

## Ultrasound Reference Ranges: Updated Feb 2024

SITE	CONTEXT	MEASUREMENT
Ankle/brachial index	Normal Mild to mod ischaemia Severe	>0.95 0.5 to 0.95 <0.5
Abdominal Aneurysm	High risk (measurement +-3mm) CT variability 3D US most accurate	>5cm needs CTA +5mm for CT equivalent
Appendix	Appendicitis Diameter Other	>6mm appendicolith, vascularity, loss of wall stratification
Arterial bypass graft	High risk of failure	PSV < 45 or > 150
Arterial Graft Stenosis	Art bypass graft stenosis (vein graft) 60-70% >75%	200-400cm/s or ratio 2-4 >400 cm/s or ratio >4.0
Bladder wall	Normal width (Full bladder) Children	3-6mm <3mm full, <5mm empty
Bowel diameter	Normal	<3cm SB and <5cm LB
Bowel wall	Normal Abnormal	<4mm 4-6mm mild; 6-9mm mod; >9mm severe
Bowel wall -abnormal	Crohns disease -chronic CD has increased submucosal echogenicity  Ulcerative colitis	Symmetric, transmural peri-enteric LN & mesenteric fat changes +- micro perforation, perforation, obstruction, fistula, phlegmon primarily mucosal
Carotid stenosis	Less than 50% diameter narrowing <sup>i</sup>	PSV <155cm/s
Carotid stenosis	50-69% diameter narrowing <sup>i</sup>	PSV 155-230 cm/s and ICA/CCA ratio of ≥2

Carotid stenosis	>70% diameter narrowing	PSV > 230 (ICA/CCA > 4.0 supportive)
Carotid stenosis	>80% diameter narrowing	EDV of $\geq 140$ cm/s, a PSV $\geq 370$ cm/s and ICA/CCA ratio of $\geq 6$
Carotid stenosis	Occlusion	No patent lumen & no flow on colour doppler, and power U/S
Carotid stenosis post CEA	No reliable figures. note 2x PSV at distal end patch is OK	Progressive increase or PSV > 180
Carotid stenosis with stent <sup>ii</sup>	>50% >80%	PSV > 220 & IC/CC ratio > 2.7 PSV >340 & IC/CC ratio > 4.15
Carpal Tunnel Syndrome	See median nerve.	
Central retinal artery	RI PSV	>0.7 >13 cm/s
Cerebellum	Foetal 2 <sup>ND</sup> trimester	= number weeks gestation
Cervix	Length in pregnancy If <35mm TA then do TV Cervical incompetence < 25mm TV	35-50mm  Refer for OBS review & progesterone pessaries
Cisterna magna	Foetal 18 weeks (Normal range) Pathological	2-10mm >13mm
Club foot	MM-Navicular distance (neutral) MM-Navicular distance (Abduction)	<4mm (normal 9 <sup>+4</sup> ) <7mm (normal 12 <sup>+5</sup> )
Coeliac artery	Normal low resistance flow	60-140 cm/s
Coeliac stenosis	Poor sensitivity	PSV > 200 tardus-parvus in spleen/ liver
Common bile duct	Diameter	<7mm
Common bile duct	Diameter post cholecystectomy	<10mm
Common hepatic duct	Diameter	<7mm
Cord tethering	Lose pulsatility, not central, wrong level conus	<i>count up from 1<sup>st</sup> sacral segment</i>
Conus medullaris	Level at birth 6mths age	L2,3 disc L1

