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**The Relationship of Post-Operative Delirium and
Post-Operative Cognitive Decline**:
The Successful Aging after Elective Surgery (SAGES) Study

Summary

Objective: To examine the overlap of and contrast risk factors for post-operative delirium (POD) and post-operative cognitive decline (POCD) in a sample of elderly elective surgery patients.

Methods: Patient data were obtained from the SAGES cohort (560 elective surgery patients and 119 non-surgical comparison patients). POD was identified during the hospital stay following surgery using daily Confusion Assessment Method (CAM) and chart review methods.

POCD was defined using performance on neuropsychological tests at pre-operative baseline and 1-month, 2-month, and 6-month post-operative follow-up.[1] The ISPOCD definition was used to define POCD: a reliable decline in performance (1.96 within-person standard deviation units) on two or more tests or a cumulative (within-person) standardized decline of 1.96 or more on seven neuropsychological tests. Because the SAGES and ISPOCD neuropsychological tests differ and could not be unambiguously matched by content or domain, we used 10 possible combinations of SAGES neuropsychological tests to complete groups of 7 tests and treated the resulting POCD indicators as multiply imputed data to combine results across test combination.

We examined the overlap of POD and POCD, and we examined the strength of association of published risk factors for both POCD and POD.

Results (month 1) The (tetrachoric) correlation between POCD and POD at month 1 had a range of .14 - .27 over 10 test combinations, and a median value of 0.20). Below is the implied cross-tab of POCD and post-operative delirium from the multiply-imputed data (cell entries are proportions) at month 1:

	POCD		
Delirium	No	Yes	Total
No	0.433	0.333	0.766
Yes	0.099	0.135	0.234
Total	0.532	0.468	1.000

At month 1 the agreement of POCD and POD ranged from $\kappa =.07$ to $\kappa =.14$ across the 10 imputations of POCD. (Remember that values less than 0.20 fall in the "poor" agreement range of Landis and Koch (1977)).

Results (month 2) The (tetrachoric) correlation between POCD and POD at month 2 had a range of -.01 - .11 over 10 test combinations, and a median value of 0.03). Below is the implied cross-tab

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[1] We discussed including the 12-month follow-up in this list. However, because of neuropsych data not being collected at the 12M outcome time point for the non-surgical comparison group, we would have to inconsistently implement the retest effect correction across time point. Therefore, I limit the analysis to the 6M follow-up.

of POCD and post-operative delirium from the multiply-imputed data (cell entries are proportions) at month 2:

| | POCD | | |
Delirium	No	Yes	Total
No	0.593	0.172	0.765
Yes	0.178	0.057	0.235
Total	0.771	0.229	1.000

At month 2 the agreement of POCD and POD ranged from κ =-.01 to κ =.06 across the 10 imputations of POCD. (Remember that values less than 0.20 fall in the "poor" agreement range of Landis and Koch (1977)).

Results (month 6) The (tetrachoric) correlation between POCD and POD at month 6 had a range of 0 - .17 over 10 test combinations, and a median value of 0.07). Below is the implied cross-tab of POCD and post-operative delirium from the multiply-imputed data (cell entries are proportions) at month 6:

| | POCD | | |
Delirium	No	Yes	Total
No	0.650	0.117	0.767
Yes	0.189	0.044	0.233
Total	0.839	0.161	1.000

At month 6 the agreement of POCD and POD ranged from κ =0 to κ =.09 across the 10 imputations of POCD. (Remember that values less than 0.20 fall in the "poor" agreement range of Landis and Koch (1977)).

1 Definition of POCD

POCD is defined in a series of steps:

1. Compute, for each of 7 neuropsychological tests, the z-score for the test for a patient. The z-score is defined as the change from baseline to 1 month, less the mean change from baseline in the primary care group (PCG), and divided by the within-subject standard deviation from the PCG.

2. Persons with two or more tests showing z-score of -1.96 or lower meet criteria for POCD.

3. Persons who have a sum of 7 z-scores of -1.96 or lower meet criteria for POCD.

1.1 Which tests

We are modeling our definition of POCD after ISPOCD, specifically as described in Rasmussen, L. S., & Siersma, V. D. (2004). Postoperative cognitive dysfunction: true deterioration versus random variation. *Acta Anaesthesiologica Scandinavica*, 48(9), 1137-1143.

