



**Government
of South Australia**

SA Health

Division of Medical Imaging



FLINDERS
MEDICAL
CENTRE

Normal Sonographic Measurements and

**Guidelines for EIF, CPC, fetal renal
dilatation, markers for chromosomal
abnormalities and fetal abnormalities**

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Abdomen

Adrenal

- 4-6mm
- Thickness 2-4mm
- Width 2-3mm

Aorta

- The maximum transverse outer wall diameter is the preferred measurement for assessment of aortic size
- Avoid transverse measurements if there is side to side tortuosity
- Total length of aneurysm measurements are of no use clinically and should not be quoted as this can lead to confusion with the AP diameter
- Aneurysm > 3.0cm

Appendix

- Abnormal: Outer diameter \geq 6mm, non compressible

Gall Bladder

- Width abnormal if > 4 cm
- Wall Thickness: abnormal > 3 mm

Bile Duct

- Normal \leq 6mm
- Useful rule of thumb: bile duct caliber increases 1mm with each decade from 60years onwards, i.e. 6mm at 60yrs, 7mm at 70 yrs etc.
- Post cholecystectomy: 6-10mm indeterminate

Kidney Length

- Normal Range: lower 9-10cm, upper 12-13 cm, variable depending on body size
- Left usually longer than right, difference <1.5cm

Liver

- Mid hepatic line > 15.5cm enlarged in 75%
- Portal Vein calibre: normal range 8-13 mm, normal variation with respiration:> 20%
- Splenic Vein /SMV > 20% change in calibre with respiration

Pancreas AP Diameter

- Head 1.9 - 2.5 cm
- Body 1.5 – 2.1 cm

Spleen

- Normal Length < 13 cm
- See chart below (refer to paediatric section)for length in children
- Rule of thumb for children: spleen length = 6 cm + 1/3 cm per year of age

Prostate

- Upper limit of normal: 30 cc

Liver Transplant Doppler

Hepatic Artery

- Measurements should be made of the hepatic artery at the porta and of the right and left branches in each hemi-liver in all cases.
- High resistance with little or no end diastolic flow is common at day 1 scan (and may continue for a few days in cases where the donor organ has had an extended period between retrieval and insertion).

- Tardus parvus waveform changes in the left and right hepatic arteries can suggest the presence of a proximal stenosis in the hepatic artery. As the hepatic artery is often poorly seen this may be the only clue to the existence of a stenosis. Tardus parvus waveforms can be defined by a low Resistive Index (R.I.) (due to the reduced systolic velocity) and slowed systolic rise (defined by the acceleration time to the first systolic peak) or loss of the early systolic peak (ESP) sign. Note that the ESP is usually unhelpful as waveform quality is often of insufficient quality for reliable assessment.
- **Normal hepatic artery R.I. should normally be between 0.50 and 0.80**
- **Normal acceleration time is less than 80ms**
- Low R.I., low velocity and/or slow acceleration suggest changes possible due to a proximal stenosis and further investigation should be considered.
- Hepatic artery velocity. A peak systolic velocity ≥ 200 cm/sec suggests a significant stenosis and require further investigation – note that velocity measurements post transplant can be difficult and may be unreliable due to tortuous anatomy and limited access.
- If in doubt it is important to note the findings as these may be the first signs of a stenosis. Repeating the scan to confirm can be easily done whereas delayed diagnosis of arterial complications can have serious consequences.

Reference: Caiado AHM, Blasbalg R, Marcelino ASZ, et al. Complications of liver transplantation: multimodality imaging approach. Radiographics 2007; 27: 1401-1417

Portal vein

- The portal vein velocity is often around 100cm/sec and velocities in excess of this are not uncommon and are probably not significant. Velocity increases of x3-4 are not uncommon across the anastomosis site and are also unlikely to be significant.

Transjugular Intrahepatic Portosystemic Shunt (TIPS)

- Normal maximum peak velocity in stent (max anywhere in stent) < 250 cm/sec
- Normal peak velocity in portal 1/3 of stent > 50 cm/sec
- Normal peak velocity of main portal vein (pre stent) > 2/3 of baseline peak velocity
- If any one parameter is abnormal venogram should be considered

Reference: Zizka J, Elias P, Krajina A, et al. Value of Doppler sonography in revealing transjugular intrahepatic portosystemic shunt malfunction. AJR 2000; 175:141-145

Renal Transplant Doppler

- Normal arterial waveforms: Resistive Index (RI) ≤ 0.75
- As renal transplant hemodynamics can be variable, check with previous scans in case RI are permanently elevated
- Non-specific marker for increased resistance in downstream capillary bed

Renal Artery Doppler

- **NB:** Direct assessment of the renal artery origins for suspected RAS is not performed at FMC.
- Indirect assessment of intra-renal arteries is performed according to the "Stavros method" refer to Radiology. [1992 Aug;184\(2\):487-92. Segmental stenosis of the renal artery: pattern recognition of tardus and parvus abnormalities with duplex sonography.](#) Stavros AT, Parker SH, Yakes WF, Chantelois AE, Burke BJ, Meyers PR, Schenck JJ.
- For detail on this technique go to the [Sonographer Guide Renal Doppler](#)
- Normal arterial waveforms: acceleration time ≤ 70 msec and presence of an early systolic peak (ESP).
- A high quality waveform is required for this technique.
- If the waveforms are of poor quality the scan should be reported as indeterminate due to technical limitations.

INTRA-RENAL ARTERIES Normal Appearances and Values

- **Acceleration time < 0.07 sec (70 msec)**, see Fig. 1
- **Presence of an ESP**, this is the best indicator for normal renal arteries although very dependent on image quality (see Fig. 2)

Fig. 1. Intra-arterial PW Doppler tracing demonstrating the correct placement of the calipers and display of acceleration time

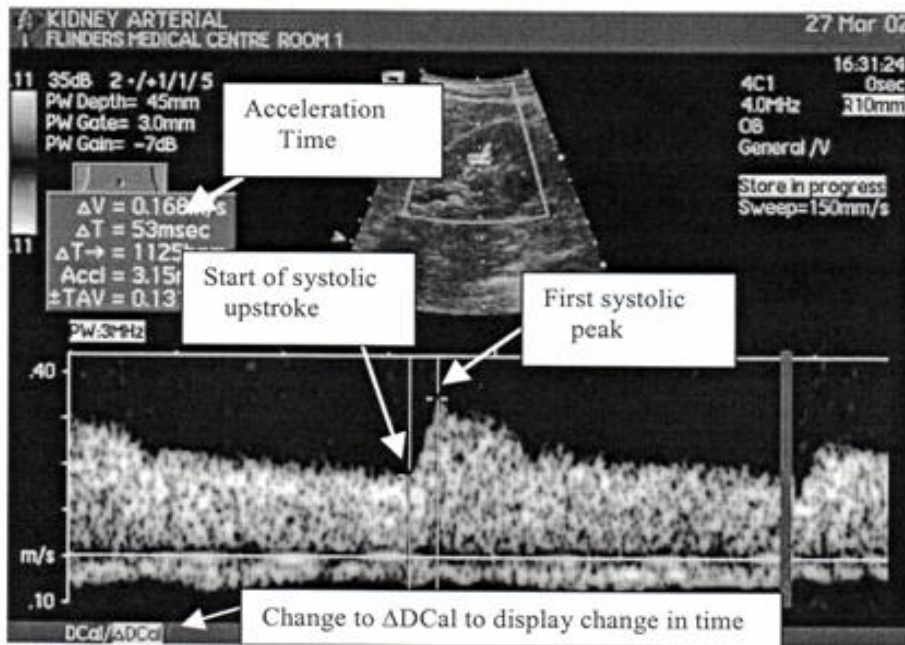
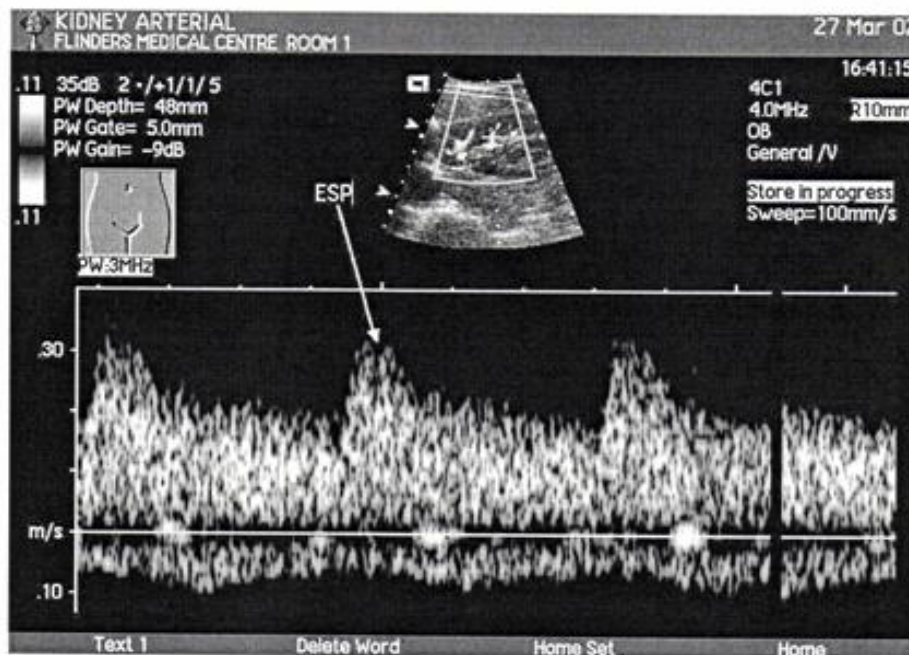


Fig. 2. Intra-arterial PW Doppler tracing demonstrating the early systolic peak (ESP)



Gynaecology

Ovary

Ovarian Volume: Prepubertal

- neonatal- 3 months: $\leq 4\text{cc}$
- 3 months- 5 years $\leq 2\text{ cc}$
- 5 years – menarche: gradual increase to 8cc

Max. Ovarian Volume: Post-pubertal

- ☐ normal $\leq 20\text{cc}$

Max Follicle Size

- ☐ normal $< 3\text{ cm}$ (mean diameter)

Uterus Size

- Prepubertal 1-12years Length 2 – 3.3 cm
- Post pubertal 12-20 years Length 5 - 8cm

Uterine Endometrial Thickness

Premenopausal

- ☐ 4-8 mm - proliferative phase
- ☐ 7-13 mm - secretory phase

Post menopausal

- ☐ normal $\leq 5\text{mm}$ (some may be up to 8mm on some HRT regimes)