Endometrium *pre-menopause	Proliferative phase Secretory	<8mm <15mm
Endometrium *post-menopause	Regardless of therapy	<5mm
Endometriosis diagnosis	Uterosacral ligament nodule Loss of glide POD, ovaries, UV pouch	Any USL nodule
Endometriosis	Ureteric involvement likely	USL nodule > 17mm
FATTY LIVER (visual)	MILD  MODERATE  SEVERE	Hyperechoic only without fatty sparing (latter =mod/severe) +loss of portal tract visibility +severe beam attenuation
Fatty Liver (HRI)	1.49-1.86 1.87-2.22 >2.22	5-25% 25-60% >60%
FIBROSIS LIVER* *SWE median of 10 readings	Significant fibrosis Cirrhosis NORMAL	>7.6 kPa >11.4 kPa <5.7kPa
Femoral artery stenosis	30-49% diameter narrowing 50-69% 70% >75%	PSV X 1.5 PSV x 2, PSV > 200, EDV>100 PSV x 3 PSV x 4
Flexor tendons	Max width at 2-4mcp	3.7mm
First Trimester Brain	Brainstem:Occipital bone ratio	0.5-1.0
Foetal bladder	Sagittal dimension Normal size (+7mm) Megacystis (posterior urethral valves, vesico-ureteral reflux, megaureter or prune-belly syndrome)	GA in weeks -5 Sag length > GA+12
Foetal cephalic index	BPD/FOD x 100	78 +- 5
Foetal Femur	Short femur	Placental insufficiency (check UA Doppler & "cupcake"placenta) trisomy, skeletal dysplasia
Foetal heart circumference	All gestations	<50% thoracic circumference
Foetal kidneys	K:A ratio (AP abdomen any age)	0.27-0.30

Foetal kidneys	Pyelectasia	<5 (2ndT); <7mm (3rdT)
Foetal T:A ratio	Standard Abdo C, thorax at 4 chamber level	>0.75
<b>Foetal soft signs 2nd trimester. Isolated Likelihood ratios for each as an isolated defect (from JOGC June 2005 and Agathokleous<sup>iii</sup>). Only a single abnormality with all others absent. This ratio should be multiplied by the background maternal risk or the adjusted 1st trimester risk.</b>	Aberrant right subclavian artery Nuchal thickening Short humerus echogenic bowel Short femur echogenic cardiac focus pyelectasia, single UA, enlarged Cis magna ventriculomegaly choroid plexus cyst nasal bone absent/hypoplastic	<b>3.94 (T21)</b> <b>3.8 (T21)</b> <b>0.8 (T21)</b> <b>1.65 (T21)</b> <b>0.6 (T21)</b> <b>0.95 (T21)</b> <b>1.08 (T21 and T18)</b> <b>3.8 (T21)</b> <b>1-1.5 (T21) and 7 (T18)</b> <b>6.6 ((T21)</b>
<b>Foetal soft signs 2nd trimester for T21. Calculating likelihood ratios from 2<sup>nd</sup> trimester scan<sup>iii</sup>. The compound risk is derived from multiplying all positive and negative ratios to obtain a derived ratio, which should then be multiplied by the background maternal risk or the adjusted 1st trimester risk.</b>	Aberrant right subclavian artery Nuchal thickening Short humerus echogenic bowel Short femur echogenic cardiac focus pyelectasia ventriculomegaly nasal bone absent/hypoplastic	21.5 (+) or 0.71 (-) 23.3 (+) or 0.80 (-) 4.8 (+) or 0.74 (-) 11.5 (+) or 0.90 (-) 3.7 (+) or 0.80 (-) 5.8 (+) or 0.80 (-) 7.6 (+) or 0.9 (-) 27.5 (+) or 0.94 (-) 23.3 (+) or 0.46 (-)
Foetal Growth Restriction	Early Onset	AC< 3 <sup>rd</sup> percentile OR UA absent or reversed EDV OR AC< 10 <sup>th</sup> centile plus abnormal UA doppler
Foetal Growth Restriction	Late onset	AC< 3 <sup>rd</sup> percentile OR at least 2 of the following: -AC< 10 <sup>th</sup> centile -decline in AC >30% from 28+ weeks -abnormal UA doppler -CPR <5 <sup>th</sup> percentile -UT art PI>95 <sup>th</sup> percentile or bilateral notching
Gallbladder wall	Thickness	<3mm
Heel Pad thickness <sup>iv</sup> First MT fat pad thickness	Measured at medial calcaneal tubercle Measure at 1 <sup>st</sup> MT head	>13mm >6mm