The neuropsychological tests used in SAGES do not exactly match up with those used in Rasmussen & Siersma (2004) [R&S04]. Here's how we make the crosswalk:

Name of test Hopkins Verbal Learning Test, Revised (HVLT-R) Sum of learning trials

Description of test A list of words is read to the participant, who is asked to repeat the list back over multiple learning and delayed recall trials.

Domain of test Verbal episodic memory

Stands in for R&S04 Visual verbal learning, cumulated number of words

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Name of test HVLT-R Delayed Recall

Description of test (see above)

Domain of test Verbal episodic memory

Stands in for R&S04 Visual verbal learning, delayed recall

Name of test DKEFS Trail Making Test (part B time)

Description of test The participant must connect a sequence of alternating numbers and letters. Score is time to complete (up to 300 seconds).

Domain of test Executive function, visuospatial function

Stands in for R&S04 Concept Shifting Test, part C, time

Name of test DKEFS Trail Making Test (part B errors)

Description of test (see above). Score is number of errors.

Domain of test Executive function, visuospatial function

Stands in for R&S04 Concept Shifting Test, part C, errors

Name of test Visual Search and Attention Test (VSAT)

Description of test Four timed visual cancellation tasks where the participant must cross out letters and symbols that are identical to a target.

Domain of test Executive, visuospatial function

Stands in for R&S04 No test in Rasmusen and Siersma (2004) (R&S04). But, Stroop Color Word Test is R&S04 (errors and time)

Name of test Boston Naming Test (BNT)

Description of test The participant is presented with drawings of common objects, which then must be named correctly.

Domain of test Confrontation naming, language.

Stands in for R&S04 No test in R&S04. Could also have chosen from category fluency, phonemic fluency, or WAIS Digit Span Forward and Backward, to fill the number of tests to 7. There may be a sensitivity analysis in here.

Name of test RBANS Digit Symbol

Description of test Using a key provided, the participant matches symbols to numbers as quickly as possible while being timed.

Domain of test Executive function, visuospatial function.

Stands in for R&S04 Letter-Digit Coding.

The following neuropsychological tests don't have an exact match in SAGES and Rasmussen & Siersma (2004) [R&S04]. But we do use them in a multiply-imputed version of POCD:

Name of test WAIS Digit Span Forward and Backward

Description of test Participants are asked to repeat a string of digits forward and in reverse order.

Domain of test Attention

Name of test Category Fluency

Description of test The participant must generate as many words as possible from a semantic category (animals).

Domain of test Executive function, semantic memory, language

Name of test Phonemic Fluency

Description of test The participant must generate as many words as possible beginning with a given letter over 3 trials (F, A, and S)

Domain of test Executive function, semantic memory, language

Even 'tho the tests don't line up perfectly, we think it's important to have the same count (7) of tests. This is because one of the R&S04 criteria for POCD uses a sum of z-scores indicating greater than 1.96 decline in neuropsychological test performance as an condition for ruling in POCD. If we used 10 SAGES tests, it'd be easier to get to the sum of -1.96 or less. This discrepancy in tests rules out confident replication for the R&S04 POCD definition, however. Wouldn't it be great if everyone used the NIH Toolbox or there were at least standards for harmonization across neuropsychological tests?

Table 1
Participant sociodemographic and clinical characteristics

Characteristic	Total	
	Mean or *n*	**(SD or %)**
Number of observations [N (%)]		
	551	(100)
Age (years) [mean (SD)]	76·7	(5·2)
Sex [n (%)]		
Men	231	(41·9)
Women	320	(58·1)
Marital status [n (%)]		
Never married	26	(4·7)
Married or living with partner	327	(59·3)
Widowed	132	(24·0)
Divorced	60	(10·9)
Separated	6	(1·1)
Race [n (%)]		
White	510	(92·6)
All other race and ethnicity groups	41	(7·4)
English a second language [n (%)]		
English as first language	514	(93·3)
English not first language	37	(6·7)
Education (years) [mean (SD)]	15·0	(2·9)
Education level [n (%)]		
Less than high school	24	(4·4)
High school graduate	134	(24·3)
Some college	134	(24·3)
Four years of college	95	(17·2)
More than four years of college	164	(29·8)
Any ADL Impairment [n (%)]		
No	511	(92·7)
Yes	40	(7·3)
Any IADL impairment [n (%)]		
No	403	(73·1)
Yes	148	(26·9)

