led Clinic and referred in by the Aortic ANP via Onbase. Of note the ABC approach is analogous to that within the NHS 10 year plan and based around risk factor management (**A**F, **B**P and **C**holesterol).

i. New

The clinical assessment in the ABC-*V* clinic will follow a vascular specific as well personalized pathway for an integrated and holistic management of patients at high risk for the diseases of aorta according to three main pillars:

1) **A**ortic stiffness assessment will be carried out at each visit through non-invasive applanation tonometry for the measurement of pulse wave velocity. The tools will provide several parameters including vascular age which will be corelated with biological age and provides an overall evaluation of the health of the vascular tree. Additional parameter as for example augmentation index and PWV which are derivative of aortic elasticity will be recorded and monitored at follow up visits. All these parameters will be compared with the imaging tests carried out as part of conventional follow up (CT and MRI).

2) **B**lood pressure optimization. Patients followed in the ABCv will undergo strict monitoring of the blood pressure with periodic assessment of 24hrs brachial pressure

monitoring. The clinic is provided also with tools for the 24 hours monitoring of central blood pressure. Optimal values of brachial blood pressure as well central blood pressure will be targeted in every patient.

3) **C**omorbidities including cardio**vascular** disease will be assessed concomitantly within the clinic according to the aim to avoid as much as possible specialist referral. The disease of the aorta can be identified as complex disease in which a pattern of comorbidities which can identified as concordant (cardiovascular) or discordant (in other organ system) develop in high percentage of cases. The holistic assessment carried in the ABC vascular has the main advantage to provide a unified approach for the management of risk factors, adoption of lifestyle changes and choices of medical therapy which will target the diseases of the aorta and the potential comorbidities associated.

In addition, clinic pathway will follow similar course to Small Aneurysm Clinic (New and Follow-up) with:

NOTE: Patients may require referral for genetic screening within ANP Clinics

Beta aspects to Clinic:

It is intended that Small Aneurysm Clinic Follow-up will be principally via letters with patients allocated to clinic slots to ensure robustness of follow-up. Future approaches may include “sub-contracting” imaging follow-up for those within the lung cancer screening programme.

4. Aortic related MDT arrangements

Proximal MDT, Distal MDT, Aortopathy MDT and Structural Heart MDT are organised by the Aortic Administrator. A degree of “clinical scrutiny” is required for the Distal MDT (Aortic Fellow) and Aortopathy MDT (Aortovascular Physician). Appendix.

5. Imaging and follow-up

The initial index presentation and diagnosis should be based on a gated contrast CT whole aorta. During subsequent follow-up, default should be where possible for low-risk targeted imaging such as echocardiography or MRI rather than CT. Where indications for surgery are equivocal based on borderline dimensions or surgical planning is required then a gated contrast CT whole aorta should be performed.

a. Follow-up of sub-therapeutic surveillance patients:

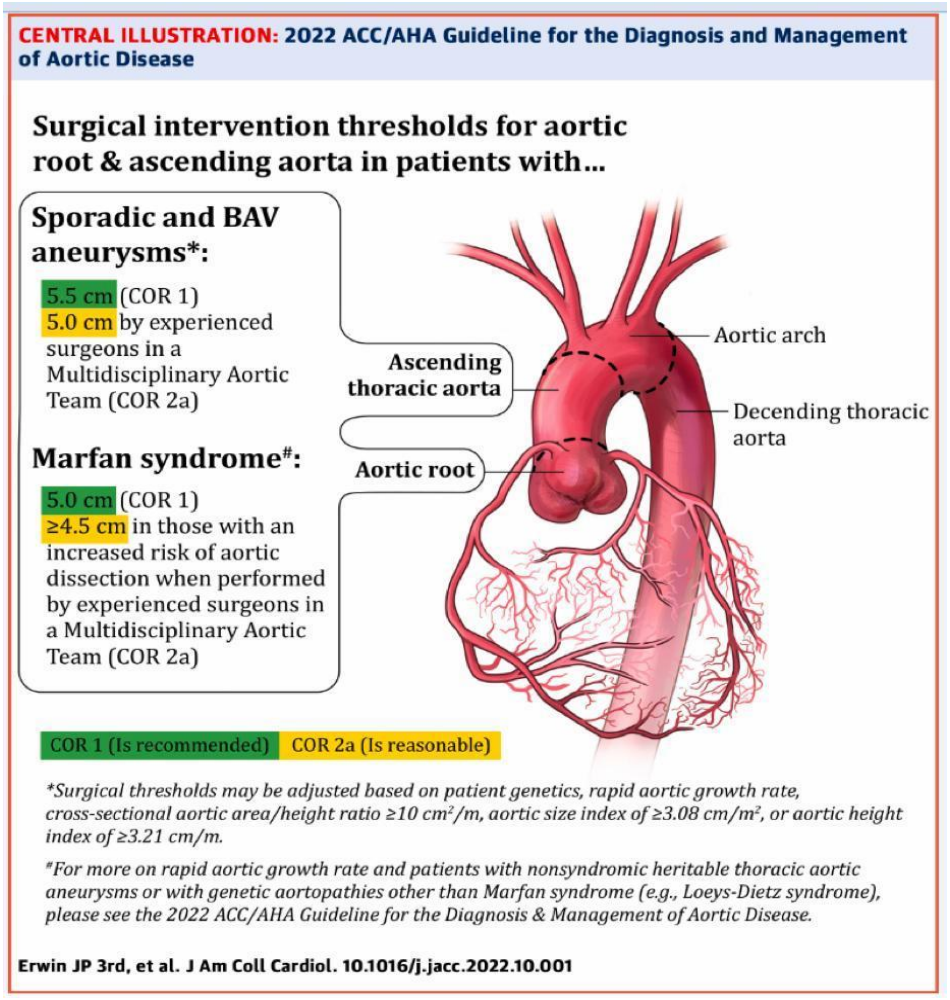
The table below are recommendations from AHA Guidelines (2022). There is however significant clinical judgement in the modality of follow-up and frequency of follow-up based on anatomy, pathology and patient factors as well as current size indications for surgery and concomitant cardiac disease.

