

Figure S1 A sketch of vortical flow (A) and helical flow (B).

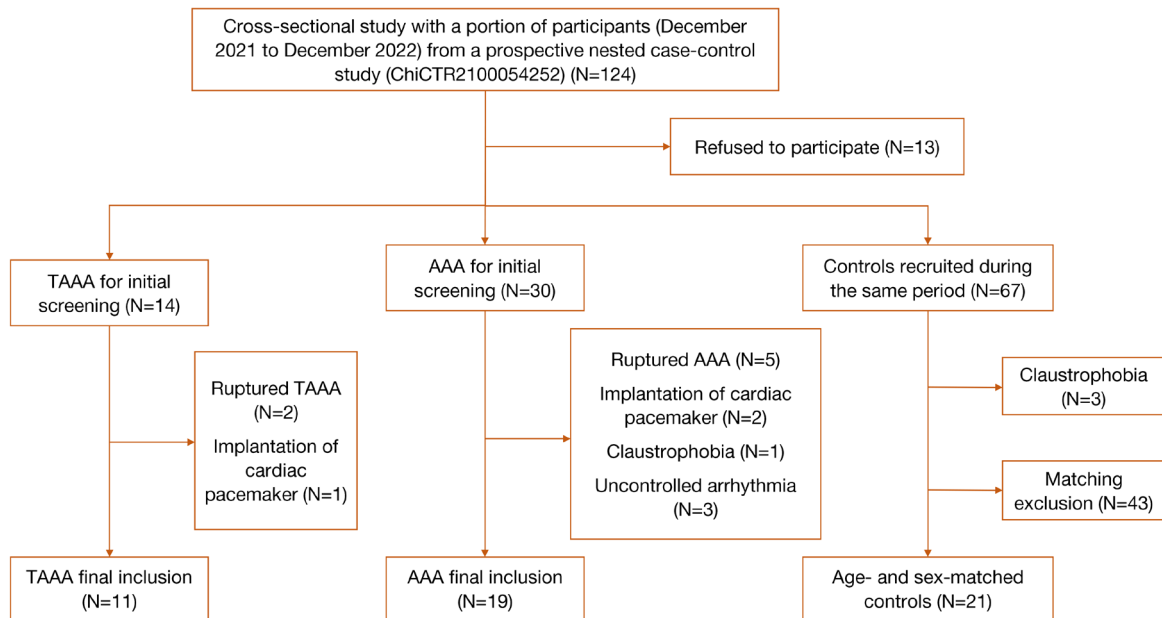


Figure S2 Flow diagram of participant selection in the study. TAAA, thoracoabdominal aortic aneurysm; AAA, abdominal aortic aneurysm.

Table S1 Overview of clinical characteristics of the three cohorts

Basic information	TAAA (N=11)	AAA (N=19)	Control (N=21)	P value		
				TAAA vs. AAA	TAAA vs. control	AAA vs. control
Age (years)	53.18±11.90	58.00±11.73	55.43±14.96	0.29	0.67	0.552
BMI (kg/m ²)	24.67±4.08	24.55±3.27	23.48±3.53	0.926	0.396	0.329
HR	72.64±12.59	70.32±8.25	75.84±10.26	0.546	0.454	0.076
Sex				0.603	0.998	0.654
Male	10 (90.91%)	16 (84.21%)	19 (90.48%)			
Female	1 (9.09%)	3 (15.79%)	2 (9.52%)			
HTN	4 (36.36%)	5 (26.32%)	3 (14.29%)	0.84	0.968	0.911
DM	1 (9.09%)	1 (5.26%)	3 (14.29%)	0.685	0.673	0.607
CAD	4 (36.36%)	7 (36.84%)	3 (14.29%)	0.979	0.151	0.1
Cerebrovascular	2 (18.18%)	1 (5.26%)	2 (9.52%)	0.256	0.482	0.609
COPD	1 (9.09%)	0 (0.00%)	0 (0.00%)	0.367	0.344	–
CKD	1 (9.09%)	0 (0.00%)	0 (0.00%)	0.367	–	–
CTD	3 (27.27%)	3 (15.79%)	0 (0.00%)	0.641	–	0.098
AA diameter (mm)	47.00 (44.45–58.35)	45.00 (33.15–50.00)	14.90 (13.95–17.12)	0.182	<0.001	<0.001
ASC diameter (mm)	35.00 (32.50–40.00)	36.50 (31.10–39.85)	31.20 (26.23–34.55)	0.796	0.043	0.04
LCIA diameter (mm)	12.40 (10.00–16.00)	16.10 (12.75–20.55)	9.85 (8.55–11.00)	0.048	0.022	<0.001
RCIA diameter (mm)	15.00 (10.50–18.50)	18.20 (13.65–23.95)	9.90 (8.50–11.00)	0.097	0.007	<0.001
Scan time (minutes)	7.49±1.26	7.16±1.76	6.00±1.13	0.413	0.005	0.024