Activity level (MLTA, kcal) [mean (SD)]	779	(1191)
SF12 physical composite T-score [mean (SD)]	35·4	(10·0)
Geriatric Depression Scale (GDS [0-15]) [mean (SD)]	2·4	(2·5)
Visual Impairment (over 20 70 after correction) (Inouye '93 Factor 1) [n (%)]		
No	546	(99·5)
Yes	3	(0·5)
Cognitive Impairment (MMSE below 24) (Inouye '93 Factor 2) [n (%)]		
No	521	(94·7)
Yes	29	(5·3)
Severe Illness (Apache II above 16) (Inouye '93 Factor 3) [n (%)]		
No	518	(94·0)
Yes	33	(6·0)
BUN Creatinine 18+ (Inouye '93 Factor 4) [n (%)]		
No	286	(51·9)
Yes	265	(48·1)
Delirium Risk Group (from Inouye 1993) [n (%)]		
Low 0 Inouye 1993 Risk Factors	261	(47·4)
Intermediate 1-2 Inouye 1993 Risk Factors	285	(51·7)
High 3-4 Inouye 1993 Risk Factors	5	(0·9)
Sugery type [n (%)]		
Orthopedic	446	(80·9)
Vascular	34	(6·2)
Gastrointestinal	71	(12·9)
Charlson Comorbidity Index [mean (SD)]	1·02	(1·25)
3MS Score [mean (SD)]	93·6	(5·3)
General cognitive performance (T) [mean (SD)]	57·7	(7·2)
Proxy IQCODE Impairment [>3.2] [n (%)]		
No	425	(78·8)
Yes	114	(21·2)
Proxy IQCODE [mean (SD)]	3·12	(0·24)
Brain tissue fraction [mean (SD)]	0·717	(0·050)
Anesthesia type [n (%)]		
1	469	(85·1)
2	78	(14·2)
3	4	(0·7)

2 Post-operative delirium and POCD - Multiple Imputation

In this section, we take each of the 10 different ways in which we could have constructed our set of 7 neuropsychological tests taking 2 from 5 ambiguously matched tests to R&S04 and generate 10 versions of POCD. Each of the 10 is taken as one of a possible imputation of POCD, and the data are analyzed as if they were generated from a multiple imputation algorithm.

2.1 Month 1 computations

Below is the implied cross-tab of POCD and post-operative delirium from the multiply-imputed data (cell entries are proportions) at month 1:

	POCD		
Delirium	No	Yes	Total
No	0.433	0.333	0.766
Yes	0.099	0.135	0.234
Total	0.532	0.468	1.000

Table 2
Different ways of composing neuropsychological test battery to define POCD and summary statistics capturing association and agreement with post-operative delirium. SAGES study, month 1.

Component neuropsychological tests	P(POCD)	R	κ	RR (95% CI)	p-value
BNT, Digit Span	0.44	0.14	0.07	1.23 (1.00 - 1.51)	0.048
Digit Span, Phenomic Fluency	0.49	0.19	0.09	1.28 (1.07 - 1.53)	0.007
Digit Span, Category Fluency	0.47	0.18	0.09	1.27 (1.06 - 1.54)	0.011
VSAT, Digit Span	0.46	0.19	0.10	1.31 (1.08 - 1.58)	0.005
BNT, Phenomic Fluency	0.48	0.19	0.09	1.29 (1.07 - 1.55)	0.006
Category Fluency, Phenomic Fluency	0.49	0.22	0.11	1.33 (1.11 - 1.58)	0.002
BNT, Category Fluency	0.43	0.23	0.12	1.41 (1.16 - 1.71)	0.001
VSAT, BNT	0.45	0.26	0.13	1.44 (1.19 - 1.73)	0.000
VSAT, Category Fluency	0.46	0.27	0.14	1.45 (1.21 - 1.73)	0.000
VSAT, Phenomic Fluency	0.51	0.23	0.11	1.34 (1.13 - 1.58)	0.001
Overall	0.47	0.20	0.11	1.33 (1.07 - 1.66)	0.009

Notes: P(POCD), prevalence of post-operative cognitive decline; R, κ and RR are the tetrachoric correlation, kappa coefficient, and relative risk respectively, for post-operative cognitive decline and (or given) post-operative delirium, VSAT, Visual Search and Attention Test (VSAT); BNT, Boston Naming Test (BNT); Digit Symbol, RBANS Digit Symbol; Digit Span, WAIS Digit Span Forward and Backward; Category Fluency, Category Fluency; Phenomic Fluency, Phonemic Fluency. **All versions include** the following tests: Hopkins Verbal Learning Test, Revised (HVLT-R) Sum of learning trials, HVLT-R Delayed Recall, DKEFS Trail Making Test (part B time), DKEFS Trail Making Test (part B errors).