Recommendations for Surveillance of Thoracic Aortic Dilation and Aneurysm

COR	LOE	RECOMMENDATIONS
1	C-LD	1. In patients with a dilated thoracic aorta, a TTE is recommended at the time of diagnosis to assess aortic valve anatomy, aortic valve function, and thoracic aortic diameters.[1-4]
2a	C-LD	2. In patients with a dilated thoracic aorta, a CT or MRI at the time of diagnosis is reasonable to assess thoracic aortic anatomy and diameters.[1,3,5-7]
2a	C-LD	3. In patients with a dilated thoracic aorta, follow-up imaging (with TTE, CT, or MRI, as appropriate based on individual anatomy) in 6 to 12 months is reasonable to determine the rate of aortic enlargement; if stable, surveillance imaging every 6 to 24 months (depending on aortic diameter) is reasonable.[1,3,4]

Sub-clinics

i. **ANP led Small Aneurysm Clinic:** The surveillance clinics follow a specific cohort of non-syndromic, asymptomatic, proximal aortic aneurysms and have a preferred follow-up policy and based around current indications for surgery:



Providing there are no indications for surgery (principally a stable aneurysm <5.0cm), imaging follow-up should be default 2 yearly. Exceptions may apply with more frequent imaging for those patients close to the threshold or high-risk features.

ii. **Aortopathy Clinic:** The Aortopathy Clinic includes patients at high risk of AAS including Marfan, LDS, EDS, Turners and those with aggressive gene mutations and VUS. Acknowledging the lower size threshold for surgery in this cohort (>4.5cm Marfan and LDS) and the potential for AAS in some of the sub-groups at near normal sizes, imaging follow-up should be more frequent and attentive. Given the clinic is attended by consultant cardiologist with interest in

genetics and imaging, as well as cardiac surgeon – the follow-up imaging will be patient specific and determined by those attending.

iii. **LCS Clinic:** The clinic is attended by consultant anaesthetist, vascular physician as well as cardiac and vascular surgeon. The cohort are highly nuanced and patient specific and determined by those attending.
iv. **Aortic Clinic:** Largely as per general guidance above.
v. **ABC- Vascular Clinic:** Largely as per Small Aneurysm Clinic.

b. Outpatient follow-up after repair AAS (Appendix):

The current AHA 2022 Guidelines are tabulated below. There is considerable flexibility based on anatomy, pathology and patient factors. In-patient CT schedule for acute patients in covered in other policies but all patients should have a CT whole aorta prior to discharge whether operated or not.

Recommendations for Long-Term Surveillance Imaging After Aortic Dissection and IMH
Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	RECOMMENDATIONS
1	B-NR	1. In patients who have had an acute aortic dissection and IMH treated with either open or endovascular aortic repair and have residual aortic disease, surveillance imaging with a CT (or MRI) is recommended after 1 month, 6 months, and 12 months and then, if stable, annually thereafter.[1-6]
1	B-NR	2. In patients who have had an acute aortic dissection and IMH that was managed with medical therapy alone, surveillance imaging with a CT (or MRI) is recommended after 1 month, 6 months, and 12 months and then, if stable, annually thereafter.[7]

The exact frequency of imaging follow-up will depend on the high risk features identified in the native dissected aorta

c. Follow-up of post operative patients

All patients who have undergone TEVAR, DTA/TAAA, arch and FET and repair acute Type A as well as other rare operations such as debranching, should have predischarge CT scans.

Isolated proximal surgery including hemiarch, root surgery, VSRR and Ross are not required to have predischarge CT. Ross and VSRR should however have predischarge echo. Bentall root or AVR and ascending replacement does not require routine echocardiography or CT prior to discharge.

The AHA Guidelines do not specify follow-up of patients who have undergone elective aortic surgery apart from (b) as post emergency repairs.