Data are presented as the n (%) or mean standard deviation. Diameters are presented as the median (interquartile range). TAAA, thoracoabdominal aortic aneurysm; AAA, abdominal aortic aneurysm; BMI, body mass index; HR, heart rate; HTN, hypertension; DM, diabetes mellitus; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; CKD, chronic kidney disease; CTD, connective tissue disease; AA, arterial aneurysm; ASC, ascending aorta; LCIA, left iliac artery; RCIA, right iliac artery.

Table S2 Interobserver variability in hemodynamic parameters assessed by intraclass correlation coefficient in 10 healthy volunteers

Hemodynamic parameters of 11 ROIs	ICC	P value
Ascending aorta: root		
TFV	0.868	0.003
V_{\max}	0.979	<0.001
RF	0.941	<0.001
axi-WSS _{max}	0.792	0.014
axi-WSS _{avg}	0.802	0.012
cir-WSS _{max}	0.927	<0.001
cir-WSS _{avg}	0.783	0.016
WSS _{max}	0.88	0.002
WSS _{avg}	0.997	<0.001
Ascending aorta: middle		
TFV	0.952	<0.001
V_{\max}	0.582	0.105
RF	0.826	0.888
axi-WSS _{max}	0.698	0.044
axi-WSS _{avg}	0.494	0.162
cir-WSS _{max}	0.533	0.136
cir-WSS _{avg}	0.871	0.003
WSS _{max}	0.782	0.017
WSS _{avg}	0.877	0.002
Aortic arch at the plane of the brachiocephalic trunk		
TFV	0.962	<0.001
V_{\max}	0.688	0.049
RF	0.768	0.02
axi-WSS _{max}	0.875	0.002
axi-WSS _{avg}	0.681	0.052
cir-WSS _{max}	0.84	0.006
cir-WSS _{avg}	0.846	0.005
WSS _{max}	0.96	<0.001
WSS _{avg}	0.937	<0.001

Table S2 (continued)

Table S2 (continued)

Hemodynamic parameters of 11 ROIs	ICC	P value
Aortic arch at the plane of the left common carotid artery		
TFV	0.963	<0.001
V_{\max}	0.63	0.077
RF	0.777	0.018
axi-WSS _{max}	0.793	0.014
axi-WSS _{avg}	0.737	0.03
cir-WSS _{max}	0.763	0.022
cir-WSS _{avg}	0.632	0.076
WSS _{max}	0.968	<0.001
WSS _{avg}	0.955	<0.001
Aortic arch at the plane of the left subclavian artery		
TFV	0.955	<0.001
V_{\max}	0.689	0.048
RF	0.974	<0.001
axi-WSS _{max}	0.735	0.031
axi-WSS _{avg}	0.841	0.006
cir-WSS _{max}	0.566	0.115
cir-WSS _{avg}	0.785	0.016
WSS _{max}	0.971	<0.001
WSS _{avg}	0.98	<0.001
Descending aorta at the plane of the pulmonary trunk bifurcation		
TFV	0.915	0.001
V_{\max}	0.964	<0.001
RF	0.878	0.002
axi-WSS _{max}	0.716	0.037
axi-WSS _{avg}	0.835	0.007
cir-WSS _{max}	0.604	0.092
cir-WSS _{avg}	0.878	0.002
WSS _{max}	0.725	0.034
WSS _{avg}	0.855	0.004

Table S2 (continued)

Table S2 (continued)

