

On-line Table 1: List of studies and reporting of parameters when using transcranial Doppler to detect microemboli

Study	Study Details	Year	Device	Transducer	Insonated Artery	Insonation Depth (mm)	Algorithm	Scale Setting
1	Forteza et al ⁴	1999	Nicolet Biomedical, Madison, Wisconsin, Pioneer TC-2020, software v.2.31	—	R and L MCAs via temporal window	56	—	—
2	Sulek et al ²⁰	1999	Neuroguard, Fremont, California	—	R and L MCAs	—	—	—
3	Edmonds et al ¹⁷	2000	Nicolet Biomedical (16 pts); Medsonics, Mountain View, California (4 pts)	—	Upper MCA via temporal window	40–50	—	—
4	Rodriguez et al ¹¹	2001	Medsonics	2 MHz pulse wave	R and L MCAs via temporal window	—	—	—
5	Rodriguez et al ¹²	2001	Medsonics	2 MHz pulse wave	R and L MCAs via temporal window	—	—	—
6	Riding et al ¹⁵	2004	Neuroguard, Medasonics, Newark, California	—	MCA bilateral (knee); ipsilateral (hip)	—	—	—
7	Rodriguez et al ¹⁹	2005	Neuroguard Plus, Medasonics	—	Bilat. MCA via temporal window	47–45	—	—
8	Kalairajah et al ¹⁸	2006	MultiDop- (MultiDop-2; DWL), Eleektronische System GmbH, Hamburg, Germany	—	L MCA	46–54	Blackman time-weighted function	—
9	Koch et al ⁸	2007	Nicolet Pioneer TC-4040	—	R or L MCA	50–60	—	—
10	Barak et al ⁵	2008	Embodop, DWL Compumedics, GmBH, Hamburg, Germany	Multifrequency.	Bilat. MCA	45–60	—	150/120
11	Gray et al ⁶	2008	Companion III, Nicolet Biomedical	—	R or L MCA via temporal window	48–60	—	—
12	Gray et al ²²	2009	Companion III, Nicolet Biomedical	—	R or L MCA via temporal window	48–60	—	—
13	Patel et al ¹³	2009	Nicolet Eme, Pioneer 2020 (Cardinal Health, Warwick, UK)	2-MHz pulse wave	R or L MCA via temporal window	—	—	—
14	Patel et al ⁷	2010	Nicolet Eme Pioneer 2020 (Cardinal Health)	2-MHz pulse wave	R or L MCA via temporal window	—	—	—

Note:—R, indicates right; L, left; Bilat., bilateral.

On-line Table 2: List of studies and reporting of parameters when using transcranial Doppler to detect microemboli

Study	Study Details	Detection Threshold (dB)	Sample Volume (mm)	FFT Size	FFT Length	FFT Overlap	Filter (Hz)	Ultra sound Frequency	Recording Time (min)	Extra
1	Forteza et al ⁴	-	10	256-point	-	-	-	2 MHz	-	Headband
2	Sulek et al ²⁰	-	-	-	-	-	-	2 MHz	-	Headband
3	Edmonds et al ¹⁷	-	-	-	-	-	-	2 MHz	-	-
4	Rodriguez et al ¹¹	-	7	-	-	-	150	2 MHz	2 Minutes before skin incision to time of surgical closure	Headband
5	Rodriguez et al ¹²	-	7	-	-	-	150	2 MHz	30	-
6	Riding et al ¹⁵	-	-	-	-	-	-	2 MHz	-	Headband
7	Rodriguez et al ¹⁹	6	-	-	-	-	150	2 MHz	Before surgical incision to end of surgery	-
8	Kalirajah et al ¹⁸	12	10	128	-	60%	-	2 MHz	From tourniquet to 5 minutes after release	Power set at 0.6 mW; headband
9	Koch et al ⁸	6	-	-	-	-	-	2 MHz	-	-
10	Barak et al ⁵	28	12	-	-	-	200	2.0 and 2.5 MHz	-	Power = 188 mW
11	Gray et al ⁶	-	-	-	-	-	-	2 MHz	Continuous through surgery	-
12	Gray et al ²²	-	-	-	-	-	-	2 MHz	15 Minutes prior to skin incision to wound closure	-
13	Patel et al ¹³	3	-	-	<300 ms	-	-	2 MHz	Before skin incision to patient returned to supine	Elastic head set to secure probe
14	Patel et al ⁷	-	-	-	-	-	-	2 MHz	Before skin incision to patient returned to supine	Elastic head set to secure probe

Note:—FFT indicates fast Fourier transformation.