Root +/- ascending **+/- hemiarch** **-No distal pathology** **-No risk factors for aneurysmal disease**	-Post operative CT Aorta to be booked at 6 week OPA along with echocardiography as required -Further review at 3 months with scans Consider discharging patients to cardiologist after post-op review at 3 months for routine follow-up of prosthetic valves and secondary prophylaxis ? any opportunity for PIFU

Root+/- ascending+/- hemiarch **-residual distal pathology** **-risk factors for aneurysmal disease**	-Post operative CT Aorta to be booked at 6 week OPA along with echocardiography as required -Further review at 3 months with scans Dependent on residual disease or risk factors: -CT/MRI and echo every 1 year aiming for 2-3 year follow-up once stability of disease established Consider discharging patients of age 80 years or above or PIFU Consider discharging/PIFU for patients to cardiologist after 10 years
Repair acute Type A Dissection	-Pre-discharge CT whole aorta should be performed -Post operative CT Aorta to be booked at 6 week OPA along with echocardiography as required -Further review at 3 months with scans Dependent on residual disease and risk factors: -CT/MRI and echo every 6 months initially aiming for 1-3 year follow-up once stability of disease established These patients are prone to rapid disease progression and require close monitoring. Patients should be cross referred to LCS Clinic. No patients should be discharged.

Total arch and conventional ET	-Predischarge CT Aorta should be performed -Post operative CT Aorta to be booked at 6 week OPA along with echocardiography as required -Further review at 3 months with scans Dependent on residual disease or risk factors: -CT/MRI and echo every 1 year aiming for 2-3 year follow-up once stability of disease established Patients should be cross referred to LCS Clinic Consider discharging/PIFU patients of age 80 years or above Consider discharging/PIFU patient to cardiologist after 10 years
Total arch and frozen ET	-Predischarge CT Aorta should be performed -Post operative CT Aorta to be booked at 6 week OPA along with echocardiography as required -Further review at 3 months with scans Dependent on residual disease or risk factors: -CT and echo every 1 year aiming for 2-3 year follow-up once stability of disease established Patients should be cross referred to LCS Clinic Consider discharging/PIFU patients of age 80 years or above

	Consider discharging/PIFU patient to cardiologist after 10 years These patients require close follow-up for possible endoleaks and need for TEVAR extension Cross refer to LCS Clinic for “endovascular follow-up”
Acute Type B aortic dissection **-medical management**	Complicated acute Type B aortic dissection will have been transferred as in-patient and had clinically indicated imaging Uncomplicated acute Type B aortic dissection should have received a diagnostic index CT scan with a recommendation for further scan at 48 hours and 1 week. Providing BP control and asymptomatic status they will be seen in LCS Clinic within 6 weeks to consider TEVAR in the sub-acute phase (2-12 weeks) after MDT discussion. A CT scan should be booked at the 6 week review and seen in less than 3 months with a view to sub-acute stenting.
Acute Type B aortic dissection **-surgical/TEVAR**	- A pre-discharge CT Aorta should be performed -Post operative CT Aorta to be booked at 6 week OPA in LCS Clinic with further review at 3 months -Dependent on residual disease or risk factors:

	-CT/MRI every 1 year aiming for 2-3 year follow-up once stability of disease established Consider discharging /PIFU patients of age 80 years or above Consider discharging/PIFU patient to cardiologist after 10 years
DTA and thoraco-abdominal aortic aneurysm repair	-A pre-discharge CT Aorta should be performed -Post-operative CT Aorta to be booked at 6 week OPA -Further review at 3 months with scans -Dependent on residual disease or risk factors: -CT/MRI every 1 year aiming for 2-3 year follow-up once stability of disease established Consider discharging/PIFU for patients of age 80 years or above Consider discharging/PIFU patient to cardiologist after 10 years
Isolated TEVAR and CABG EVAR Patients	-A pre-discharge CT Aorta should be performed -Post-operative CT Aorta to be booked at 6 week OPA along with echocardiography as required -Further review at 3 months with scans Follow-up in LCS Clinic

	Patients should be referred onto Vascular Services for long term monitoring for endoleaks

6. Discharge from Imaging follow-up and Clinic

i. General

a. There should be an expectation to discharge all octogenarians from all clinics, whether surveillance or post-surgical. This should come with an offer to patients of "open" self-referral back into clinic if they so wish (PIFU). This comes with several caveats:

   i. Octogenarians are referred for surveillance and surgery as new referrals and they will need to be seen and assessed and educated. This includes emergency referrals.
   ii. Some octogenarians may still be candidates for elective intervention.
   iii. Some octogenarians may request regular imaging follow-up even accepting they are not for intervention.
   iv. Patients should be referred back to Medicine for Best Medical Therapy.

b. There should be an expectation to discharge all patients who are deemed unfit for intervention. Patients should be referred back to their referrer for Best Medical Therapy.

c. It should be clearly documented on EPR what decisions have been made about discharge and expectations if and when patients present with acute aortic syndromes so that on-call teams may make good decisions.

d. PIFU is an option for patients who would ordinarily be discharged but would like to have the option to come back for a further consultation within a specific timeframe. The PIFU option and agreed PIFU timeframe should be ticked on the outcome document and the patient

should be notified that should they not choose to activate their PIFU appointment with the agreed timeframe, they will automatically be discharged once this period expires. They can however request re-referral by their GP/consultant if required in future.

ii. Proximal Aortic Root Surgery

Emphasis should be on discharge from Clinic of proximal patients to referring Cardiologist for:

a) Imaging follow-up of prosthetic valve and graft
b) Secondary prophylaxis of risk factors
(BP, lipids, diabetes, smoking etc)

but only if:

a) Documentation of a satisfactory post operative scan is completed
b) No acute surgical issues remain
c) No residual aortic disease (aneurysmal or dissection)
d) No significant risk factors for aortic disease (Aortopathy)

Patients who have undergone VSRR or Ross procedure should be discharged to Valve Clinic after the first post-operative review.

iii. Arch +/- FET

Emphasis should be for life-long follow-up at LHCH unless deferred to regional centres. Surgery is complex and requires local follow-up. Any patients with distal disease in DTA/TAAA should be referred to LCS Clinic, some patients may have conventional elephant or frozen elephant trunks which should initially be cross referred into LCS Clinic. In-house reporting of specialist cross sectional imaging is underway.