Paediatrics

Pylorus

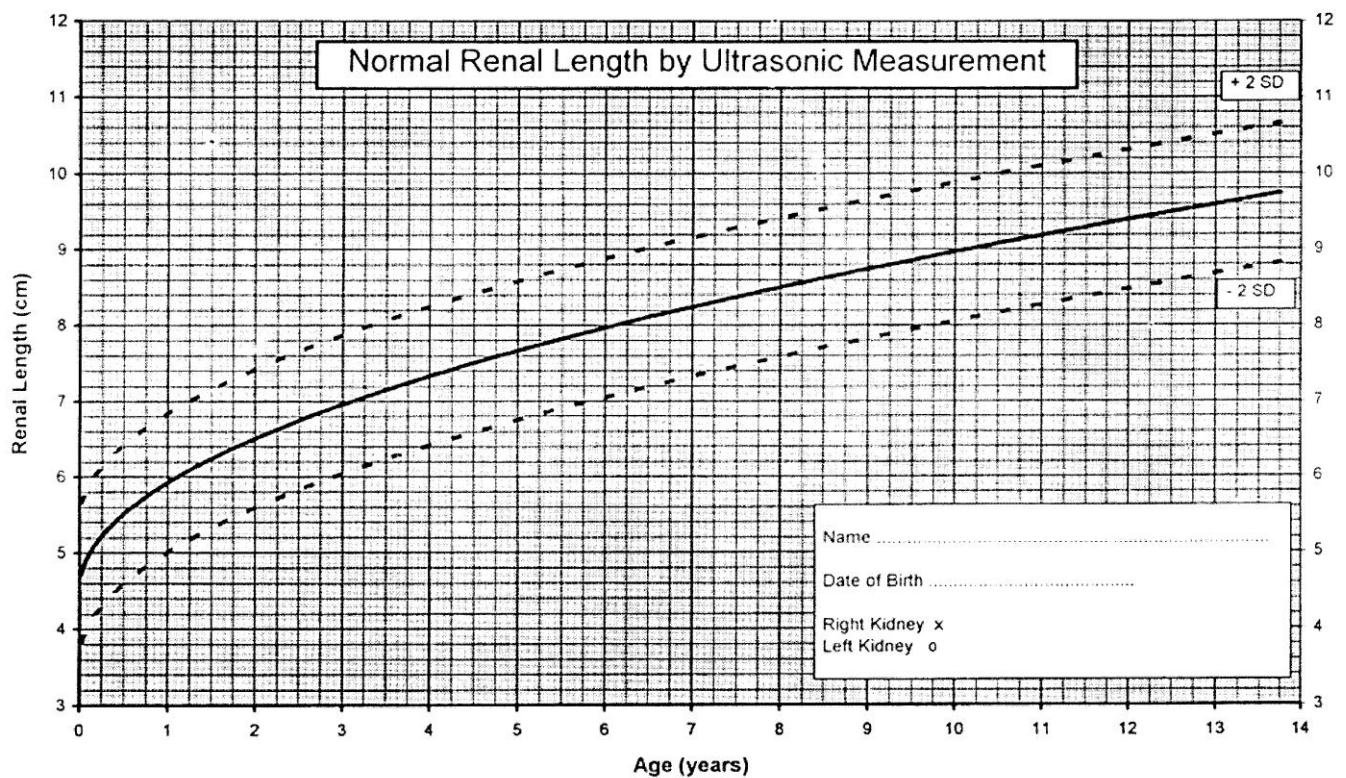
- Muscle Thickness: < 2.5mm normal, >3.5mm abnormal (most sensitive measurement)
- ☐ Length ≥ 1.4cm length
- Pyloric Diameter > 1.0cm abnormal (least sensitive measurement)

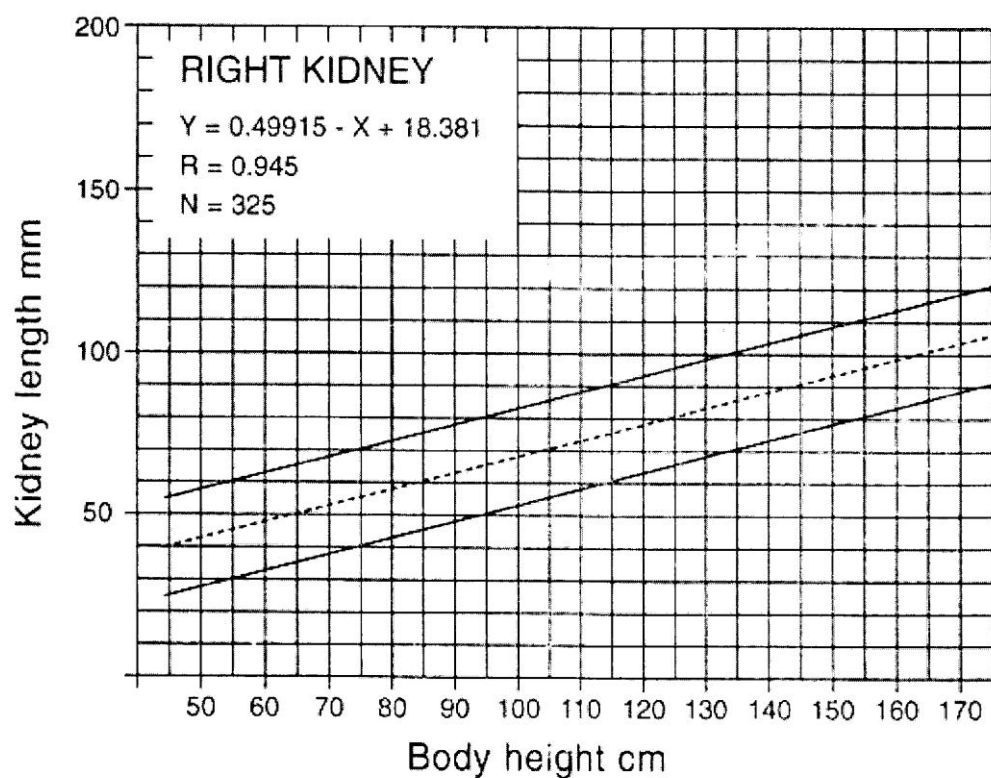
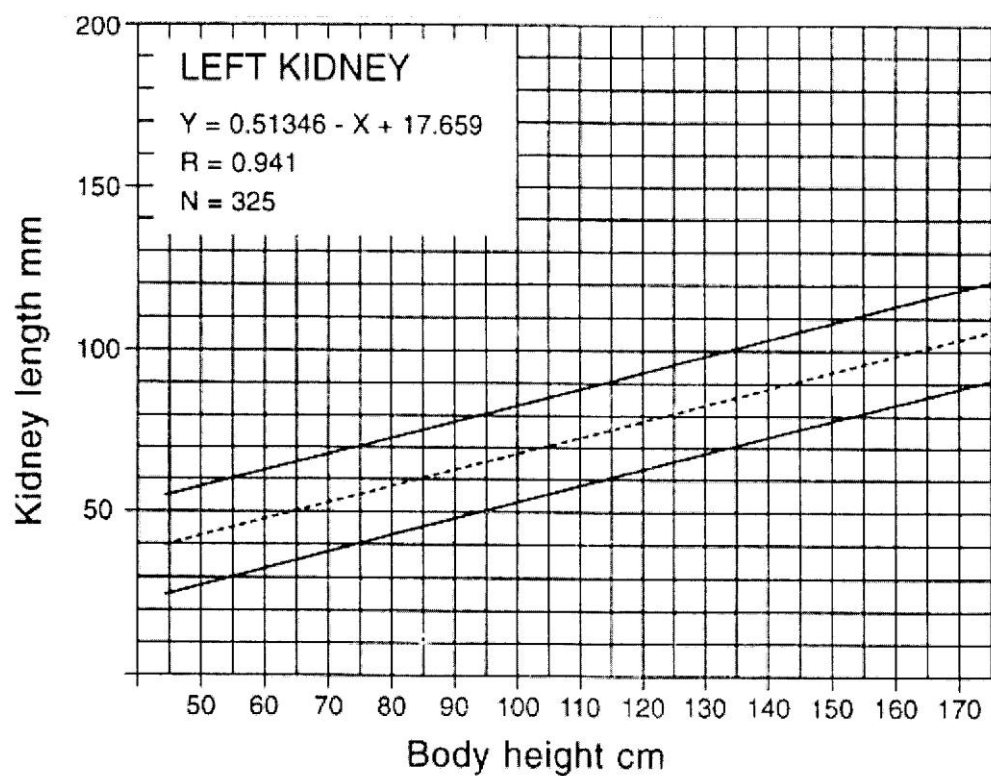
Index: $\frac{T \times L \times (D-T) \text{ cm}}{Wt \text{ kg}}$

Upper Limit Normal = 0.22

Renal Length

WOMEN'S AND CHILDREN'S HOSPITAL, ADELAIDE Department of Diagnostic Ultrasound





Length of both kidneys related to body height. Mean values and the 95% regions of tolerance are determined by routine statistical analysis of 325 children.

Spleen

Age	Size	
3 months	≤ 6.0 cm	
6 months	≤ 6.5 cm	
12 months	≤ 7.0 cm	
2 years	≤ 8.0 cm	
4 years	≤ 9.0 cm	
6 years	≤ 9.5 cm	
8 years	≤ 10.0 cm	
10 years	≤ 11.0 cm	
12 years	≤ 11.5 cm	
15+ years	≤ 12.0 cm	girls
15+ years	≤ 13.0 cm	boys

Superficial Parts

Testes

- Length normal < 5 cm
- Width normal < 4 cm
- Depth normal < 3 cm

Epididymis -

- Head diameter normal < 12mm
- Body diameter normal < 4mm
- Varicocoele - increase in diameter with valsalva to ≥ 3 mm

Thyroid

- Lobe length normal < 6 cm
- AP diameter of lobe normal < 2 cm

Vascular

Stenosis Criteria: Carotid and Peripheral Arteries

Note: Where a stenotic lesion causes a reduction in the arterial diameter in excess of 95%, the flow velocities measured across this will plateau or even fall resulting in a falsely reduced PSVR and possibly, an under estimation of the severity of the stenosis.

Carotid Arteries

At FMC, the protocols and diagnostic criteria for the evaluation of carotid artery disease follow the broad guidelines suggested by ASUM (readily viewed on their internet web site).

ASUM criteria for carotid artery stenosis are set out below.

Stenosis Grade	Ultrasound Criteria - ICA
0	Normal waveform and image
< 15% diameter reduction	Deceleration spectral broadening PSV < 125 cm/sec
16 - 49% diameter reduction	Pansystolic spectral broadening PSV < 125 cm/sec
50 - 69% diameter reduction	- Pansystolic spectral broadening - PSV > 125 cm/sec and EDV < 110 cm/sec or - ICA/CCA > 2
70 - 79% diameter reduction	- Pansystolic spectral broadening - PSV > 270 cm/sec or - EDV > 110 cm/sec or - ICA/CCA > 4
80 - 99% diameter reduction	As above plus - EDV > 140 cm/sec
Occluded	No flow Terminal thump

ICA	Internal carotid artery
CCA	Common carotid artery
PSV	Peak systolic velocity
EDV	End diastolic velocity
ICA/CCA	Ratio of ICA PSV to CCA PSV

A combination of spectral criteria as well as colour or grey scale cues should be used to assign specific degrees of stenosis. The appearance of and changes in flow velocity wave forms proximal and distal to a lesion must also be considered when assigning specific degrees of stenosis.

Peripheral Arteries

Peripheral Artery Stenosis Criteria (Crossman, 1989)

Diameter Reduction	PSV (cm/sec)	PSV Ratio
Normal	< 150	<1.5
0 – 49%	150-200	1.5 – 2.0
50 – 75%	200-400	> 2.0 - 4.0
≥ 75%	> 400	> 4
Occluded	No Flow Detected	No Flow Detected

- Changes in flow velocity wave forms distal to a lesion, e.g. loss of the characteristic tri-phasic waveform, are strong indicators of a significant lesion
- Care must also be taken when assessing more distal stenoses after the identification of a proximal stenosis in the peripheral arteries. Reduction in volume and dampening of the waveform distal to a hemodynamically significant stenosis can make standard diagnostic criteria less reliable.

Reference: (Crossman DV, Ellison JE, Wagner WH et al. Comparison of contrast arteriography to arterial mapping with colour-flow duplex imaging in the lower extremity. Journal of Vascular Surgery 1989, 10:522-529.)

Surveillance post graft / stent /angioplasty.