On-line Table 3: Details of the 14 studies that have used transcranial Doppler ultrasound to detect microemboli during orthopedic surgery

Study	Study Details	Year	Surgery	Patients	Emboli Detection	HITS Count	Uni- or Bilateral
1	Forteza et al ⁴	1999	Long bone fractures	5 Adults (49, 47, 39, 26, 2 yr); only 2 cases monitored intraoperatively	Conforms to consensus	Automatic and confirmed by 2 blinded observers off-line	Case 4 bilateral; others unilateral
2	Sulek et al ²⁰	1999	Total knee arthroplasty	22 Adults; mean age, 62 ± 3 yr	Conforms to consensus	Counted manually off-line by 2 independent observers; artifacts not mentioned	Bilateral
3	Edmonds et al ¹⁷	2000	Total hip arthroplasty	23 Adults; mean age, 62 yr (range, 37–80 yr)	Duration altered to <0.1 second	Reviewed and counted manually by a single observer off-line	Unilateral acoustic window found in 20 subjects
4	Rodriguez et al ¹¹	2001	Scoliosis surgery	13 Adolescents (range, 13–17 yr)	Conforms to consensus	Counted on-line; stored, verified by investigator; artifacts excluded	Bilateral
5	Rodriguez et al ¹²	2001	Scoliosis surgery	4 Adolescents (range, 13–15 yr)	Conforms to consensus	Counted manually during surgery; confirmation of count off-line; not told by whom	Bilateral
6	Riding et al ¹⁵	2004	20 Hip, 21 knee arthroplasties	41 Adults; median age, 67 yr (range, 49–84 yr)	Conforms to consensus	Increased emboli with v-a shunts; recorded on digital audiotape and analyzed by 2 observers off-line	Bilateral knee; ipsilateral hip
7	Rodriguez et al ¹⁹	2005	Total knee arthroplasty	37 Adults; mean age, 69 ± 9 yr	Conforms to consensus	Off-line recordings, 2 independent blinded observers; excluded artifacts	34 Bilateral, 3 unilateral
8	Kalairajah et al ¹⁸	2006	Knee arthroplasty, computer-assisted vs non-navigated	24 Adults; mean age, 63.4 yr (range, 45–78 yr)	Threshold 12 dB, much greater than consensus recommendation	Not stated	Not stated
9	Koch et al ⁸	2007	Hip or knee arthroplasty	24 Adults; mean age, 74 ± 6 yr	Conforms to consensus except threshold raised to 6 db	Not stated	Unilateral
10	Barak et al ⁵	2008	Fixation of hip fracture	22 Adults; median age, 82 yr (range, 51–97 yr)	Dual-frequency probe; detection threshold of 28 db; no other detection criteria listed	Verified off-line by same investigator; studied only if acoustic window located	Bilateral
11	Gray et al ⁶	2008	Hip arthroplasty	20 Adults; mean age, 70 ± 9.3 yr	Conforms to consensus	Automatic and confirmed by 2 blinded observers off-line	Unilateral
12	Gray et al ²²	2009	Fracture fixation	20 Adults; median age, 38 yr (range, 17–79 yr)	Conforms to consensus	Counted manually off-line by 2 independent observers	Unilateral
13	Patel et al ¹³	2009	Hip arthroplasty and hip resurfacing	12 Patients for each procedure; hip arthroplasty: mean age, 57.8 yr (range, 44–69 yr); hip resurfacing: mean age, 55.9 yr (range 42–70 yr)	Conforms to consensus	Counted manually off-line by 1 independent observer	Unilateral
14	Patel et al ⁷	2010	Hip arthroplasty	45 Adults; mean age, 69.9 ± 9.6 yr	Conforms to consensus	Counted manually off-line by 1 observer	Unilateral

Note:—v-a indicates venous-arterial.