Hemodynamic parameters of 11 ROIs	ICC	P value
Descending aorta at the plane of the heart apex or diaphragm		
TFV	0.939	<0.001
V_{max}	0.935	<0.001
RF	0.852	0.004
axi-WSS _{max}	0.89	0.001
axi-WSS _{avg}	0.884	0.002
cir-WSS _{max}	0.679	0.053
cir-WSS _{avg}	0.842	0.006
WSS _{max}	0.975	<0.001
WSS _{avg}	0.928	<0.001
Abdominal aorta at the plane of the celiac trunk		
TFV	0.7	0.004
V_{max}	0.978	<0.001
RF	0.905	0.001
axi-WSS _{max}	0.949	<0.001
axi-WSS _{avg}	0.971	<0.001
cir-WSS _{max}	0.511	0.15
cir-WSS _{avg}	0.937	<0.001
WSS _{max}	0.959	<0.001
WSS _{avg}	0.985	<0.001
Abdominal aorta at the plane of the renal artery		
TFV	0.666	0.059
V_{max}	0.799	0.013
RF	0.615	0.086
axi-WSS _{max}	0.797	0.013
axi-WSS _{avg}	0.919	<0.001
cir-WSS _{max}	0.649	0.068
cir-WSS _{avg}	0.875	0.002
WSS _{max}	0.989	<0.001
WSS _{avg}	0.995	<0.001
Abdominal aorta: middle		
TFV	0.929	<0.001
V_{max}	0.791	0.015
RF	0.972	<0.001

Table S2 (continued)

Table S2 (continued)

Hemodynamic parameters of 11 ROIs	ICC	P value
axi-WSS _{max}	0.54	0.131
axi-WSS _{avg}	0.835	0.007
cir-WSS _{max}	0.521	0.144
cir-WSS _{avg}	0.752	0.025
WSS _{max}	0.891	0.001
WSS _{avg}	0.968	<0.001
Abdominal aorta: aortic bifurcation		
TFV	0.968	<0.001
V_{max}	0.791	0.014
RF	0.972	<0.001
axi-WSS _{max}	0.881	0.002
axi-WSS _{avg}	0.919	<0.001
cir-WSS _{max}	0.744	0.028
cir-WSS _{avg}	0.969	<0.001
WSS _{max}	0.955	<0.001
WSS _{avg}	0.947	<0.001
Segmental hemodynamic parameters		
Whole aorta		
PWV	0.75	0.025
VEL _{max}	0.977	<0.001
VEL _{avg}	0.976	<0.001
Thoracic aorta		
PWV	0.6	0.094
VEL _{max}	0.84	0.006
VEL _{avg}	0.924	<0.001
Abdominal aorta		
PWV	0.81	0.015
VEL _{max}	0.781	0.017
VEL _{avg}	0.71	0.04

ROIs, regions of interest; ICC, intraclass correlation coefficient; TFV, total flow volume; RF, regurgitation fraction; axi-WSS_{max}, maximum axial WSS; axi-WSS_{avg}, average axial WSS; cir-WSS_{max}, maximum circumferential WSS; cir-WSS_{avg}, average circumferential WSS; WSS_{max}, maximum overall wall shear stress; WSS_{avg}, average overall wall shear stress; PWV, pulse wave velocity; VEL_{max}, maximum viscous energy loss; VEL_{avg}, average viscous energy loss.