The Vascular Team needs to be contacted urgently if:

- Peak systolic velocity < 45 cm/sec
Velocity ratio at stenosis ≥ 2.5
ABI decrease ≥ 0.15

DO NOT SEND PATIENT AWAY - Contact:

Vascular Reg On-call
Vascular RMO or contact Ward 5A

Popliteal Aneurysm

- Aneurysmal ≥ 1.5 cm

First Trimester

- Mean sac diameter (MSD) is the preferred method for measuring gestational sac size
- The relationship between MSD and human chorionic gonadotropin should be used to aid assessment of the uterus and endometrial cavity in early pregnancy
- CRL should be used for gestational age assessment once a fetal pole is detected
- Discriminatory values for pregnancy viability in the 1st trimester:
 - Fetal pole must be seen when MSD >25 mm
 - Fetal heart activity must be seen when CRL >7 mm on TV or ≥ 9 mm on TA (TV scanning should be performed if there is any doubt)

Mean sac diameter (mm)	Mean gestational age (wk)	Gestational age (days)	
		Mean	95% confidence interval
2	5.0	34.9	34.3-35.5
3	5.1	35.8	35.2-36.3
4	5.2	36.6	36.1-37.2
5	5.4	37.5	37.0-38.0
6	5.5	38.4	37.9-38.9
7	5.6	39.3	38.9-39.7
8	5.7	40.2	39.8-40.6
9	5.9	41.1	40.7-41.4
10	6.0	41.9	41.6-42.3
11	6.1	42.8	42.5-43.2
12	6.2	43.7	43.4-44.0
13	6.4	44.6	44.3-44.9
14	6.5	45.5	45.2-45.8
15	6.6	46.3	46.0-46.6
16	6.7	47.2	46.9-47.5
17	6.9	48.1	47.8-48.4
18	7.0	49.0	48.6-49.4
19	7.1	49.9	49.5-50.3
20	7.3	50.8	50.3-51.2
21	7.4	51.6	51.2-52.1
22	7.5	52.5	52.0-53.0
23	7.6	53.4	52.9-53.9
24	7.8	54.3	53.7-54.8
25	7.9	55.2	54.6-55.7
26	8.0	56.0	55.4-56.7
27	8.1	56.9	56.3-57.6
28	8.3	57.8	57.1-58.5
29	8.4	58.7	58.0-59.4
30	8.5	59.6	58.8-60.4

*The mean gestational age was calculated from a regression equation.
From Daya S et al: Early pregnancy assessment with transvaginal ultrasound scanning, *Can Med Assoc J* 144:441-445, 1991.

Crown-Rump Length Measurements for an Australian Population					
Gestation (weeks/days)	CRL (mm)	Gestation (weeks/days)	CRL (mm)	Gestation (weeks/days)	CRL (mm)
5.2	1	8.3	20	11.4	52
5.3	2	8.4	21	11.5	55
5.4	3	8.5	22	11.6	56
5.5	3	8.6	22	12.0	57
5.6	4	9.0	23	12.1	58
6.0	4	9.1	24	12.2	60
6.1	5	9.2	26	12.3	61
6.2	6	9.3	27	12.4	63
6.3	7	9.4	28	12.5	64
6.4	8	9.5	29	12.6	65
6.5	9	9.6	31	13.0	68
6.6	10	10.0	34	13.1	70
7.0	11	10.1	36	13.2	72
7.1	11	10.2	37	13.3	74
7.2	12	10.3	38	13.4	76
7.3	12	10.4	39	13.5	77
7.4	13	10.5	39	13.6	80
7.5	14	10.6	40	14.0	81
7.6	15	11.0	44	14.1	84
8.0	17	11.1	45	14.2	85
8.1	18	11.2	47	14.3	86
8.2	19	11.3	48	14.4	87

Figures based on a cross sectional study of 3,800 pregnancies resulting in 11,600 measurements. CRL figures based on 500 pregnancies.

Adapted from Ultrasonic Fetal Measurements - new Australian standards for the new millennium. Aust. NZ J. Obstet. Gynaecol. August 2000, vol. 40, No. 3

Accuracy of ultrasound dating throughout pregnancy

Reference range for ultrasound dating

GA weeks	≤11	12	13	14	15	16	17	18	19	20	21	22
+/-days	5	5	5	5	6	6	7	8	9	10	11	12
GA weeks	23-29						30+					
+/-weeks	2						3					

Determining EDC when no EDC is provided

1. All request forms need to have an EDC provided on the request form
2. If there is a regular LMP provided that will be entered into viewpoint
3. The most accurate ultrasound is 8wks and over
4. If an ultrasound has been performed prior to 8 weeks gestation then the next ultrasound will be used to determine the EDC
5. If there is no previous ultrasound performed or no information on the request form of a previous ultrasound and an EDC has not been provided then the AUA from the morphology scan will be used for EDC on viewpoint

TABLE A-6. Combined Data Comparing Menstrual Age With Mean Gestational Sac Diameter, Crown Rump Length, and HCG Levels*

Menstrual Age (days)	Menstrual Age (weeks)	Gestational Sac Size (mm)	Crown Rump Length (cm)	HCG Level (First IRP) Mean (U/L)	HCG Level (First IRP) Range (U/L)
30	4.3				
31	4.4				
32	4.6	3		1710	(1050-2800)
33	4.7	4		2320	(1440-3760)
34	4.9	5		3100	(1940-4980)
35	5.0	5.5		4090	(2580-6530)
36	5.1	6		5340	(3400-8450)
37	5.3	7		6880	(4420-10,810)
38	5.4	8		8770	(5680-13,660)
39	5.6	9		11,040	(7220-17,050)
40	5.7	10	0.2	13,730	(9050-21,040)
41	5.9	11	0.3	15,300	(10,140-23,340)
42	6.0	12	0.35	16,870	(11,230-25,640)
43	6.1	13	0.4	20,480	(13,750-30,880)
44	6.3	14	0.5	24,560	(16,650-36,750)
45	6.4	15	0.6	29,110	(19,910-43,220)
46	6.6	16	0.7	34,100	(25,530-50,210)
47	6.7	17	0.8	39,460	(27,470-57,640)
48	6.9	18	0.9	45,120	(31,700-65,380)
49	7.0	19	0.95	50,970	(36,130-73,280)
50	7.1	20	1.0	56,900	(40,700-81,150)
51	7.3	21	1.1	62,760	(45,300-88,790)
52	7.4	22	1.2	68,390	(49,810-95,990)
53	7.6	23	1.3	73,640	(54,120-102,540)
54	7.7	24	1.4	78,350	(58,100-108,230)
55	7.9	25	1.5	82,370	(61,640-112,870)
56	8.0	26	1.6	85,560	(64,600-116,310)
57	8.1	26.5	1.7		
58	8.3	27	1.8		
59	8.4	28	1.9		
60	8.6	29	2.0		
61	8.7	30	2.1		
62	8.9	31	2.2		
63	9.0	32	2.3		
64	9.1	33	2.4		
65	9.3	34	2.5		
66	9.4	35	2.6		
67	9.6	36	2.8		
68	9.7	37	2.9		
69	9.9	38	3.0		
70	10.0	39	3.1		
71	10.1	40	3.2		
72	10.3	41	3.4		
73	10.4	42	3.5		
74	10.6	43	3.7		
75	10.7	44	3.8		
76	10.9	45	4.0		
77	11.0	46	4.1		
78	11.1	47	4.2		
79	11.3	48	4.4		
80	11.4	49	4.6		
81	11.6	50	4.8		
82	11.7	51	5.0		
83	11.9	52	5.2		
84	12.0	53	5.4		

* Data from Daya S, Woods S: Transvaginal ultrasound scanning in early pregnancy and correlation with human chorionic gonadotropin levels. J Clin Ultrasound 19:139, 1991. Hadlock FP, Shah YP, Kanon DJ, et al: Fetal crown rump length: Reevaluation of relation to menstrual age (5-18 weeks) with high-resolution real-time US. Radiology 182:501, 1992. Robinson HP: "Gestation sac" volumes as determined by sonar in the first trimester of pregnancy. Br J Obstet Gynaecol 82:100, 1975.

Table appears in this form in Nyberg, Hill, Bohm-Velez, et al: Transvaginal Ultrasound. St. Louis: Mosby-Year Book, 1992.

IRP = International Reference Preparation; U/L = units/liter.

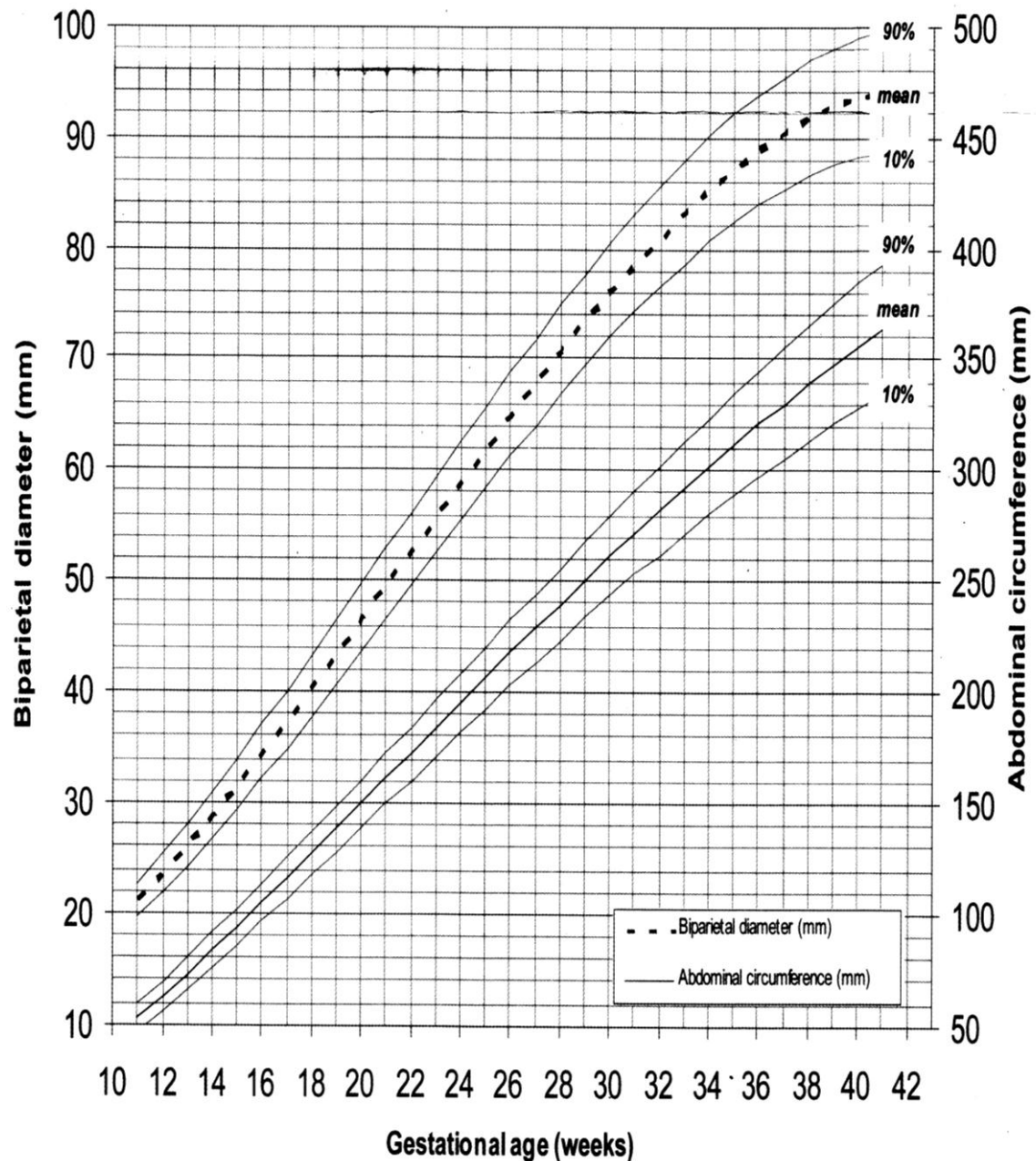
Second and Third Trimester Biometry

- BPD, HC, AC and FL routinely obtained in 2nd and 3rd trimester
- A minimum of BPD and FL should be used for gestational age assessment. The AUA according to the ultrasound machine software should be used in the sonographer worksheet and the radiology report.
- Correct the BPD if it is discrepant with HC. Correcting should be applied if the uncorrected BPD is likely to cause incorrect conclusions regarding growth, dating or symmetry of measurements. The “sliding bars” in the Viewpoint report are useful guides to deciding when to apply a correction.