Any patients having undergone TEVAR should be cross referred into LCS Clinic and where appropriate referred to RLUH for follow-up.

iv. DTA/TAA/TEVAR

Emphasis should be for life-long follow-up at LHCH for all open cases and referral back to RLUH Surveillance Programme for all endovascular intervention.

Discharge with “normal aorta”

In order to avoid “labelling” patients with a disease which has lifelong consequences, not isolated to insurance, it is important to discuss very mild aneurysms that when corrected to BSA, are “normal”. Such patients should be informed and discharged with a clear letter to the GP.

7. Outpatient review of infected prosthetic material

There is a regular flow of patients referred into clinics after ward discharge. These include patients with infected prosthetics treated solely with antibiotics or have undergone surgery. Commonly this cohort are on a 6 week course of IV antibiotics in the community with weekly CRP by the GP. Attendance at clinic if often to assess whether patients need to stop all antibiotics, continue with additional oral antibiotics or continue with IV antibiotics. CT +/- echo should have been performed prior to review and the contemporary bloods available. Ideally a temperature chart should also be available. Decisions around antibiotics, investigations and lines need to communicated and actioned.

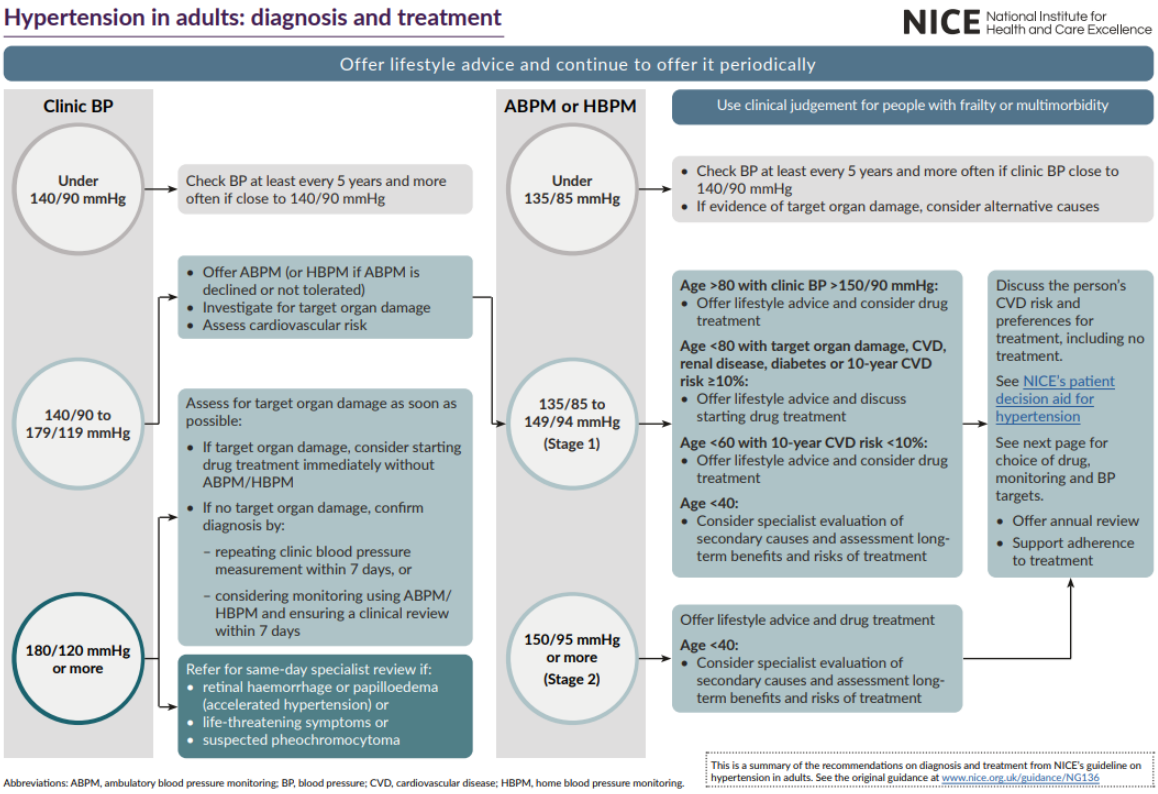
8. Medical therapies for thoracic aortic aneurysms