Table S3 Circumferential WSS and axial WSS in 11 ROIs

WSS of 11 ROIs	TAAA (N=11)	AAA (N=19)	Control (N=21)	P value		
				TAAA vs. AAA	TAAA vs. control	AAA vs. control
Ascending aorta (root)						
axi-WSS _{max} (Pa)	1.31 (1.00–1.74)	0.83 (0.60–1.18)	1.06 (0.66–1.80)	0.063	0.483	0.345
axi-WSS _{avg} (Pa)	0.08 (0.07–0.10)	0.07 (0.06–0.08)	0.09 (0.08–0.12)	0.258	0.173	0.003
cir-WSS _{max} (Pa)	1.08 (0.64–1.29)	0.69 (0.59–0.86)	0.87 (0.64–1.47)	0.23	0.885	0.273
cir-WSS _{avg} (Pa)	0.07 (0.06–0.09)	0.07 (0.06–0.08)	0.09 (0.07–0.10)	0.689	0.063	0.028
Ascending aorta (middle)						
axi-WSS _{max} (Pa)	0.81 (0.59–1.39)	1.25 (0.71–1.47)	1.21 (0.70–1.96)	0.29	0.332	0.715
axi-WSS _{avg} (Pa)	0.09 (0.08–0.12)	0.11 (0.10–0.13)	0.13 (0.11–0.15)	0.078	0.01	0.293
cir-WSS _{max} (Pa)	0.54 (0.51–0.88)	0.74 (0.56–1.16)	0.65 (0.49–0.89)	0.466	0.68	0.891
cir-WSS _{avg} (Pa)	0.06 (0.05–0.07)	0.06 (0.06–0.08)	0.08 (0.06–0.08)	0.437	0.027	0.127
Aortic arch at the plane of the brachiocephalic trunk						
axi-WSS _{max} (Pa)	0.58 (0.49–0.96)	0.57 (0.42–0.85)	0.92 (0.56–1.14)	0.854	0.254	0.187
axi-WSS _{avg} (Pa)	0.07 (0.07–0.10)	0.09 (0.07–0.11)	0.11 (0.08–0.14)	0.405	0.009	0.081
cir-WSS _{max} (Pa)	0.31 (0.19–0.57)	0.29 (0.22–0.55)	0.39 (0.24–0.51)	0.902	0.533	0.516
cir-WSS _{avg} (Pa)	0.04 (0.03–0.06)	0.05 (0.04–0.06)	0.06 (0.04–0.08)	0.621	0.058	0.118
Aortic arch at the plane of the left common carotid artery						
axi-WSS _{max} (Pa)	0.76 (0.37–1.11)	0.97 (0.45–1.33)	0.92 (0.46–1.58)	0.46	0.451	0.715
axi-WSS _{avg} (Pa)	0.08 (0.06–0.10)	0.09 (0.07–0.12)	0.11 (0.09–0.14)	0.735	0.093	0.1
cir-WSS _{max} (Pa)	0.64 (0.35–0.81)	0.50 (0.24–0.72)	0.45 (0.25–0.60)	0.622	0.591	0.871
cir-WSS _{avg} (Pa)	0.05 (0.04–0.08)	0.06 (0.05–0.07)	0.07 (0.05–0.09)	0.689	0.575	0.174
Aortic arch at the plane of the left subclavian artery						
axi-WSS _{max} (Pa)	0.56 (0.40–0.84)	0.57 (0.46–0.78)	0.63 (0.48–0.91)	0.815	0.591	0.615
axi-WSS _{avg} (Pa)	0.05 (0.05–0.07)	0.09 (0.06–0.10)	0.09 (0.08–0.10)	0.048	0.003	0.182
cir-WSS _{max} (Pa)	0.34 (0.30–0.57)	0.46 (0.36–0.74)	0.60 (0.38–0.78)	0.204	0.189	0.665
cir-WSS _{avg} (Pa)	0.05 (0.04–0.06)	0.05 (0.04–0.08)	0.09 (0.06–0.10)	0.586	0.011	0.041
Descending aorta at the plane of the pulmonary trunk bifurcation						
axi-WSS _{max} (Pa)	0.61 (0.43–0.91)	1.01 (0.73–1.25)	1.22 (0.93–1.80)	0.036	0.003	0.201
axi-WSS _{avg} (Pa)	0.08 (0.06–0.09)	0.10 (0.09–0.14)	0.14 (0.13–0.22)	0.006	<0.001	0.013
cir-WSS _{max} (Pa)	0.44 (0.26–0.51)	0.50 (0.24–0.76)	0.60 (0.43–0.84)	0.438	0.186	0.377
cir-WSS _{avg} (Pa)	0.04 (0.03–0.07)	0.05 (0.04–0.06)	0.09 (0.07–0.10)	0.54	0.015	0.002

Table S3 (continued)

Table S3 (continued)