Ultrasonic Fetal Measurement Standards for an Australian Population Compiled by Susan Campbell Westerway – Faculty of Health Sciences University of Sydney August 2000©							
Gestation (weeks)	BPD (mm)	OFD (mm)	Head circ.(mm)	Abdominal circ.(mm)	Femur (mm)	Humerus (mm)	Gestation (weeks)
+/-2 standard deviations shown in brackets. Measurements are completed weeks.							
11	16 (2.0)	21 (2.0)	59 (10)	52 (10)	8 (2.0)	8 (3.0)	11
12	20 (4.0)	24 (2.0)	70 (14)	63 (10)	10 (2.5)	9 (2.0)	12
13	24 (4.0)	29 (3.0)	84 (16)	74 (9.0)	11 (2.5)	11 (3.0)	13
14	28 (4.0)	34 (3.0)	96 (18)	84 (11)	15 (3.0)	14 (4.0)	14
15	31 (4.0)	38 (3.0)	108 (15)	96 (8.0)	17 (3.5)	17 (5.5)	15
16	36 (5.0)	46 (3.0)	128 (18)	106 (7.0)	22 (4.0)	21 (4.0)	16
17	39 (5.0)	50 (3.0)	141 (17)	120 (12)	25 (4.0)	25 (5.0)	17
18	42 (4.0)	54 (3.5)	151 (20)	131 (11)	28 (5.0)	27 (5.5)	18
19	45 (5.0)	57 (3.5)	160 (20)	140 (12)	30 (5.0)	29 (5.0)	19
20	47 (4.0)	61 (3.5)	170 (26)	151 (12)	32 (6.0)	31 (5.0)	20
21	49 (4.0)	63 (4.0)	176 (25)	164 (12)	34 (6.0)	32 (6.0)	21
22	52 (5.0)	68 (3.5)	188 (22)	176 (10)	37 (5.0)	35 (6.0)	22
23	57 (5.0)	76 (4.0)	210 (12)	186 (10)	43 (5.0)	38 (4.0)	23
24	60 (6.0)	79 (4.0)	220 (20)	201 (10)	45 (4.0)	40 (6.0)	24
25	64 (6.0)	82 (4.5)	231 (21)	212 (10)	48 (5.0)	43 (5.0)	25
26	67 (4.0)	84 (4.5)	238 (14)	223 (12)	49 (5.0)	44 (4.0)	26
27	68 (5.0)	86 (4.5)	250 (21)	230 (10)	50 (5.0)	47 (4.0)	27
28	72 (4.0)	95 (5.0)	263 (13)	242 (10)	54 (4.0)	50 (5.0)	28
29	75 (4.0)	97 (5.5)	269 (25)	259 (12)	55 (5.5)	51 (5.0)	29
30	76 (4.0)	98 (5.5)	274 (26)	262 (10)	58 (6.0)	52 (5.0)	30
31	80 (6.0)	101 (5.0)	284 (22)	272 (10)	59 (5.5)	54 (5.0)	31
32	81 (4.0)	102 (5.0)	288 (28)	283 (13)	62 (6.0)	56 (5.0)	32
33	84 (6.0)	107 (5.5)	300 (20)	294 (10)	65 (4.0)	57 (6.0)	33
34	86 (6.0)	108 (5.5)	305 (21)	305 (10)	66 (4.0)	59 (5.5)	34
35	88 (6.5)	109 (5.5)	310 (26)	315 (10)	67 (6.0)	60 (6.0)	35
36	90 (6.0)	112 (5.5)	317 (22)	325 (12)	69 (6.0)	62 (5.0)	36
37	92 (6.5)	113 (6.0)	321 (24)	333 (12)	72 (5.0)	63 (6.0)	37
38	93 (6.0)	116 (5.5)	328 (22)	342 (12)	73 (5.5)	64 (6.0)	38
39	95 (8.0)	119 (6.0)	336 (26)	356 (12)	75 (6.0)	65 (5.5)	39
40	96 (8.0)	120 (6.0)	340 (22)	362 (10)	76 (4.0)	66 (6.0)	40
41	98 (8.0)	122 (6.0)	344 (24)	367 (10)	77 (5.0)	68 (6.0)	41

Fetal Growth Chart

- Fetal growth is charted using the Viewpoint Software program. Currently this uses the data from ASUM Policies and Statements D7 "Statement of Normal Ultrasonic Fetal Measurements 2007" and uses ± 2 SD ranges.
- The patient's handheld record uses Schluter et al data with 10 and 90 percentile ranges as shown below.



Schluter PJ, Pritchard G and Gill MA. Ultrasonic fetal size measurements in Brisbane, Australia.
Australasian Radiology (2004); 48: 480-456

Amniotic Fluid Index (AFI)

- Sum of the largest vertical depth of largest pool in each quadrant excluding cord and fetal parts. Note slim "slivers" of fluid, i.e. <1cm wide, should not be measured
 - 0 – 5 cm: oligohydramnios
 - 5 – 8 cm: Borderline
 - 8 – 20 cm: Normal
 - 20 – 25 cm: High normal
 - > 25 cm: polyhydramnios

Deepest Pool (DP)

- < 2 cm: oligohydramnios
- 2 - 3 cm: borderline
- > 3 cm: normal
- > 8 cm: polyhydramnios

TABLE 22–3. Amniotic Fluid Index Values in Normal Pregnancy

Week	Amniotic Fluid Index Percentile					n
	2.5th	5th	50th	95th	97.5th	
16	73	79	121	185	201	32
17	77	83	127	194	211	26
18	80	87	133	202	220	17
19	83	90	137	207	225	14
20	86	93	141	212	230	25
21	88	95	143	214	233	14
22	89	97	145	216	235	14
23	90	98	146	218	237	14
24	90	98	147	219	238	23
25	89	97	147	221	240	12
26	89	97	147	223	242	11
27	85	95	146	226	245	17
28	86	94	146	228	249	25
29	84	92	145	231	254	12
30	82	90	145	234	258	17
31	79	88	144	238	263	26
32	77	86	144	242	269	25
33	74	83	143	245	274	30
34	72	81	142	248	278	31
35	70	79	140	249	279	27
36	68	77	138	249	279	39
37	66	75	135	244	275	36
38	65	73	132	239	269	27
39	64	72	127	226	255	12
40	63	71	123	214	240	64
41	63	70	116	194	216	162
42	63	69	110	175	192	30

Amniotic fluid index values are obtained by measuring the vertical depth of the largest clear amniotic fluid pocket in each of four equal uterine quadrants. The values from each quadrant are measured in millimeters and added together.

From Moore TR, Cayle JE: The amniotic fluid index in normal human pregnancy. *Am J Obstet Gynecol* 162:1168, 1990.

Cervical Length

- Length
 - Assessment should be performed with transvaginal technique unless contra-indicated
 - < 2.5cm is abnormal (radiology registrar to contact obstetric registrar on-call or referring obstetric team)

Fetal Head

- Cephalic index: $\text{BPD} / \text{OFD} \times 100$; normal range 70 - 86
- BPD correction formula: $\sqrt{\text{BPD} \times \text{OFD} / 1.24}$ or $\text{BPD} + \text{OFD} / 2.25$
- Head Circumference = $(\text{BPD} + \text{OFD}) \times 1.57$
- Normal Nuchal Fold Thickness <6mm, 6mm or greater is considered a soft marker for chromosomal abnormality and so results in recalculation of maternal prior risk of T21 (likelihood ratio =17). It is valid to 20 weeks.
- Lateral ventricle Normal <10mm

Trout et al

Table 1: Associations with Hypotelorism

Holoprosencephaly
Chromosomal abnormalities
Microcephaly
Maternal phenylketonuria
Meckle-Gruber syndrome
Myotonic dystrophy
Williams syndrome
Oculodental dysplasia
Trigonocephaly

Table 2: Associations with Hypertelorism

Median cleft syndrome
Frontal, ethmoidal, or sphenoidal meningoencephalocele
Craniosynostosis
Megalencephaly

Table 3: Normal Orbital Diameters in the Fetus

Gestational Age (weeks)	Inner Diameters (mm)			Outer Diameters (mm)		
	5th %ile	50th %ile	95th %ile	5th %ile	50th %ile	95th %ile
13	4	7	10	12	16	20
14	5	8	11	14	18	22
15	5	8	11	17	21	25
16	6	9	12	19	23	27
17	7	10	13	21	25	29
18	8	11	14	24	27	31
19	8	11	14	26	30	34
20	9	12	15	28	32	36
21	10	13	16	30	34	38
22	10	13	16	32	36	40
23	11	14	17	33	37	41
24	12	14	17	35	39	43
25	12	15	18	37	41	45
26	13	16	19	39	43	47
27	13	16	19	40	44	48
28	14	17	20	42	46	50
29	14	17	20	43	47	51
30	15	18	21	45	49	52
31	15	18	21	46	50	54
32	16	19	22	47	51	55
33	17	20	23	48	52	56
34	17	20	23	49	53	57
35	18	21	24	50	54	58

Table generated from raw data using two separate quadratic regression models:

Outer Diameter = $-22.17 + 3.36 (\text{Age}) - 0.03 (\text{Age}^2)$ $R^2 = 0.96, P < 0.001$ Inner Diameter = $-4.14 + 0.94 (\text{Age}) - 0.007 (\text{Age}^2)$ $R^2 = 0.84, P < 0.001$

Fetal Limbs

TABLE A-16. Length of Fetal Long Bones (mm)

Week No.	Humerus Percentile			Ulna Percentile			Radius Percentile			Femur Percentile			Tibia Percentile			Fibula Percentile		
	5	50	95	5	50	95	5	50	95	5	50	95	5	50	95	5	50	95
11	—	6	—	—	5	—	—	5	—	—	6	—	—	4	—	—	2	—
12	3	9	10	—	8	—	—	7	—	—	9	—	—	7	—	—	5	—
13	5	13	20	3	11	18	—	10	—	6	12	19	4	10	17	—	8	—
14	5	16	20	4	13	17	8	13	12	5	15	19	2	13	19	6	11	10
15	11	18	26	10	16	22	12	15	19	11	19	26	5	16	27	10	14	18
16	12	21	25	8	19	24	9	18	21	13	22	24	7	19	25	6	17	22
17	19	24	29	11	21	32	11	20	29	20	25	29	15	22	29	7	19	31
18	18	27	30	13	24	30	14	22	26	19	28	31	14	24	29	10	22	28
19	22	29	36	20	26	32	20	24	29	23	31	38	19	27	35	18	24	30
20	23	32	36	21	29	32	21	27	28	22	33	39	19	29	35	18	27	30
21	28	34	40	25	31	36	25	29	32	27	36	45	24	32	39	24	29	34
22	28	36	40	24	33	37	24	31	34	29	39	44	25	34	39	21	31	37
23	32	38	45	27	35	43	26	32	39	35	41	48	30	36	43	23	33	44
24	31	41	46	29	37	41	27	34	38	34	44	49	28	39	45	26	35	41
25	35	43	51	34	39	44	31	36	40	38	46	54	31	41	50	33	37	42
26	36	45	49	34	41	44	30	37	41	39	49	53	33	43	49	32	39	43
27	42	46	51	37	43	48	33	39	45	45	51	57	39	45	51	35	41	47
28	41	48	52	37	44	48	33	40	45	45	53	57	38	47	52	36	43	47
29	44	50	56	40	46	51	36	42	47	49	56	62	40	49	57	40	45	50
30	44	52	56	38	47	54	34	43	49	49	58	62	41	51	56	38	47	52
31	47	53	59	39	49	59	34	44	53	53	60	67	46	52	58	40	48	57
32	47	55	59	40	50	58	37	45	51	53	62	67	46	54	59	40	50	56
33	50	56	62	43	52	60	41	46	51	56	64	71	49	56	62	43	51	59
34	50	57	62	44	53	59	39	47	53	57	65	70	47	57	64	46	52	56
35	52	58	65	47	54	61	38	48	57	61	67	73	48	59	69	51	54	57
36	53	60	63	47	55	61	41	48	54	61	69	74	49	60	68	51	55	56
37	57	61	64	49	56	62	45	49	53	64	71	77	52	61	71	55	56	58
38	55	61	66	48	57	63	45	49	53	62	72	79	54	62	69	54	57	59
39	56	62	69	49	57	66	46	50	54	64	74	83	58	64	69	55	58	62
40	56	63	69	50	58	65	46	50	54	66	75	81	58	65	69	54	59	62

From Jeanty P: Fetal limb biometry. (Letter) Radiology 147:602, 1983.