Hydrocephalus	Neonatal brain: Ant Horn of LV at level of Foramen of Munro see also <a href="#">subarachnoid space</a>	<5mm normal 5-10mm mild-mod >10mm severe
Inferior mesenteric artery	Patent, occluded or non-visualised <i>relevant if SMA or Coeliac disease</i>	
Inguinal Canal	Infants normal Infants hernia	<4mm at Internal ring >4mm
Inferior vena Cava	Normal	<3.7cm
Kidney: normal	Grade 0: cortical echogenicity is less than that of spleen, with well-maintained cortico-medullary differentiation (grade 0)	9.5-12cm
Kidney: CKD <sup>v</sup>	Grade 1: cortical echogenicity is same as that of spleen, with maintained cortico-medullary differentiation.	>9.5cm
Kidney: CKD	Grade 2- cortical echogenicity is more than that of spleen, decreased cortico-medullary differentiation.	>9.5cm
Kidney: CKD	Grade 3: cortical echogenicity is more than that of spleen, with poorly maintained cortico-medullary differentiation.	<9.5cm
Knee Cartilage thickness men femoral condyles	Measured in full flexion <sup>vi</sup> , transverse image	MC 2.1 +/-0.4mm IC 2.2 +/-0.4 LC 2.1 +/-0.3
Knee cartilage thickness women femoral		MC 1.9 +/-0.3mm IC 2.0 +/-0.4 LC 1.9 +/-0.3
Lisfranc ligament	Tear can be assessed between Cuneiform1 and metatarsal2	Non-visualisation of the dorsal C1-M2 ligament and C1-M2 distance > 2.5 mm
Liver fibrosis	Normal shear wave stiffness Mild Mild-mod Mod-severe	2.0-5.7 kPa 5.7-7.6 7.6-11.5 >11.5
Median nerve	Area at proximal carpal tunnel Transverse diameter Flattening ratio (trans/AP diameters)	<0.10 cm <sup>2</sup> <5.5mm <2.6 (if >4.0 will need Surg) <sup>vii</sup>

Median nerve	Bowing Outlet: Baseline connects trapezium & hook of hamate. Inlet line b/w scaph/pisiform	<2mm (inlet) <1mm (outlet)
Median Nerve	Change in area between pronator quadratus and Carpal Tunnel	<2mm <sup>2</sup>
Nuchal thickness	18 weeks	<6mm
Oligohydramnios <sup>ix</sup>	AFI Deepest Pocket (SDP) Diamniotic pregnancy (SDP)	<5cm <2cm <2.2cm
Ovarian follicle	Dominant mid-cycle	<40mm
Ovarian size	<2yrs 2-puberty pre-menopause	<1cm <sup>3</sup> <4 cm <sup>3</sup> 6-18 cm <sup>3</sup>
Ovarian vein	Diameter Pelvic congestion (AJR 2004 March; 182:683-688) <i>see also pelvic venous incompetence</i>	<5mm reverse flow; dilated transuterine veins; varicocoele; PCO;
Paediatric HIPS <sup>viii</sup>	Femoral head coverage (normal) Femoral head coverage (abnormal) $\alpha$ -angle (normal) $\alpha$ -angle (abnormal)	>53% <45% >59° <50°
Parotid gland	axis parallel to the mandibular ramus transverse axis Extensions of the parotid parenchyma are lateral to the mandible dorsal to the mandible.	46.3 ± 7.7 mm 37.4 ± 5.6 mm 7.4 ± 1.7 mm 22.8 ± 3.6 mm
Patellar tendon	AP diameter proximal attachment	<3mm >5mm = severe tendinopathy
Pelvic Venous incompetence	Ovarian vein Pelvic varicocoele Uterine arcuate veins	>6mm >5mm >5mm connecting varicocoeles
Peroneal nerve	Check at fibular head and 1—12cm above ankle where pierces fascia	Sensory and/or motor Dorsal foot pain
Placenta	Thickness midpoint insufficiency with reduced volume	>2cm “cupcake” appearance
Plantar Fascia origin	Thickness	<3mm