On-line Table 4: Details of the 14 studies that have used transcranial Doppler ultrasound to detect microemboli during orthopedic surgery

Study	Study Details	Year	Emboli Count	PFO Implicated	Neurologic or Cognitive Change
1	Forteza et al ⁴	1999	Case 2: 36 during surgery; case 3: 43 during surgery; nonsurgical cases also exhibit counts	No PFO demonstrated by TEE in either surgical case; PFO by TEE in 1 nonsurgical case	Acute brain injury noted as part of fat embolic syndrome
2	Sulek et al ²⁰	1999	13 Patients; bilateral 87 ± 20; right: 31 ± 23; left: 56 ± 44; during tourniquet release	TEE emboli in left atrium in 2 patients with pre-existing PFO; in 6 patients, echogenic material appeared through pulmonary veins	Neurologic exam, no deficits identified
3	Edmonds et al ¹⁷	2000	Emboli in 8 patients; patient two, 158; patient ten, 200; patient twenty, 92; 5 patients with range, 1–10	Not investigated	No confusion or stroke identified
4	Rodriguez et al ¹¹	2001	Counts range, 1–14 (median, 5); 2 high counts: 265, 63	TEE confirms PFO in both subjects with high counts	No neurologic complications identified
5	Rodriguez et al ¹²	2001	Case 1, 265; case 2, 63; case 3, 4–0	Case 1, TEE showed PFO; case 2, TEE revealed TCD used to identify v-a shunts (spontaneous or provoked by coughing or Valsalva);	No neurologic complications
6	Riding et al ¹⁵	2004	18 of 34 Subjects (all had v-a shunts); 16 classified as PFO (>15 HITS); 2 intraoperative HITS of 368, and 203 were in PFO classification	34 of 41 subjects had v-a shunts; 16 had >15 HITS and were classified as PFO	2 Patients with high emboli counts (108 and 522) had postoperative confusion
7	Rodriguez et al ¹⁹	2005	22 Patients; mean HITS, 4 ± 8 (range, 0–40); patients with preoperative shunts had greater HITS, 22 ± 14 vs 2 ± 2	Saline agitation by TEE preoperatively; shunt found in 4 patients and PFO shown in 2 patients	Cognitive testing showed no relationship to HITS count
8	Kalairajah et al ¹⁸	2006	Computer-assisted: all 10 insonated; 7 had emboli detected; mean, 0.6 ± 0.7; non-navigated: 9 of 14 insonated; all had emboli detected (mean, 10.7 ± 13.5)		No relation of mental test score to embolic count
9	Koch et al ⁸	2007	Emboli detected in all patients; mean count, 9.9 ± 18; embolic count greater in patients with v-a shunt vs no shunt (15.4 vs 4.4) but not statistically significant	TCD to recruit 12 patients with v-a shunt and 12 without	Cognitive testing showed no relation to cognitive change and emboli count
10	Barak et al ⁵	2008	9 Patients had HITS; subject 4 (Rt, 232 solid, 174 gas; Lt, 75 solid, 62 gas) and subject 5 (Rt, 464 solid, 479 gas; Lt, 228 solid, 140 gas) had high counts; remaining 7 patients ranged from 7 to 43		Subject 1 (Rt, 11 solid, 14 gas; Lt, 3 solid, 15 gas) had stroke 4 days after surgery
11	Gray et al ⁶	2008	11 Patients; range, 1–550; median, 3 (IQ, 2–16); 1 patient had >500 HITS but no cognitive change.	TEE on patient with count of 550 showed PFO	Cognitive change measured; no difference in test scores between patients with and without emboli and embolic count
12	Gray et al ²²	2009	4 Patients; range, 2–9 HITS		Quality of life measured; no difference between groups
13	Patel et al ¹³	2009	No emboli in hip resurfacing group; 5/12 in hip arthroplasty group showed emboli with counts of 1, 2, 2, 3, 3	Microcavitation saline, intravenously, followed by Valsalva maneuver and search for microemboli within 25 seconds; hip arthroplasty: 1 patient with PFO; hip resurfacing: 2 patients with PFO	Cognitive change measured; no relationship between cognitive change and embolic count
14	Patel et al ⁷	2010	HITS in 10 of 45 patients (23%); median = 0	Agitated saline injected intravenously and search for microemboli; 37% had PFO	Cognitive battery, preoperatively, 6–8 weeks and 6 months postoperatively; no decline in cognition; no association with PFO

Note.—v-a indicates venous-arterial; Rt, right; Lt, left; IQ, interquartile range.