Fetal Humerus

The humerus is considered shortened if it is more than 2SD below that expected for gestational age. This is a marker for T21.

The table below indicates the -2SD measurement for completed weeks of gestation.

SHORT HUMERUS	
Completed Weeks	-2SD (2.27 percentile) in mm
11	5
12	7
13	8
14	10
15	11.5
16	17
17	20
18	21.5
19	24
20	26
21	26
22	29
23	34
24	34
25	38
26	40
27	43
28	45
29	46
30	47
31	49
32	51
33	51
34	53.5
35	54
36	57
37	57
38	58
39	59.5
40	60
41	62

Fetal Abdomen

- Abdominal Circumference = $\pi \times \text{MAD}$

Fetal Renal Tract

- Fetal Renal Pelvic Diameter (A.P.) normal:
 - < 4mm at morphology and up to 32 weeks
 - < 7mm at or after 32 weeks
- Mild dilatation:
 - Renal Pelvis ≥ 4 and < 7mm at morphology scan,
 - Renal Pelvis ≥ 7 and < 10mm at or after 32 weeks,
 - Mild intra-renal calyceal dilatation (even if the renal pelvis is not dilated)
 - If found prior to 32 weeks then follow-up with an obstetric scan at 32 weeks should be recommended.
 - If there is no dilatation at the 32 week follow-up scan no neonatal follow-up is required. If dilatation is still present then follow-up at one week of age should be recommended.
 - Mild dilatation seen at or after 32 weeks requires follow-up at one week of age.
 - Please note that this is no longer considered a marker for Tr21
- Moderate/marked:
 - ≥ 7 mm at morphology,
 - ≥ 10 mm at or after 32 weeks
 - requires referral to Perinatal Dysmorphology Meeting, with follow-up to be decided at this meeting
 - Ureteric dilatation or bladder dilatation should be considered as a significant finding even with AP pelvic diameter < 7 or 10mm (depending on gestational age)

TABLE 17–1. Mean Renal Lengths for Various Gestational Ages

Gestational Age (weeks)	Mean Length (cm)	SD	95% CI	n
18	2.2	0.3	1.6–2.8	14
19	2.3	0.4	1.5–3.1	23
20	2.6	0.4	1.8–3.4	22
21	2.7	0.3	2.1–3.2	20
22	2.7	0.3	2.0–3.4	18
23	3.0	0.4	2.2–3.7	13
24	3.1	0.6	1.9–4.4	13
25	3.3	0.4	2.5–4.2	9
26	3.4	0.4	2.4–4.4	9
27	3.5	0.4	2.7–4.4	15
28	3.4	0.4	2.6–4.2	19
29	3.6	0.7	2.3–4.8	12
30	3.8	0.4	2.9–4.6	24
31	3.7	0.5	2.8–4.6	23
32	4.1	0.8	3.1–5.1	23
33	4.0	0.3	3.3–4.7	28
34	4.2	0.4	3.3–5.0	36
35	4.2	0.5	3.2–5.2	17
36	4.2	0.4	3.3–5.0	36
37	4.2	0.4	3.3–5.1	40
38	4.4	0.6	3.2–5.6	32
39	4.2	0.3	3.5–4.8	17
40	4.3	0.5	3.2–5.3	10
41	4.5	0.3	3.9–5.1	4

Gestational age is an average of the gestational ages in weeks determined on the basis of biparietal diameter, femoral length, and abdominal circumference. A *t* distribution was used when $n < 30$.

SD, standard deviation; 95% CI, 95% confidence interval; n, number of fetuses.

Adapted from Cohen HL, Cooper J, Eisenberg P, et al: Normal length of fetal kidneys: Sonographic study in 397 obstetric patients. *AJR Am J Roentgenol* 157:545, 1991.

Fetal Thorax

- Thoracic area to heart area ratio roughly 3:1
- Thoracic circumference measured around bony margins

1032 Measurements Frequently Used to Estimate Gestational Age and Fetal Biometry

TABLE A-22. **Fetal Thoracic Circumference Measurements***

Gestational Age (wk)	No.	Predictive Percentiles								
		2.5	5	10	25	50	75	90	95	97.5
16	6	5.9	6.4	7.0	8.0	9.1	10.3	11.3	11.9	12.4
17	22	6.8	7.3	7.9	8.9	10.0	11.2	12.2	12.8	13.3
18	31	7.7	8.2	8.8	9.8	11.0	12.1	13.1	13.7	14.2
19	21	8.6	9.1	9.7	10.7	11.9	13.0	14.0	14.6	15.1
20	20	9.5	10.0	10.6	11.7	12.8	13.9	15.0	15.5	16.0
21	30	10.4	11.0	11.6	12.6	13.7	14.8	15.8	16.4	16.9
22	18	11.3	11.9	12.5	13.5	14.6	15.7	16.7	17.3	17.8
23	21	12.2	12.8	13.4	14.4	15.5	16.6	17.6	18.2	18.8
24	27	13.2	13.7	14.3	15.3	16.4	17.5	18.5	19.1	19.7
25	20	14.1	14.6	15.2	16.2	17.3	18.4	19.4	20.0	20.6
26	25	15.0	15.5	16.1	17.1	18.2	19.3	20.3	21.0	21.5
27	24	15.9	16.4	17.0	18.0	19.1	20.2	21.3	21.9	22.4
28	24	16.8	17.3	17.9	18.9	20.0	21.2	22.2	22.8	23.3
29	24	17.7	18.2	18.8	19.8	21.0	22.1	23.1	23.7	24.2
30	27	18.6	19.1	19.7	20.7	21.9	23.0	24.0	24.6	25.1
31	24	19.5	20.0	20.6	21.6	22.8	23.9	24.9	25.5	26.0
32	28	20.4	20.9	21.5	22.6	23.7	24.8	25.8	26.4	26.9
33	27	21.3	21.8	22.5	23.5	24.6	25.7	26.7	27.3	27.8
34	25	22.2	22.8	23.4	24.4	25.5	26.6	27.6	28.2	28.7
35	20	23.1	23.7	24.3	25.3	26.4	27.5	28.5	29.1	29.6
36	23	24.0	24.6	25.2	26.2	27.3	28.4	29.4	30.0	30.6
37	22	24.9	25.5	26.1	27.1	28.2	29.3	30.3	30.9	31.5
38	21	25.9	26.4	27.0	28.0	29.1	30.2	31.2	31.9	32.4
39	7	26.8	27.3	27.9	28.9	30.0	31.1	32.2	32.8	33.3
40	6	27.7	28.2	28.8	29.8	30.9	32.1	33.1	33.7	34.2

* Measurements in centimeters.

From Chitkara U, Rosenberg J, Chervenak FA, et al: Prenatal sonographic assessment of the fetal thorax: Normal values. Am J Obstet Gynecol 156:1069, 1987.

Fetal Weight

EFW (using the Hadlock four measurement method - BPD, HC, AC & FL) should be calculated and reported in all growth studies as: "x gm +/- 15% if EFW \geq 1500 gm and \leq 4000gm or +/- 20% if EFW < 1500 gm or > 4000 gm. The EFW percentile should also be reported.

Low Lying Placenta/Placenta Praevia

Perform transvaginal scan.

- Normal \geq 2cm. Report as unremarkable, do not state a measurement (2nd and 3rd trimesters)
- Low lying placenta: < 2cm from the os (2nd and 3rd trimesters)
- Marginal praevia: touching os (3rd trimester)
- Complete praevia: covering os (3rd trimester)
- Central complete praevia: completely covering os and extending onto opposite side of uterus (2nd and 3rd trimesters)

Nuchal Translucency

First trimester screening scan is not offered at FMC and is only performed as a second opinion scan if a screening scan has demonstrated a nuchal translucency of \geq 3mm.

- Only valid between 45 and 84 mm
- First trimester risk of Trisomy 21 is calculated by SAMSAS using markers from maternal serum and a nuchal translucency (NT) measurement.
- T21 risk should not be calculated from the NT in isolation.
- A NT above 3 mm:
 - ❖ carries a significantly raised risk of fetal abnormality (especially cardiac abnormalities) and poor outcome regardless of the calculated T21 risk
 - ❖ Referral to the Perinatal Dysmorphology Meeting, detailed ultrasound assessment and fetal echocardiography is recommended.

Fetal Thorax & Fetal Head in the setting of Congenital Diaphragmatic Hernia (CDH)

- Lung-to-head ratio should be performed in the fetus with CDH
- **LHR = volume of healthy lung, contralateral to the diaphragmatic defect divided by the fetal head circumference**
- Volume of healthy lung = longest lung diameter (in mm) multiplied by its perpendicular diameter (in mm)
- Head circumference = (BPD + OFD) x 1.57

LHR: < 1.0 = poor prognosis
> 1.4 = favourable prognosis

NB: Refer to sonographer guide for instructions and examples on how to perform the lung-to-head ratio

Risk of Trisomy 21 and 18

Recalculation of risk should be performed using this (SAMSAS) table

MATERNAL AGE RISK @ 18 weeks

AGE RISK @ 18 weeks	T21 Ratio 1: n	T18 Ratio 1: n
20	1330	4146
21	1316	4035
22	1297	3970
23	1273	3906
24	1243	3812
25	1203	3674
26	1155	3485
27	1096	3247
28	1026	2967
29	945	2659
30	855	2335
31	759	2007
32	659	1689
33	561	1393
34	468	1125
35	383	893
36	308	696
37	245	537
38	191	412
39	149	314
40	114	239
41	88	180
42	66	133
43	51	97
44	39	75
45	33	74

Reference:

Update 15

SAMSAS Prenatal Screening for Down syndrome, revised age specific performance

Update 15 Supplement

SAMSAS Prenatal Screening for Down syndrome, revised age specific performance

Issued: August 2009

The table below (Nicolaides) provides an indication of the change in risk with increasing gestational age and maternal age. The risk ratios differ from those provided by the SAMSAS table due to differences in the sample populations and due to changes in risk through gestation.

Table 2. Estimated risk for trisomies 21, 18 and 13 (1/number given in the table) in relation to maternal age and gestation.

Maternal age (yrs)	Trisomy 21 Gestation (wks)				Trisomy 18 Gestation (wks)				Trisomy 13 Gestation (wks)			
	12	16	20	40	12	16	20	40	12	16	20	40
20	1068	1200	1295	1527	2484	3590	4897	18013	7826	11042	14656	42423
25	946	1062	1147	1352	2200	3179	4336	15951	6930	9778	12978	37567
30	626	703	759	895	1456	2103	2869	10554	4585	6470	8587	24856
31	543	610	658	776	1263	1825	2490	9160	3980	5615	7453	21573
32	461	518	559	659	1072	1549	2114	7775	3378	4766	6326	18311
33	383	430	464	547	891	1287	1755	6458	2806	3959	5254	15209
34	312	350	378	446	725	1047	1429	5256	2284	3222	4277	12380
35	249	280	302	356	580	837	1142	4202	1826	2576	3419	9876
36	196	220	238	280	456	659	899	3307	1437	2027	2691	7788
37	152	171	185	218	354	512	698	2569	1116	1575	2090	6050
38	117	131	142	167	272	393	537	1974	858	1210	1606	4650
39	89	100	108	128	208	300	409	1505	654	922	1224	3544
40	68	76	82	97	157	227	310	1139	495	698	927	2683
41	51	57	62	73	118	171	233	858	373	526	698	2020
42	38	43	46	55	89	128	175	644	280	395	524	1516

From: Nicolaides KH. The 11 to 13+6 weeks scan, Fetal Medicine Foundation 2004.

