

## Ultrasound Reference Ranges: Updated Jan 2019

SITE	CONTEXT	MEASUREMENT
Ankle/brachial index	Normal	>0.95
	Mild to mod ischaemia	0.5 to 0.95
	Severe	<0.5
Arterial bypass graft	High risk of failure if...	PSV < 45 or > 150
Arterial Graft Stenosis	Art bypass graft stenosis (vein graft) 60-70%	200-400cm/s or ratio 2-4
	>75%	>400 cm/s or ratio >4.0
Bladder wall	Normal width (Full bladder)	3-6mm
Calcaneal nerves	ICN: Baxter's nerve seen b/w FDB and Quad Planae	Echogenic/denervated Abd dig minimi
	Medial plantar nerve	Knot of Henry (Xover FDL/FHL deep to Abd Hall)
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 ≥140 cm/s, a PSV ≥370 cm/s and ICA/CCA ratio of ≥6
Carotid stenosis	Occlusion	No patent lumen & no flow on color, 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%	PSV > 220 & IC/CC ratio > 2.7
	>80%	PSV >340 & IC/CC ratio > 4.15
Carpal Tunnel Syndrome	See median nerve.	
Central retinal artery	RI	>0.7
	PSV	>13 cm/s

Cerebellum	Foetal 2 <sup>ND</sup> trimester	= number weeks gestation
Cervix	Length in pregnancy Cx incompetence < 2cm	35-50mm
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	Loss 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
FATTY LIVER	MILD  MODERATE SEVERE	Hyperechoic only without fatty sparing (latter =mod/severe) +loss of portal tract visibility +severe beam attenuation
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

Foetal age (days)	MGSD= mean gestational sac diameter	30 +MGSD
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 dysplasias
Foetal heart circumference	All gestations	<50% thoracic circumference
Foetal kidneys	K:A ratio (AP abdomen any age)	0.27-0.30
Foetal kidneys	Pyelectasis	<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>.</b> <i>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.</i>	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 (-)
Gallbladder	Length x width	3x9cm
Gallbladder wall	Thickness	<3mm

Heel Pad thickness adapted from <sup>iv</sup>	At rest Compression	12-16mm (exc PF)
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
Lisfranc ligament	Tear can be assessed between Cuneiform 1 and metatarsal 2	Non-visualisation of the dorsal C1-M2 ligament and C1-M2 distance > 2.5 mm
Liver fibrosis	Normal shearwave stiffness Mild Mild-mod Mod-severe	2.0-4.5 kPa 4.5-5.7 5.7-12.0 >12.0
Median nerve	Area at proximal carpal tunnel	<0.10 cm <sup>2</sup>
Median nerve	Transverse diameter (long axis)	<5.5mm
Median Nerve	Change in area between pronator quadratus and Carpal Tunnel	<2mm <sup>2</sup>
Nuchal thickness	18 weeks	<6mm

Oligohydramnios <sup>vii</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)	<5mm reverse flow; dilated transuterine veins; varicocoele; PCO;
Paediatric HIPS <sup>vi</sup>	Femoral head coverage (normal) Femoral head coverage (abnormal) $\alpha$ -angle (normal) $\alpha$ -angle (abnormal)	>53% <40% >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 prox attachment	<3mm >5mm = sever t'pathy
Placenta	Thickness midpoint insufficiency with reduced volume	>2cm "cupcake" appearance
Plantar plate	Metatarsal	20 x 9 x 2mm
Polyhydramnios <sup>vii</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 Congestion Index	ratio between the cross-sectional area (cm <sup>2</sup> ) and the blood flow velocity (cm/sec) of the portal vein <sup>viii</sup>	<0.1 NORMAL >0.1 possible PHT >0.15 PHT
PORTAL HYPERTENSION	SHEARWAVE ELASTOGRAPHY <sup>ix</sup>	>13.9Kpa VARICES >16.1 HIGH RISK VARICES
Portal Vein	Normal calibre Normal Velocity (hepatopetal)	<13mm >40

	suggestive of PHT Severe PHT	<30 reversed flow
Posterior interosseus nerve <sup>x</sup>	Entrapment at arcade of Frohse (level of supinator)	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	Neonate max canal length	14mm
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>xi</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

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; paramandibular extension to gland depth, extension in frontal scanning	30-40mm 9-20mm 29-39mm
SMA stenosis	Poor sensitivity	PSV > 275 EDV>100 when severe SMA/Ao > 3.5
Spleen size Spleen volume	Less than (max 13cm any age) Adults (0.524 × Width × Thickness ×Length) <sup>xii</sup>	1/3 <sup>rd</sup> AGE + 6 35-210cc <sup>xiii</sup>
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
Testicle	Length x AP x trans	3-5cm x 2-3 x 2-3
Testicle	Volume	16-20mls
Thyroid	Volume	6-14mls
Tibialis posterior tendon <sup>xiv</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)	<0.06 cm <sup>2</sup>
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 ABNORMAL	>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

<sup>i</sup> Shaalan WE et al. J Vasc Surg 2008 Jul;48(1):104-112.

<sup>ii</sup> J Vasc Surg 2008 Jan;47(1):63-73

<sup>iii</sup> Agathokleous et al: Second trimester screening for trisomy 21. *Ultrasound Obstet Gynecol* 2013; **41**: 247–261.

<sup>iv</sup> Sabir et al: J Ultrasound Med 2005; 24:1041–1048

<sup>v</sup> Shivashankara et al. Journal of Clinical and Diagnostic Research. 2016 Feb, Vol-10(2): TC09-TC11

<sup>vi</sup> C. Gunay & H. Atalar & H. Dogruel & O. Y. Yavuz & I. Uras & U. Sayli: Correlation of femoral head coverage and Graf  $\alpha$  angle in infants being screened for developmental dysplasia of the hip. *International Orthopaedics* 2008.

<sup>vii</sup> Dubil E and Magann E. AJUM 2013;16(2):62-70.

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<sup>viii</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>ix</sup> J Ultrasound Med, July 2016, Vol. 35:7, pp. 1373-1381

x Dong Q et al. J Ultrasound Med 2010;29:691-6

<sup>xi</sup> Granat et al. [J Ultrasound](#). 2015 Jun; 18(2): 101–107.

<sup>xii</sup> <https://www.ajronline.org/doi/10.2214/ajr.181.6.1811615>

<sup>xiii</sup> [ncbi.nlm.nih.gov/pubmed/12397778](https://pubmed.ncbi.nlm.nih.gov/12397778/) ([Hepatogastroenterology](#). 2002 Nov-Dec;49(48):1726-7.)

xiv Premkumar et al. AJR2002;178:223-232