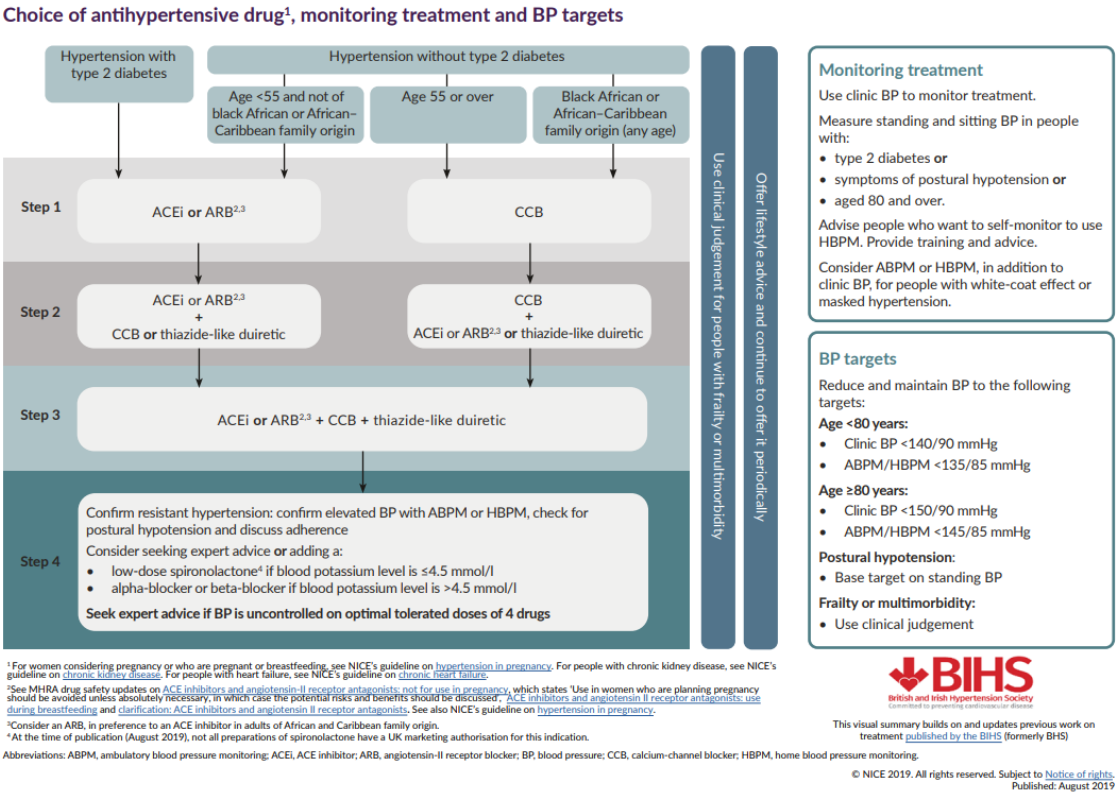
Efficacy of medical modification of aneurysm growth with drugs that modify TGF-b systems remains a controversial area as does modification of wall stress with B-blockers. The literature remains unclear around the role of these two drugs classes in addition to simple blood pressure modulation.

Our current approach is that all patients (syndromic and non-syndromic) should be on a b-blocker and TGF-B modulating drug if they can tolerate them.

9. Blood pressure management

Blood pressure control is the cornerstone of medical management of patients with aortic disease. Every patient attending our clinics should have BP measured in both arms and acted upon if necessary. Clear instructions for long term management should be communicated with the GP. Where BP measurement becomes complex and difficult, it is recommended the patient is referred to Professor Lip's Hypertension Clinic.





i. Blood Pressure Measurements in ABC – Vascular Clinic

More recently, the concept of central aortic pressure as an major determinant of aneurysmal growth and acute dissection has emerged. Of note an increased central blood pressure has been detected in patient with normal brachial pressure. Therefore, our approach is to have an assessment of both brachial and central aortic pressure during evaluation of the patients. In the first phase this will be restricted to the cohort assigned to the ABC Clinic.

All patients will have at first clinical consultation

1) Central blood pressure assessment with Pulse wave velocity

2) 24 hours BP Holter monitoring requested

Optimization of the BP will be carried out based on the results of 24 hours Holter monitoring and correspondence between brachial and central BP.

After this first assessment patients will be educated to assess their BP at least once a week preferably in the morning, taking the measurement in both arms and keep recording. If the measurements are consistently above 130/80 mmHg will be advised to seek appointment with the GP for review.

10. Life-style advice and risk factor management

Patients should be given general health advice as it relates to cardiovascular disease and specifically around:

- blood pressure
- smoking
- cholesterol
- glucose
- weight
- diet
- exercise

We endorse NHS Guidance on prevention of coronary artery disease, for which there is overlay with thoracic aneurysm disease.

Coronary heart disease - Prevention - NHS (www.nhs.uk)

Eat a healthy, balanced diet

A low-fat, high-fibre diet is recommended, which should include plenty of fresh fruit and vegetables (5 portions a day) and whole grains.

You should limit the amount of salt you eat to no more than 6g (0.2oz) a day as too much salt will increase your blood pressure. 6g of salt is about 1 teaspoonful.

There are 2 types of fat: saturated and unsaturated. You should avoid food containing saturated fats, because these will increase the levels of bad cholesterol in your blood.