Obstetric Doppler

Obstetric Doppler

Please use this document in conjunction with the OB Doppler algorithm.

Fetal Anaemia

Measure MCA PSV. Refer to WCH graph (see below).

Fetal Hydrops

Measure MCA PSV and perform DV Doppler (see below).

Cardiac Abnormality

Perform DV Doppler (see below).

Placental Insufficiency (known or suspected)

Perform UA Doppler. If equivocal or abnormal, measure MCA RI.

If 'brain-sparing' is present, perform DV Doppler.

UA RI Doppler.

- An RI above the 95th percentile but with forward diastolic flow represents an equivocal result not an abnormal result. An MCA RI should be obtained.
- AEDV or REDV is abnormal. Both MCA and DV Doppler should be performed. If the finding is unexpected, the responsible clinical team should be notified before the patient leaves the Ultrasound Unit.

MCA RI Doppler. Angle correct all MCA Doppler

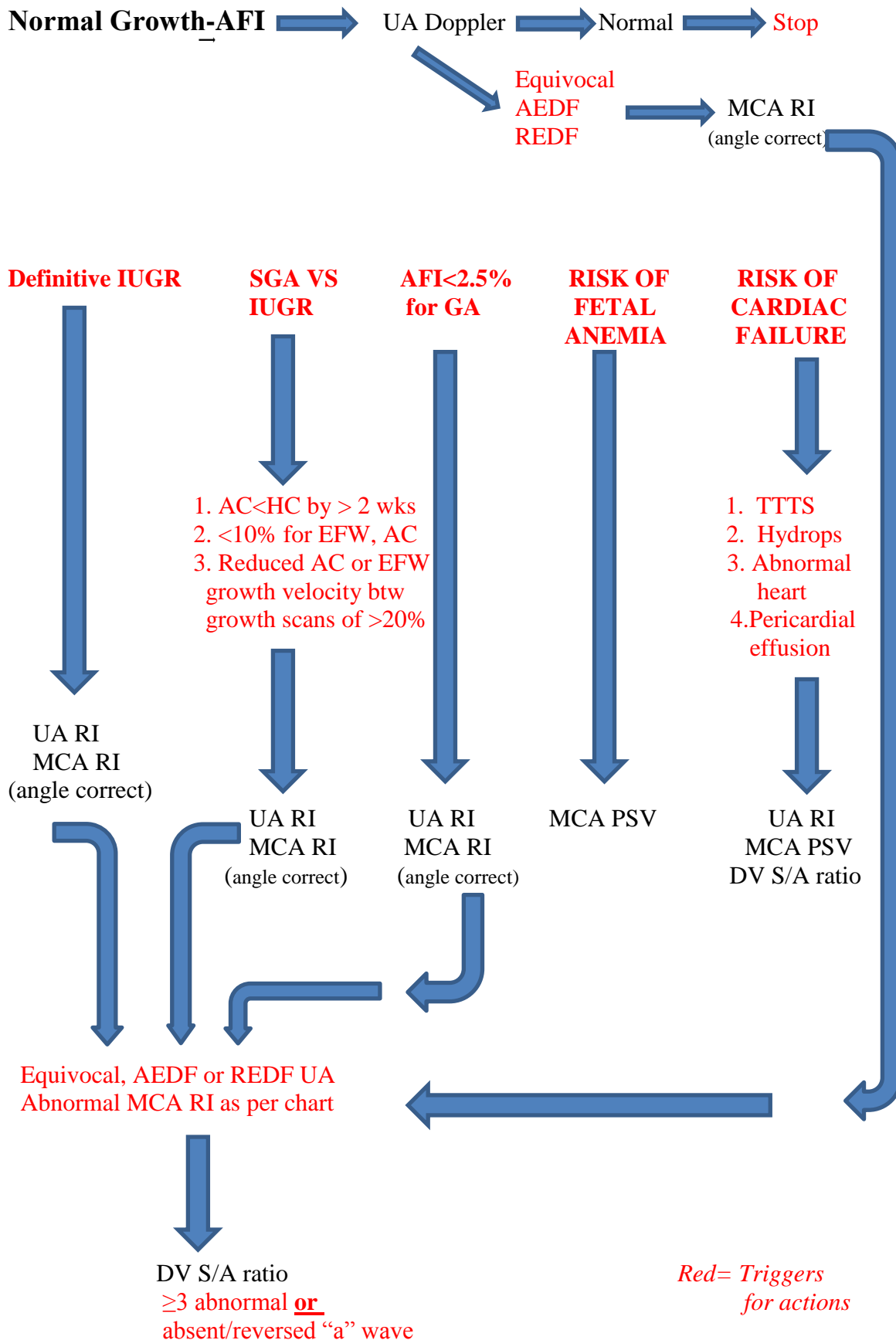
- This should be performed if:
 - UA RI is equivocal or abnormal
 - SGA (AC or EFW < 10th %tile)
 - AC < HC (greater than 2 week discrepancy)
 - Reduced AC or EFW growth velocity (greater than 20th %tile EFW difference between follow up growth scans)
 - Liquor reduced (< 2.5th %tile for GA)
- An abnormal MCA demonstrates increased end diastolic flow due to the "brain-sparing" phenomenon. If the finding is unexpected, the responsible clinical team should be notified before the patient leaves the Ultrasound Unit.
- This implies that the fetus is hypoxaemic but the severity of the hypoxaemia can't be judged from this finding.
- DV Doppler should be performed if the MCA is abnormal.
- All three Doppler parameters should be repeated on the next obstetric Doppler evaluation but may not need to be repeated on subsequent Doppler evaluations. (see flow chart for clarification)
- If increased PSV is identified, make a note and Radiologist suggests that clinical correlation is required. (As per Dr J McGavigan and Dr Downey). DO NOT PLOT on MCA graph for anaemia unless specifically requested.

DV Doppler.

- This should be performed if:
 - the MCA is abnormal
 - there is A/REDV in the UA
 - if fetal hydrops is present (cardiac effusion)
 - Structural cardiac abnormality
- In a normal DV waveform the "a" wave component will drop no lower than 1/2 toward the baseline in comparison with the "D" wave peak (S/a ratio of ≤ 2.0).
- A DV with an "a" wave lower than 1/2 but $< 2/3$ is equivocal and non-reassuring (S/a ratio 2 - 2.9). If the finding is unexpected, the responsible clinical team should be notified before the patient leaves the Ultrasound Unit.
- A DV with an S/a ratio ≥ 3 or "a" wave reaching the baseline or reversing, is abnormal and implies myocardial dysfunction due to acidaemia. This confirms that the fetus is severely affected by the placental insufficiency and urgent referral to the clinical team is required.

Obstetric Doppler Algorithm – Placental Insufficiency

Algorithm For Fetal Doppler Evaluation



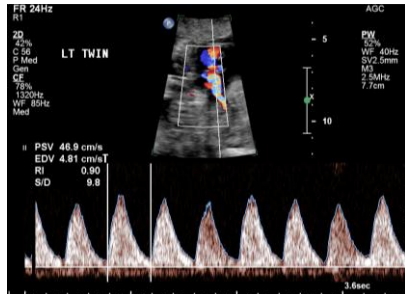
Obstetric Doppler - Normal and Abnormal Findings: Definitions

Umbilical Artery (UA) Doppler

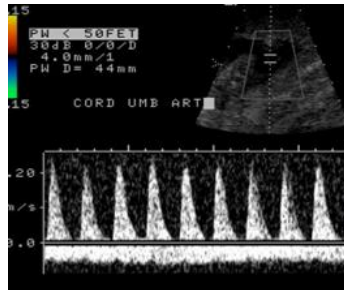
Normal: R.I $\leq 95\%$ *

Equivocal: Reduced but not absent end diastolic velocity (AEDV), R.I $> 95\%$ *

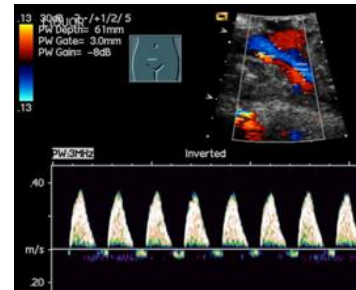
Abnormal: AEDV or REDV



Equivocal



AEDV

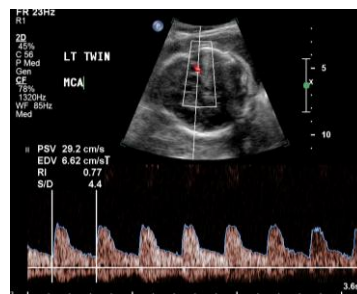


REDV

Middle Cerebral Artery (MCA) Doppler

Normal: MCA R.I. $\geq 5\%$ *

Abnormal: MCA R.I. $< 5\%$ *

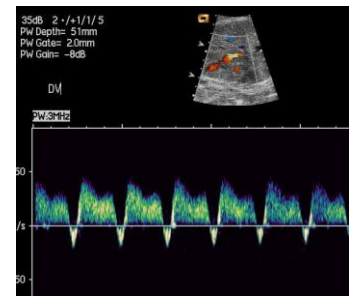
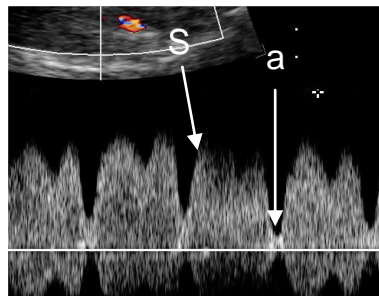
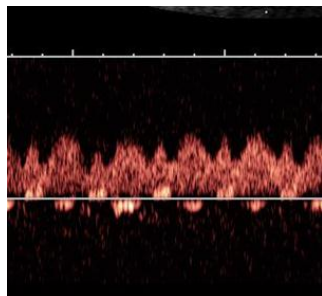


Ductus Venosus (DV) Doppler

Normal: S/a < 3 ($< 95\%$)

Abnormal: S/a ≥ 3 ($\geq 95\%$)

Abnormal: Absent/Reversed "a" wave flow



- * UA and MCA R.I reference range: Kurmanivicius J. Ultrasound Obstet Gynecol 1997;10:112-120
- ** DV S/a reference range: Baschat AA. Ultrasound Obstet Gynecol 2003;22:556-566

Resistance Indices for Umbilical Artery and Middle Cerebral Artery

Reference resistance indices of the umbilical, fetal middle cerebral and uterine arteries at 24-42 weeks of gestation (p 112-120)
J. Kurmanavicius, I. Florio, J. Wisser, G. Hebisch, R. Zimmermann, R. Müller, R. Huch, A. Huch Ultrasound Obstet Gynecol. 10 (1997) 112-120.

Resistance indices

Kurmanavicius et al.