Plantar fascia	Normal heel pad thickness -measured at medial calcaneal tubercle	12-16mm (non-compressed)
Plantar plate	Metatarsal	20 x 9 x 2mm
Polyhydramnios <sup>ix</sup>	AFI Deepest Pocket (SDP) Diamniotic Pregnancy (SDP)	>25cm >8cm >7.5cm
Popliteal artery stenosis	>50% >70%	PSV x 2 PSV x 3 or PSV > 200
PORTAL HYPERTENSION ASSESSMENT	<b>Congestion Index:</b> ratio between the cross-sectional area (cm <sup>2</sup> ) and the blood flow velocity (cm/sec) of the portal vein <sup>x</sup>  <b>SHEARWAVE ELASTOGRAPHY<sup>xi</sup></b>	<0.1 NORMAL >0.1 possible PHT >0.15 PHT  >13.9Kpa possible PHT >16.1 HIGH RISK VARICES >29.5 Definite PHT <sup>xii</sup>
Portal Vein	Normal calibre Normal Velocity (antegrade) suggestive of PHT Severe PHT	<13mm >20cm/s <16cm/s reversed flow
Posterior interosseus nerve <sup>xiii</sup>	Entrapment at arcade of Fröhse (level of supinator). Test with resisted pronation.	Normal average 1.1mm entrapped average 0.7mm
Posterior tibial tendon	Normal width	4-6mm
Pregnancy Failure	MSD	>25mm (TV)
Pregnancy Failure	For CRL >7mm	NO FHM
Prostate	Size	4x4x3cm
Prostate	Volume	<30cc
Pylorus	Pyloric max canal length <sup>xiv</sup> Normal canal length	<15mm <6mm
Pylorus	Muscle width max	<3mm
Renal Artery Stenosis (direct)	> 60% stenosis beware occluded RA	PSV >250; RAR > 3.5; post-stenotic turbulence
Renal Artery Stenosis	50-60% (borderline significance)	180-250cm <sup>s</sup> , RAR>3.0-3.5

Renal Artery Stenosis (indirect)	> 60% stenosis -LESS SENSITIVE than DIRECT	AT >60 ms; AI <3.0m/s <sup>2</sup> ; R/L waveform asymmetry; RI <0.45
Renal Transplant	Rejection, ATN, RV thrombosis obstruction, collections Perinephric collection	RI >0.8  urine, blood, lymph, pus
Renal Transplant doppler	RA stenosis <sup>xv</sup>  RV stenosis	PSV >250 and ratio >2.5 plus intrarenal changes PSV RA <b>OR</b> >13x PSV intralobar art 3-4 x velocity
Resistive Indices KIDNEYS	Acute Obstruction or tubulointerstitial disease  NORMAL in nephritis or chronic obstruction	>0.7 or difference of >0.10 side-side
Renal Vein (left)	Nut-cracker syndrome	Peak velocity > 80
Rotator cuff	mean thickness	3.9-6.6mm (men) 3.6-6.2mm (women)
Sacroiliac joint	Resistive index (AJR 9/99:677) sacroiliitis	0.91 ±0.09 0.62 ±0.13
Shoulder muscle wasting	Deltoid +/- Teres minor TM + Infraspinatus +/- supraspinatus TM + infraspinatus	Quadrilateral space syndrome SSN (check spinoglenoid notch) Parsonage Turner syndrome involves variable nerves
Shoulder Capsulitis	Inferior glenohumeral ligament (inside to inside, thickest part) Coracohumeral Ligament	>3.5mm  >2.2mm
Skull (neonatal ) (AJR 97;168:819-21)	Lambdoid suture Coronal Sutures Sagittal	0.55-1.35mm 0.55-1.25mm 0.65-1.21mm
Submandibular Gland	anterior-posterior length, 35 ± 5.7 mm; Para mandibular extension to gland depth, extension in frontal scanning	30-40mm 9-20mm 29-39mm
SMA Syndrome	SMA angle (Aorta-SMA°) <i>abnormal</i> <i>normal</i>	6-25°  >38°
SMA Syndrome	Aoro-mesenteric distance <i>abnormal</i> <i>normal</i>	<8mm  >10