Foods high in saturated fat include:

- meat pies
- sausages and fatty cuts of meat
- butter
- ghee – a type of butter often used in Indian cooking
- lard
- cream
- hard cheese
- cakes and biscuits
- foods that contain coconut or palm oil

However, a balanced diet should still include unsaturated fats, which have been shown to increase levels of good cholesterol and help reduce any blockage in your arteries.

Foods high in unsaturated fat include:

- oily fish
- avocados
- nuts and seeds
- sunflower, rapeseed, olive and vegetable oils

You should also try to avoid too much sugar in your diet, as this can increase your chances of developing diabetes, which is proven to significantly increase your chances of developing CHD.

Read more about:

- healthy eating
- eating less saturated fat
- the facts about sugar

Be more physically active

Combining a healthy diet with regular exercise is the best way of maintaining a healthy weight. Having a healthy weight reduces your chances of developing high blood pressure.

Regular exercise will make your heart and blood circulatory system more efficient, lower your cholesterol level, and also keep your blood pressure at a healthy level.

Exercising regularly reduces your risk of having a heart attack. The heart is a muscle and, like any other muscle, benefits from exercise. A strong heart can pump more blood around your body with less effort.

Any aerobic exercise, such as walking, swimming and dancing, makes your heart work harder and keeps it healthy.

Read more about fitness and exercise.

Keep to a healthy weight

A GP or practice nurse can tell you what your ideal weight is in relation to your height and build. Alternatively, find out what your body mass index (BMI) is by using our BMI calculator.

Read more about losing weight.

Give up smoking

If you smoke, giving up will reduce your risk of developing CHD.

Smoking is a major risk factor for developing atherosclerosis (furring of the arteries). It also causes the majority of cases of coronary thrombosis in people under the age of 50.

Research has shown you're up to 3 times more likely to successfully give up smoking if you use NHS support together with stop-smoking medicines, such as patches or gum.

Ask a doctor about this or visit NHS Smokefree.

Read more about stopping smoking.

Reduce your alcohol consumption

If you drink, do not exceed the maximum recommended limits.

- men and women are advised not to regularly drink more than 14 units a week
- spread your drinking over 3 days or more if you drink as much as 14 units a week

Always avoid binge drinking, as this increases the risk of a heart attack.

Read more about drinking and alcohol.

Keep your blood pressure under control

You can keep your blood pressure under control by eating a healthy diet low in saturated fat, exercising regularly and, if needed, taking medicine to lower your blood pressure.

Your target blood pressure should be below 140/90mmHg. If you have high blood pressure, ask a GP to check your blood pressure regularly.

Read more about high blood pressure.

Keep your diabetes under control

You have a greater chance of developing CHD if you have diabetes. Being physically active and controlling your weight and blood pressure will help manage your blood sugar level.

If you have diabetes, your target blood pressure level should be below 130/80mmHg.

Read more about diabetes.

Take any prescribed medicine

If you have CHD, you may be prescribed medicine to help relieve your symptoms and stop further problems developing.

If you do not have CHD but have high cholesterol, high blood pressure or a history of family heart disease, your doctor may prescribe medicine to prevent you developing heart-related problems.

If you're prescribed medicine, it's vital you take it and follow the correct dosage. Do not stop taking your medicine without consulting a doctor first, as doing so is likely to make your symptoms worse and put your health at risk.

11. Exercise

It is important to be clear with patients that exercise is good for this patient cohort when performed in moderation. There are specific recommendations on effort for different circumstances.

Recommendations for exercise included in appendices are:

a. Sub-threshold aneurysms including those with aortopathy
    i. EIM_Rx for Health_Aneurysm.pdf (exerciseismedicine.org)
    ii. 313-AneurysmExercise.pdf
    iii. Exercise and physical activity in Marfan and related disorders (Appendix)
b. Post aortic dissection
    i. Recommendations for exercise post dissection.pdf
    ii. Clinical Cardiology - 2015 - Chaddha - Exercise and Physical Activity for the Post Aortic Dissection Patient The Clinician.pdf
c. Post operative repair
    i. No residual native aortic aneurysm
        1. Without aortopathy – no restrictions once recovered from surgery and reviewed in clinic.
        2. – With aortopathy – follow (a iii)
    ii. Residual sub-therapeutic aneurysm or dissection – follow guidelines in (a) and (b).

I. Mental health

Patients with thoracic aortic aneurism commonly experience mental health disorders including anxiety, depression, shock, post-traumatic stress disorder. Also sleep disorder, memory issues and ‘post-perfusion syndrome in those underwent surgery. Any mental health issue is explored during the visit. Self-help methods are suggested. However, when needed patients are referred for specialist advise. Patients may be referred to LHCH Clinical Psychology Services via Mark Griffiths.

13. Driving

It is always best to check with the DVLA regarding a specific diagnosis and guidance on driving.

(Cardiovascular disorders: assessing fitness to drive - GOV.UK (www.gov.uk))

(Further advice will be required if other comorbid disease such as aortic stenosis, CAD etc)

Relevant guidance on our patient cohort is pasted:

Aortic aneurysm – ascending or descending thoracic and/or abdominal

All patients must have regular medical review.

Note: for Group 2 cases, the exercise or other functional test requirements will need to be met in all cases of abdominal aortic aneurysm.