Table 4 Fitted resistance index (RI) centiles in the umbilical artery, middle cerebral artery and placentocerebral ratio

Week of gestation	Umbilical artery			Middle cerebral artery			Placentocerebral ratio		
	5th	50th	95th	5th	50th	95th	5th	50th	95th
24	0.61	0.72	0.83	0.78	0.87	—	0.70	0.81	0.97
25	0.60	0.71	0.82	0.79	0.88	—	0.68	0.79	0.96
26	0.59	0.70	0.81	0.80	0.89	—	0.66	0.78	0.95
27	0.58	0.69	0.80	0.80	0.90	—	0.64	0.76	0.94
28	0.57	0.68	0.79	0.80	0.90	—	0.63	0.75	0.93
29	0.56	0.67	0.79	0.79	0.90	—	0.62	0.74	0.93
30	0.55	0.66	0.78	0.79	0.90	—	0.60	0.73	0.93
31	0.54	0.65	0.77	0.78	0.89	—	0.60	0.73	0.93
32	0.53	0.64	0.76	0.76	0.88	—	0.59	0.72	0.93
33	0.52	0.63	0.75	0.75	0.87	—	0.58	0.72	0.94
34	0.51	0.62	0.74	0.73	0.86	—	0.58	0.72	0.94
35	0.50	0.61	0.73	0.72	0.85	—	0.58	0.72	0.95
36	0.49	0.60	0.73	0.70	0.83	—	0.57	0.72	0.96
37	0.47	0.59	0.72	0.68	0.81	—	0.57	0.72	0.97
38	0.46	0.58	0.71	0.66	0.80	—	0.57	0.72	0.98
39	0.45	0.57	0.70	0.63	0.78	—	0.58	0.73	0.99
40	0.44	0.56	0.69	0.61	0.76	—	0.58	0.73	1.00
41	0.43	0.55	0.68	0.58	0.73	—	0.58	0.74	1.02
42	0.42	0.54	0.67	0.56	0.71	—	0.59	0.75	1.03

$$RI = \frac{S-D}{S}$$

Above 95% equivocal

Below 5% abnormal

Ductus Venosum S/a Ratio Table

DUCTUS VENOSUS S/a RATIO

Gestation (wks)	S/a		
	5th Percentile	50th Percentile	95th Percentile
20	1.331	2.161	2.991
21	1.329	2.159	2.989
22	1.327	2.157	2.987
23	1.324	2.154	2.984
24	1.322	2.152	2.982
25	1.320	2.150	2.980
26	1.318	2.148	2.978
27	1.315	2.145	2.975
28	1.313	2.143	2.973
29	1.311	2.141	2.971
30	1.308	2.138	2.968
31	1.306	2.136	2.966
32	1.304	2.134	2.964
33	1.301	2.131	2.961
34	1.299	2.129	2.959
35	1.297	2.127	2.957
36	1.295	2.125	2.955
37	1.292	2.122	2.952
38	1.290	2.120	2.950
39	1.288	2.118	2.948
40	1.285	2.115	2.945

Abnormal above 95% (S/a ≥ 3.0)

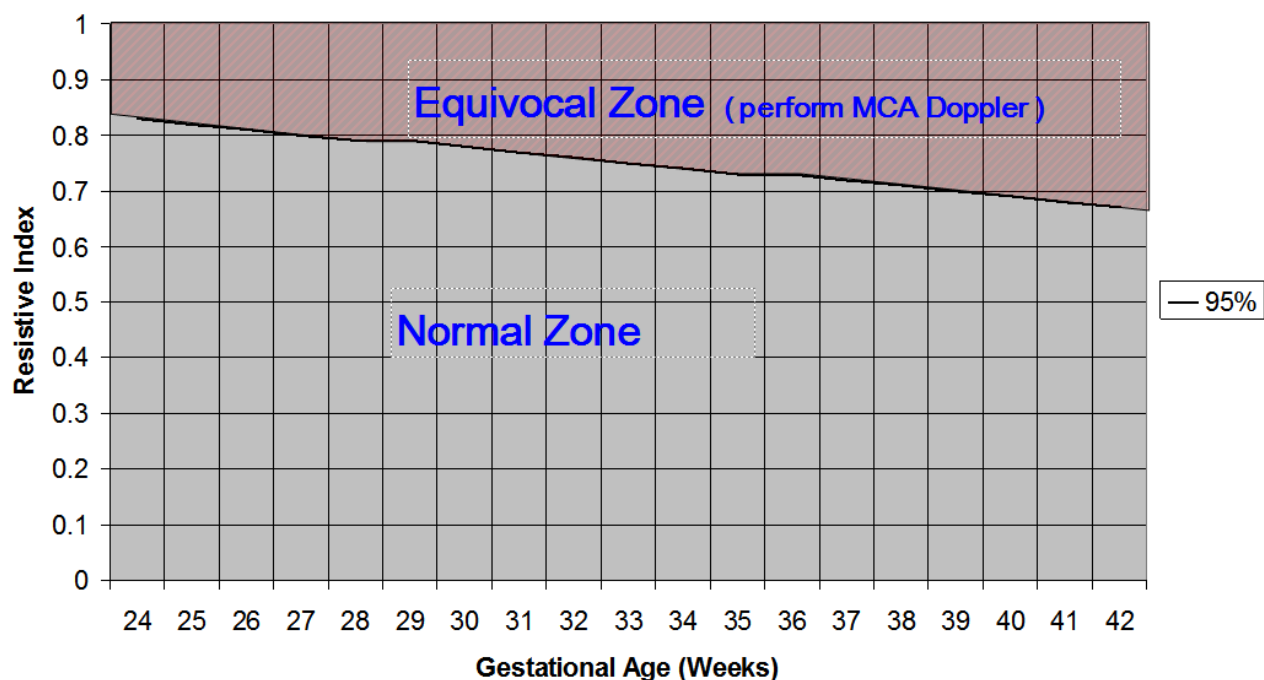
Reference: Baschat AA. Ultrasound Obstet Gynecol 2003; 22: 561-566

Umbilical Artery R.I. and MCA RI Doppler Charts



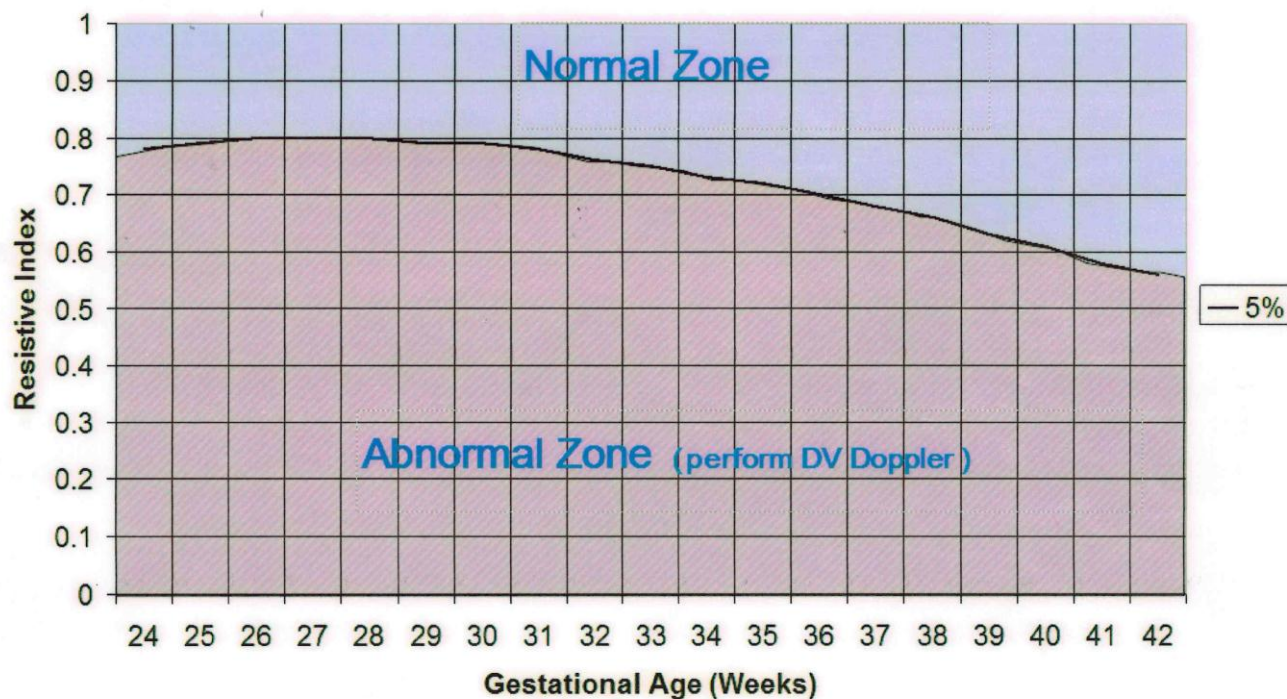
Umbilical Artery Doppler - Flinders Medical Centre

Reference: Kurmanavicius et al, UOG



MCA Doppler - Flinders Medical Centre

Reference: Kurmanavicius et al UOG



Reference: Reference resistance indices of the umbilical, fetal/middle cerebral and uterine arteries at 24-42 weeks of gestation (p 112-120)
J. Kurmanavicius, I. Florio, J. Wisser, G. Hebisch, R. Zimmermann, R. Müller, R. Huch, A. Huch Ultrasound Obstet Gynecol. 10 (1997) 112-120.

Obstetric Doppler-MCA Doppler for Suspected Fetal Anaemia or Fetal Hydrops

MCA Doppler with PSV calculation should be performed when requested on pregnancies at risk for fetal anaemia or if fetal hydrops is suspected (serous fluid collection +/- edema).

PSV should be plotted on the "Pre transfusion chart" from WCH up to 34 weeks GA and after 34 weeks GA the Viewpoint chart for MCA PSV can be used.

NB See protocol book and/or Sonographer Guide on how to perform MCA PSV.

MCDA Twins need angle corrected MCA (TTTS)

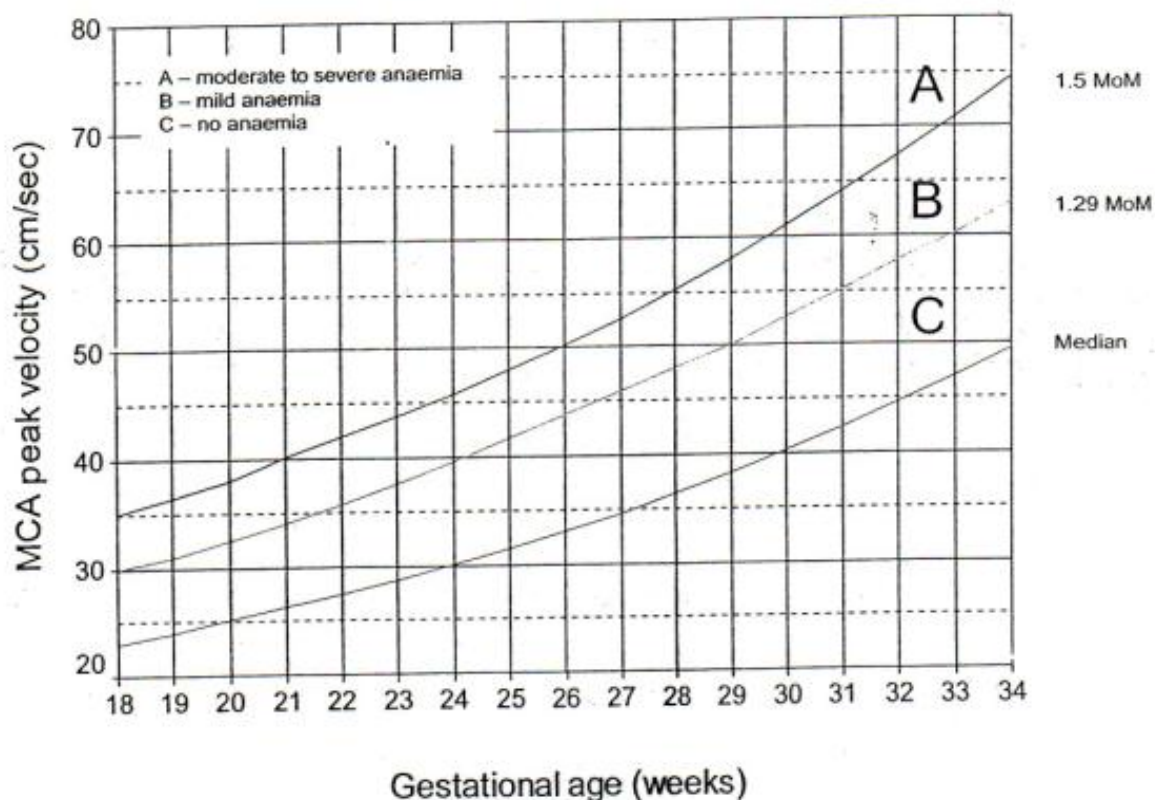
Fetal Anemia - Middle Cerebral Artery Velocity



Middle cerebral artery peak velocity by gestational age – for use only in suspected fetal anaemia where intrauterine transfusion has not been performed