SMA stenosis	Poor sensitivity	PSV > 275 EDV>100 when severe SMA/Ao > 3.5 Angle > 25°
Spleen size	Less than (max 13cm any age)	1/3 <sup>rd</sup> AGE + 6
Spleen Shearwave elastography	Normal Portal hypertension (rule out) Portal hypertension (rule in)	<20kPa <22 kPa >36 kPa
Spleen Volume	Adults (0.524 × Width × Thickness × Length) <sup>xvi</sup>	35-210cc <sup>xvii</sup>
Temporal Artery	Vasculitis: non-compressible Hypochoic wall (halo sign) with increased IMT Stenosis (with above) occlusion	normal IMT: <0.4mm -common TA <0.34mm -frontal branch <0.29 -parietal branch
Subarachnoid space	Neonatal brain (normal Sino-cortical width)) Benign External Hydrocephalus* External Hydrocephalus <i>*also check interhemispheric gap (&lt;5mm) and cortical veins not displaced</i>	<5mm <10mm >10mm
Thyroid	Volume	6-14mls
Tibialis posterior tendon <sup>xviii</sup>	AP x trans AP:Transverse ratio	1.8-4.4mm x 8.1-13mm <0.45
Twin-Twin Transfusion Syndrome	MA/DA pregnancy	Oligohydramnios in one sac and polyhydramnios in the other
Ulnar nerve	At medial epicondyle (ellipse tool) at Piso triquetral joint	<0.06 cm <sup>2</sup> may get symptoms in ulnar n distn
Umbilical Artery doppler	MCA:UA S/D ratio (<1 = foetal distress)	>1.0
Umbilical Artery RI	26 weeks 30 weeks 36-40 weeks	<5.0 <b>NORMAL</b> <4.0 <3.0
Ureters	Normal	<6mm

Uterine Artery RI	<b>ABNORMAL</b> Uterine artery RI early diastolic notch after 22 weeks is <b>ABNORMAL</b>	>0.8 at 20 weeks >7.0 at 30 weeks >6.0 at 38 weeks
Uterine wall in pregnancy	35-38 weeks at site LSCS HIGH risk of rupture	>3mm <2.3mm
Uterus	Endometrial thickness pre-menopause	<8mm (proliferative) <15mm (secretory)
Uterus	Endometrial thickness post-menopause oestrogen phase of cyclical HRT  progesterone phase of cyclical HRT continuous oestrogen & progesterone asymptomatic PM on tamoxifen	<5mm <15mm <5mm <6mm <6mm
Uterus	Size (average adult)	8x3x6 cm
Uterus length	Neonate Infant	2.3-4.6 2.5-3.3
Vascular Malformation	Paediatric	High flow, definable masses require further Ix. Low flow most likely haemangioma
Ventricle 4 <sup>th</sup>	Foetal 2 <sup>nd</sup> trimester (larger at term)	<2mm
Ventriculomegaly	Occipital horn (all ages gestation)	<10mm
Ventriculomegaly	Lat-Ventricle / hemisphere ratio	<75% (16 weeks) <35% (25 weeks)

# References

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- <sup>i</sup> Shaalan WE et al. J Vasc Surg 2008 Jul;48(1):104-112.
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- <sup>iii</sup> Agathokleous et al: Second trimester screening for trisomy 21. *Ultrasound Obstet Gynecol* 2013; **41**: 247–261.
- <sup>iv</sup> Belhan et al, 2019. See <https://doi.org/10.1016/j.aott.2019.07.005>
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- <sup>vi</sup> Bedewi et al doi: 10.1097/MD.00000000000019455
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- <sup>x</sup> Adapted from Moriyasu F et al: Congestion index of the portal vein. *AJR Am J Roentgenol.* 1986 Apr;146(4):735-9.
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- <sup>xii</sup> <https://doi.org/10.1111/liv.13243>
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- <sup>xviii</sup> Premkumar et al. *AJR*2002;178:223-232