	Group 1 car and motorcycle	**Group 2 bus and lorry**
Aortic aneurysm (see separate standards for people with bicuspid aortopathy or Marfan's syndrome)	! - May drive and need not notify DVLA if aneurysm diameter is less than 6 cm and there is no other disqualifying condition.	! - May drive if the aneurysm diameter is 5.5 cm or less and there is no other disqualifying condition. Must notify DVLA.*
	! - May drive but must notify DVLA if aneurysm diameter is between 6 cm and 6.4 cm. May be relicensed/licensed subject to annual review of licence and there is no other disqualifying condition.	✗ - Must not drive and must notify DVLA if the aneurysm diameter is greater than 5.5 cm. Licence will be refused or revoked. May be relicensed/licensed after successful surgical or interventional treatment if no aortic segment is greater than

	Group 1 car and motorcycle	Group 2 bus and lorry
		5.5cm in diameter and there is no other disqualifying condition.*
	✗- Must not drive and must notify DVLA if aneurysm diameter is 6.5 cm or greater. Licence will be refused or revoked. May be relicensed/licensed after successful surgical or interventional treatment if no aortic segment is greater than 6.4 cm diameter and there is no other disqualifying condition.	

*The exercise or other functional test requirements will need to be met in all cases of abdominal aortic aneurysm.

Bicuspid aortopathy

Note: Assess risk factors for aortic dissection for all drivers with bicuspid aortopathy*

Group 1 car and motorcycle	Group 2 bus and lorry
! - May drive and need not notify DVLA if the ascending aortic diameter is less than 5.5cm (or 5.0cm with a risk factor for aortic dissection *) and there is no other disqualifying condition.	! - May drive and need not notify DVLA if the ascending aortic diameter is less than 4.0 cm and there is no other disqualifying condition.
! - May drive but must notify DVLA if ascending aortic diameter is 5.5-6.4cm or greater (5.0-5.9 cm or greater with a risk factor for aortic dissection *) and there is no other disqualifying condition.	! - May drive but must notify DVLA if the ascending aortic diameter is 4.0-5.5cm (4.0-5.0cm with a risk factor for aortic dissection *) and there is no other disqualifying condition.
! - May be relicensed subject to annual review of licence and if there is no other disqualifying condition.	! - May be relicensed/licensed subject to annual review of licence and if there is no other disqualifying condition.
✗ - Must not drive and must notify DVLA if ascending aortic diameter is 6.5cm or greater (6.0cm or greater with a risk factor for aortic dissection *).	✗ - Must not drive and must notify DVLA if ascending aortic diameter is 5.5cm or greater (5.0cm or greater with a risk factor for aortic dissection *).
Licence will be refused or revoked.	Licence will be refused or revoked.
May be relicensed/licensed after successful surgical treatment without evidence of	May be relicensed/licensed after successful surgical treatment without

Group 1 car and motorcycle	Group 2 bus and lorry
further enlargement and if there is no other disqualifying condition.	evidence of further enlargement and if there is no other disqualifying condition.

*Risk factors for dissection include:

- Coarctation of aorta
- Systemic hypertension
- Family history of dissection
- Documented increase in aortic diameter greater than 3mm/year

Aortic dissection

Note: ‘satisfactory control of blood pressure’ means clinically relevant to aortic dissection, not the DVLA standard for hypertension.

	Group 1 car and motorcycle	Group 2 bus and lorry
Type A	✗ - Must not drive and must notify DVLA. Licence will be refused or revoked. May be relicensed/licensed after	✗- Must not drive and must notify DVLA. Licence will be refused or revoked. May be relicensed/licensed after

	Group 1 car and motorcycle	Group 2 bus and lorry
	successful surgical treatment if: ■ aortic diameter including the false lumen is less than 6 cm ■ satisfactory control of blood pressure and treatment adherence ■ satisfactory medical follow-up ■ no other disqualifying condition	successful surgical treatment if: ■ maximum transverse diameter of the aorta at any location is less than 5.5cm (including the false lumen) ■ complete thrombosis of the false lumen ■ satisfactory control of blood pressure and treatment adherence ■ satisfactory medical follow up ■ no other disqualifying condition
Type B	✗ - Must not drive and must notify DVLA. Licence will be refused or revoked. May be relicensed/licensed only after successful surgical or interventional treatment, or with medical treatment if: ■ aortic diameter (including the false lumen) at any location is 6.0cm or less ■ satisfactory control of blood pressure and treatment adherence	✗ - Must not drive and must notify DVLA. Licence will be refused or revoked. May be relicensed/licensed only after successful surgical or interventional treatment, or with medical treatment if: ■ aortic diameter (including the false lumen) at any location is 5.5cm or less ■ complete thrombosis of the false lumen ■ satisfactory control of blood pressure and treatment adherence

	Group 1 car and motorcycle	Group 2 bus and lorry
	■ satisfactory medical follow-up ■ no other disqualifying condition	■ satisfactory medical follow up ■ no other disqualifying condition

Marfan syndrome and other inherited aortopathies

Note: Assess risk factors for aortic dissection for all drivers with Marfan syndrome*

	Group 1 car and motorcycle	Group 2 bus and lorry
Marfan Syndrome without risk factors*	✓- May drive and need not notify DVLA if no aneurysm. ✗- If there is an aortic aneurysm must notify DVLA and must not drive if the aortic diameter exceeds 5cm.	! - Must notify DVLA. Must not drive if: ■ maximum aortic diameter is greater than 5 cm ■ severe aortic regurgitation ■ any other disqualifying condition Licence will be revoked/refused.