Name
DOB
UR number
Attach patient label here if available

Pre transfusion chart



- Zone C repeat in two weeks
- Zone B repeat in one week. Contact referring doctor.
- MCA PSV ≥ 1.5 MOM (Zone A) repeat in 24 hours. Contact referring doctor.
- Not proven after two transfusions

Uterine Artery Doppler

Resistive Index (RI) above the 95th percentile (shaded zone on the chart) indicates increased risk of developing pre-eclampsia later in pregnancy

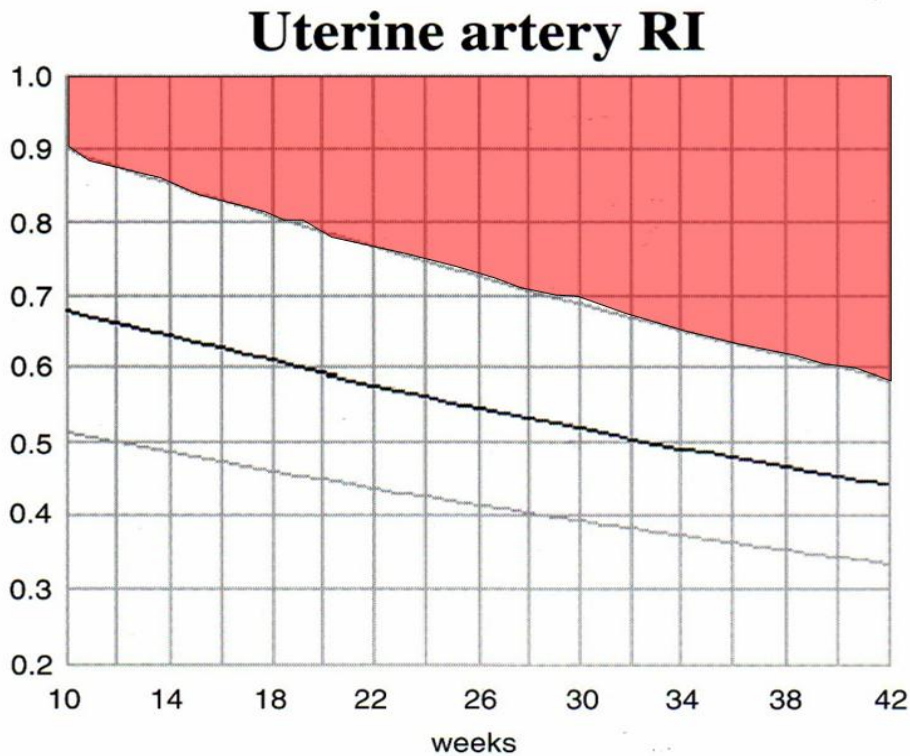


FIGURE 24–16. Reference range for uterine artery resistance index (RI) during pregnancy along with mean, 5th, and 95th percentiles. (From Kaminopetros P, Higuera MT, Nicolaides KH: Doppler study of uterine artery blood flow: Comparison of findings in the first and second trimesters of pregnancy. *Fetal Diagn Therapy* 6:58, 1991.)

Ultrasound guidelines for fetal abnormalities or markers for chromosomal abnormalities

Quick guide to ultrasound detection of markers, abnormalities and other findings at morphology scan

Procedure for immediate counseling

Radiologist/registrar to briefly notify patient of need for immediate counseling.
Radiologist/registrar to contact the CNC at WHC.
Patient sent to WHC.
WHC will contact obstetrician and arrange counseling.
Add the case to the 'DOWNEY OBS FOR REVIEW' folder on PACS.

Procedure when an abnormality is identified

The sonographer should include the finding in Viewpoint (using the "Abnormal" option) and inform the radiologist or radiology registrar.

Arrange immediate counseling.

Abnormalities

Abnormal structures (including a morphologically abnormal humerus, whatever its length), normal structures that are abnormally enlarged (e.g. ventriculomegaly), **echogenic bowel** (also recalculate T21 risk using LR = 6). Exclude mild pelviectasis and single umbilical artery (see below).

Procedure when a hard marker is identified

The sonographer should include the finding in Viewpoint (using the "Abnormal" option) and inform the radiologist or radiology registrar.

Arrange immediate counseling.

Hard Markers

- Absent (demineralised) nasal bone – one or both bones (T21 risk)
- Cystic nuchal fold (Turner Syndrome risk).

Procedure when a marker for Down syndrome as an isolated finding is identified

The sonographer should include the finding in Viewpoint (using the "Details" option) and inform the radiologist or radiology registrar.

Markers

The following are defined as markers for Down syndrome (T21)

- Thickened non-cystic nuchal fold (LR = 17)
- Shortened (<-2SD, morphologically normal) humerus (LR = 7.5)

The pre-test risk should be recalculated using the LR regardless of prior risk status.

If the recalculated risk is not elevated (<1:250), the finding should be included in the final radiologist report as a normal variant and does not need to be discussed with the patient.

If the recalculated risk is elevated ($\geq 1:250$), arrange immediate counselling.

Procedure when EIF or CPC as an isolated finding are identified

Prior low risk (<1:250 by age or SAMSAS screening)

Risk recalculation is not required and the patient doesn't need to be informed at time. Recalculation of risk is not required but the radiologist or radiology registrar should be informed and the finding should be included in Viewpoint (using the "Details" option).

The finding should be included in the final radiologist report as not clinically significant.

Prior high Risk ($\geq 1:250$)

Recalculate risk (EIF LR = 2.8 (T21 risk), CPC LR = 9 (T18 risk)) and include finding in the final report. The patient can be sent home but CNC at WHC should be informed so that rapid follow-up can occur.

Procedure when fetal upper urinary tract dilatation is identified

Mild dilatation of renal pelvis (4 - <7mm till 32/40, 7 - <10mm at ≥32/40):

The sonographer should include the finding on Viewpoint (using the "Details" option).

This finding does not need to be discussed with the patient and WHC do not need to be contacted. The finding should be included in the final report which should recommend follow-up obstetric ultrasound at 32 weeks (or neonatal ultrasound if found ≥32/40).

Moderate/marked dilatation of fetal renal pelvis (≥ 7mm till 32/40, ≥ 10mm at ≥ 32/40), moderate/marked calyceal dilatation or any ureterectasis:

The sonographer should note the finding on Viewpoint (using the "Abnormal" option).

This should be regarded as an abnormality and immediate counseling arranged.

Procedure when a single umbilical artery is identified

The sonographer should note the finding on Viewpoint (using the "Details" option).

This finding does not need to be discussed with the patient and WHC do not need to be contacted. The finding should be included in the final report which should recommend a growth scan early in the third trimester.

Procedure when two findings are identified

Mild pelviectasis and single umbilical artery, or either with CPC or EIF:

The sonographer should note the finding on Viewpoint (using the "Abnormal" option).

Arrange immediate counseling (no re-calculation required).

CPC and EIF:

These are specific for different syndromes and so are not additive. Each is treated in isolation according to EIF/CPC protocol above.

Detailed protocols

Including risk definition (including likelihood ratios), immediate patient management, communication of results and ultrasound definitions of markers.

Procedure when EIF or CPC are Identified at Morphology Scan

Note that new public hospital guidelines recommend no recalculation of risk if low risk pregnancy (see appendix 1)

1. On the day prior the booked morphology scans should have the SAMSAS screening results checked on Oacis. The back of the form should be annotated with the T21 and T18 risk from either:
 - the SAMSAS screening result or,
 - the age related risk if no SAMSAS result is available (use the age related risk table provided).If there is no form (i.e. form with patient) note the result in the daybook.
2. The sonographer should check if the patient has had prior screening for chromosomal abnormalities when a basic history is taken at the start of the scan.
3. If the patient is low risk* (by age or SAMSAS screening) the sonographer does not need to recalculate risk but should inform the radiologist or radiology registrar (the finding should be included in the Viewpoint software generated sonographer worksheet with the risk status, i.e. high risk/low risk). The finding should be included in the radiologist report as not clinically significant.
4. If the patient is high risk the sonographer should send the patient home but they should then contact WHC CNC (or deputy) at WHC (DECT 66894) to ensure that rapid follow-up will occur. The finding should be included in the final report.

Procedure when a marker for Down syndrome is identified at Morphology Scan

Note that this protocol excludes EIF and CPC as these are dealt with by a separate protocol.

Definitions:

The following are defined as markers for Down syndrome (the Likelihood Ratio (LR) associated with the marker (Bethune, 2007) is given in parentheses):

- Absent nasal bone (LR = 83)
- Thickened nuchal fold (LR = 17)
- Echogenic bowel (LR = 6)
- Shortened humerus (LR = 7.5)

The LR for a marker should be applied regardless of prior risk status

Protocol in Medical Imaging

1. The sonographer should include the finding in the Viewpoint software generated sonographer worksheet (using the "Details" option) and inform the radiologist or radiology registrar.
2. The Medical Imaging doctor should then contact the O & G Team
FMC O&G Emergency Reg DECT 67285
FMC BAS Reg DECT 67266

The finding should be included in the final report. Document name of Reg and time.
Add case to Dysmorphology agenda via Dr Peter Downey

Procedure when an abnormality is identified at Morphology Scan

Note that this protocol relates to findings that are actual fetal abnormalities but not to variants that are known to be markers for aneuploidy.

Definitions:

Abnormalities include normal structures that are abnormally enlarged such as ventriculomegaly (note that mild renal dilatation (5-7mm) should not be regarded as an abnormality but rather as a marker requiring post-natal follow-up)

Protocol in Medical Imaging

1. The sonographer should include the finding in the Viewpoint software generated sonographer worksheet (using the "abnormal" option) .Inform the Consultant or radiology registrar and suggest viewing in real time.
2. The Medical Imaging doctor should inform the patient that there is a finding that needs review by the O&G Team. Do not send patient away.
3. FMC O&G Emergency Reg DECT 67285
4. FMC BAS Reg DECT 67266
5. The finding should be included in the final report. Document name of Reg and time.
6. Add case to Dysmorphology agenda via Dr Peter Downey

Procedure when fetal renal dilatation is identified at Morphology Scan

Definitions:

At the morphology scan fetal renal dilatation is defined as:

Mild: $\geq 4\text{mm}$ but $< 7\text{mm}$
Moderate/marked: $\geq 7\text{mm}$

Later in pregnancy (≥ 32 weeks) fetal renal dilatation is defined as:

Mild: $\geq 7\text{mm}$ but $< 10\text{mm}$
Moderate/marked: $\geq 10\text{mm}$

Subjective findings such as significant intra-renal dilatation or associated abnormalities in the renal tract may require a change in follow-up and referral to the Perinatal Dysmorphology Meeting (PDM)

Protocol in Medical Imaging:

Mild dilatation:

The additional assessment should be performed:

- Coronal kidneys with measurement of renal length
- Check for caliectasis and ureteric dilatation
- The sonographer should note the finding on Viewpoint (using the "Details" option) and the report should recommend follow-up ultrasound at 32 weeks.
- This finding does not need to be discussed with the patient and WHC do not need to be contacted. The finding should be included in the final report.

Moderate/marked dilatation:

- This should be regarded as a potential abnormality and the protocol for fetal abnormalities should be followed.

Draft guidelines for South Australian public hospitals regarding the management of patients at low risk of chromosome abnormalities whose fetuses are found to have an echogenic intracardiac focus or a choroid plexus cyst as an isolated finding

Echogenic Intracardiac focus (EIF)

The isolated finding of an EIF in a low-risk patient is unlikely to be a marker for Trisomy 21. The isolated finding can be ignored as a normal variant providing adequate views have been obtained of all structures. The isolated EIF should be reported in this circumstance.

Choroid Plexus Cyst (CPC)

The isolated finding of a CPC in a low risk patient is unlikely to be a marker for Trisomy 18. The isolated finding can be ignored as a normal variant, providing adequate views have been obtained of all structures and the fingers are seen to be open and not clenched.

The isolated CPC should be reported in this circumstance.

Reference: Bethune M. Australasian Radiology (2007) 51, 324-329

Appendix 1: Draft guidelines for South Australian public hospitals