WSS of 11 ROIs	TAAA (N=11)	AAA (N=19)	Control (N=21)	P value		
				TAAA vs. AAA	TAAA vs. control	AAA vs. control
Descending aorta at the plane of the heart apex or diaphragm						
axi-WSS _{max} (Pa)	1.01 (0.55–1.53)	1.18 (0.73–1.58)	1.18 (0.97–1.61)	0.466	0.171	0.692
axi-WSS _{avg} (Pa)	0.09 (0.07–0.14)	0.15 (0.12–0.18)	0.18 (0.15–0.23)	0.024	0.002	0.103
cir-WSS _{max} (Pa)	0.41 (0.25–0.92)	0.40 (0.31–0.78)	0.55 (0.25–0.95)	0.832	0.513	0.34
cir-WSS _{avg} (Pa)	0.06 (0.04–0.08)	0.06 (0.04–0.06)	0.07 (0.06–0.08)	0.851	0.131	0.015
Abdominal aorta at the plane of the celiac trunk						
axi-WSS _{max} (Pa)	0.51 (0.44–0.86)	1.05 (0.80–1.24)	1.16 (0.93–2.06)	0.006	0.002	0.185
axi-WSS _{avg} (Pa)	0.08 (0.07–0.11)	0.14 (0.12–0.16)	0.20 (0.17–0.25)	0.002	<0.001	0.002
cir-WSS _{max} (Pa)	0.33 (0.25–0.50)	0.59 (0.30–0.67)	0.52 (0.41–0.83)	0.116	0.065	0.757
cir-WSS _{avg} (Pa)	0.06 (0.04–0.06)	0.07 (0.05–0.07)	0.08 (0.07–0.10)	0.15	0.001	0.023
Abdominal aorta at the plane of the renal artery						
axi-WSS _{max} (Pa)	0.79 (0.40–0.86)	1.16 (0.75–1.36)	1.05 (0.72–1.60)	0.037	0.028	0.989
axi-WSS _{avg} (Pa)	0.08 (0.07–0.10)	0.13 (0.10–0.16)	0.16 (0.13–0.18)	0.01	<0.001	0.05
cir-WSS _{max} (Pa)	0.43 (0.23–0.62)	0.48 (0.32–0.85)	0.37 (0.28–0.78)	0.366	0.451	0.597
cir-WSS _{avg} (Pa)	0.06 (0.04–0.07)	0.05 (0.04–0.09)	0.07 (0.06–0.10)	0.344	0.045	0.218
Abdominal aorta (middle of the abdominal aorta)						
axi-WSS _{max} (Pa)	0.44 (0.28–0.61)	0.59 (0.33–0.73)	1.11 (0.81–1.42)	0.355	<0.001	<0.001
axi-WSS _{avg} (Pa)	0.06 (0.04–0.10)	0.06 (0.05–0.09)	0.17 (0.15–0.20)	0.73	<0.001	<0.001
cir-WSS _{max} (Pa)	0.29 (0.19–0.39)	0.34 (0.25–0.55)	0.55 (0.39–0.87)	0.378	0.023	0.076
cir-WSS _{avg} (Pa)	0.04 (0.03–0.05)	0.04 (0.03–0.05)	0.08 (0.06–0.09)	0.451	<0.001	0.001
Abdominal aorta (aortic bifurcation)						
axi-WSS _{max} (Pa)	0.75 (0.23–0.94)	0.40 (0.27–0.65)	0.85 (0.64–1.10)	0.426	0.226	<0.001
axi-WSS _{avg} (Pa)	0.07 (0.04–0.10)	0.06 (0.05–0.08)	0.12 (0.10–0.16)	0.983	<0.001	<0.001
cir-WSS _{max} (Pa)	0.34 (0.17–0.56)	0.24 (0.18–0.37)	0.47 (0.33–0.61)	0.491	0.204	0.002
cir-WSS _{avg} (Pa)	0.04 (0.03–0.05)	0.04 (0.03–0.04)	0.06 (0.05–0.07)	0.931	0.013	<0.001

All data are given as the median (interquartile range). WSS, wall shear stress; ROIs, regions of interest; TAAA, thoracoabdominal aortic aneurysm; AAA, abdominal aortic aneurysm; axi-WSS_{max}, maximum axial WSS; axi-WSS_{avg}, average axial WSS; cir-WSS_{max}, maximum circumferential WSS; cir-WSS_{avg}, average circumferential WSS.