	Group 1 car and motorcycle	Group 2 bus and lorry
Marfan Syndrome with risk factors*	✓- May drive and need not notify DVLA if no aneurysm. ✗- If there is an aortic aneurysm must notify DVLA and must not drive if the aortic diameter exceeds 4.5cm.	✗- Must notify DVLA. Must not drive if: ■ maximum aortic diameter is greater than 4.5 cm ■ severe aortic regurgitation ■ any other disqualifying condition Licence will be revoked/refused.
Marfan Syndrome and aortic surgery	Driving may resume after successful surgical treatment (whether emergency or elective repair) and there is no other disqualifying condition.	✗- Debarred if emergency aortic surgery. Elective aortic surgery – individual assessment (see Appendix C for full details).

	Group 1 car and motorcycle	Group 2 bus and lorry
Other inherited aortopathies (for example, Loeys-Dietz syndrome, vascular type IV Ehlers-Danlos syndrome)	✗- Must not drive and must notify DVLA. Licence will be refused or revoked. Driving may resume after individual specialist assessment.	✗- Must not drive and must notify DVLA. Licence will be refused or revoked.

*Risk factors include:

- Family history of aortic dissection
- Severe aortic or mitral regurgitation
- Greater than 3mm per year increase than aneurysm diameter
- Pregnancy

Driving Guidelines

- For aneurysms ≥ 55 mm need to be reported to DVLA.
- For aneurysms ≥ 60 mm the DVLA prohibits driving
- Avoid road rage

14. Post operative guidance following cardiac surgery

Valve:

Car or motorcycle licence-

You do not need to tell DVLA. You should stop driving for at least 1 month and only restart driving when your doctor tells you it's safe.

Bus, coach or lorry licence-

Fill in form VOCH1 and send it to DVLA. The address is on the form.

If you have valve surgery, you must stop driving for at least 3 months and only restart driving when your doctor tells you it's safe.

CABG:

You don't need to tell DVLA if you have a coronary artery bypass or disease.

You should stop driving for at least 1 month and only restart driving when your doctor tells you it's safe.

Read the DVLA leaflet 'Car or motorcycle drivers with heart conditions' for more information.

Bus, coach or lorry licence

You must tell DVLA if you have a coronary artery bypass or disease.

You should stop driving for at least 3 months and only restart driving when your doctor tells you it's safe.

Fill in form VOCH1 and send it to DVLA. The address is on the form.

Chronic aortic dissection:

Please cross reference with advice around aneurysms

Car or motorcycle licence

You don't need to tell DVLA if you have chronic aortic dissection.

You should only start driving again after you have received successful treatment. Ask your doctor if you're not sure if your condition will affect your driving.

Bus, coach or lorry licence

You must tell DVLA if you have chronic aortic dissection.

Fill in form VOCH1 and send it to DVLA. The address is on the form.

15. Cardiac Rehabilitation

There is significant anxiety around patients undergoing cardiac rehabilitation following thoracic aortic surgery, particularly those who have residual native aneurysmal disease.

Patients who have undergone thoracic aortic surgery should undergo routine cardiac rehabilitation.

Guidance on exercise in patients with aortic disease is given above.

16. Flying, scuba diving and work

All questions around professional fitness (ie pilots, divers, drivers etc) should be referred on to professional licencing bodies and specialists in occupational health.

Flying as a passenger does not pose any known risk to aortic aneurysms however individuals should be aware that travel in general, particularly abroad, may place them distant for centres able to offer advanced treatments in the event of an acute aortic syndrome.

17. Patient Information Booklets

There are two relevant booklets for patients:

a. LHCH Patient Information Booklet
    i. thoracic-aortic-aneurysm-surgery-feb-18.pdf (lhch.nhs.uk)

b. Aortic Dissection Awareness Booklet
    i. https://aorticdissectionawareness.org/wp-content/uploads/2022/05/Aortic-Dissection-The-Patient-Guide-May-22.pdf

18. Pregnancy Care

Currently all patients are managed at Liverpool Women's Hospital with patient specific pathways through Vicki McKay and Reza Ashrafi.

The attached document may be helpful for patients:

https://aorticdissectionawareness.org/wp-content/uploads/2022/09/Planning-Pregnancy-with-Aortic-Disease.pdf

19. Primary Care

We endorse the ADCT "Field Guide for Primary Care":

Aortic-Dissection-Field-Guide-for-Primary-Care-PCCS-TADCT-v2.pdf (aorticdissectioncharitabletrust.org)

Document Statement

1. Roles and Responsibilities

2. Controlled Document Standards

3. Procedure

4. Policy Implementation Plan

5. Monitoring of Compliance

6. References

7. Appendices

8. Endorsed By:		
Name of Lead Clinician / Manager or Committee Chair	Position of Endorser or Name of Endorsing Committee	Date

9. Record of Changes

Section No	Version No	Date of Change	Description of Amendment	Description of Deletion	Description of Addition	Reason