2.2 Month 2 computations

Below is the implied cross-tab of POCD and post-operative delirium from the multiply-imputed data (cell entries are proportions) at month 2:

	POCD		
Delirium	No	Yes	Total
No	0.593	0.172	0.765
Yes	0.178	0.057	0.235
Total	0.771	0.229	1.000

Table 3
Different ways of composing neuropsychological test battery to define POCD and summary statistics capturing association and agreement with post-operative delirium. SAGES study, month 2.

Component neuropsychological tests	P(POCD)	R	κ	RR (95% CI)	p-value
BNT, Digit Span	0.23	-0.01	-0.00	0.98 (0.67 - 1.42)	0.914
Digit Span, Phenomic Fluency	0.25	0.05	0.03	1.11 (0.79 - 1.55)	0.553
Digit Span, Category Fluency	0.24	0.04	0.02	1.08 (0.77 - 1.53)	0.646
VSAT, Digit Span	0.22	0.05	0.02	1.11 (0.77 - 1.60)	0.576
BNT, Phenomic Fluency	0.24	0.03	0.02	1.07 (0.76 - 1.52)	0.688
Category Fluency, Phenomic Fluency	0.24	-0.01	-0.01	0.98 (0.68 - 1.39)	0.894
BNT, Category Fluency	0.23	0.00	0.00	1.00 (0.70 - 1.45)	0.983
VSAT, BNT	0.20	0.02	0.01	1.06 (0.71 - 1.57)	0.781
VSAT, Category Fluency	0.22	0.10	0.06	1.26 (0.89 - 1.79)	0.190
VSAT, Phenomic Fluency	0.22	0.11	0.06	1.29 (0.91 - 1.81)	0.151
Overall	0.23	0.03	0.02	1.09 (0.72 - 1.64)	0.679

Notes: P(POCD), prevalence of post-operative cognitive decline; R, κ and RR are the tetrachoric correlation, kappa coefficient, and relative risk respectively, for post-operative cognitive decline and (or given) post-operative delirium, VSAT, Visual Search and Attention Test (VSAT); BNT, Boston Naming Test (BNT); Digit Symbol, RBANS Digit Symbol; Digit Span, WAIS Digit Span Forward and Backward; Category Fluency, Category Fluency; Phenomic Fluency, Phonemic Fluency. **All versions include** the following tests: Hopkins Verbal Learning Test, Revised (HVLT-R) Sum of learning trials, HVLT-R Delayed Recall, DKEFS Trail Making Test (part B time), DKEFS Trail Making Test (part B errors).

2.3   Month 6 computations

Below is the implied cross-tab of POCD and post-operative delirium from the multiply-imputed data (cell entries are proportions) at month 6:

Delirium	POCD		
	No	Yes	Total
No	0.650	0.117	0.767
Yes	0.189	0.044	0.233
Total	0.839	0.161	1.000

Table 4
Different ways of composing neuropsychological test battery to define
POCD and summary statistics capturing association and agreement
with post-operative delirium. SAGES study, month 6.

Component neuropsychological tests	P(POCD)	R	κ	RR (95% CI)	p-value
BNT, Digit Span	0.15	0.06	0.03	1.17 (0.74 - 1.84)	0.502
Digit Span, Phenomic Fluency	0.16	0.17	0.09	1.53 (1.01 - 2.30)	0.042
Digit Span, Category Fluency	0.18	0.05	0.03	1.14 (0.75 - 1.74)	0.533
VSAT, Digit Span	0.18	0.12	0.06	1.34 (0.90 - 2.00)	0.148
BNT, Phenomic Fluency	0.13	0.03	0.01	1.09 (0.66 - 1.82)	0.728
Category Fluency, Phenomic Fluency	0.16	0.16	0.08	1.50 (0.99 - 2.28)	0.058
BNT, Category Fluency	0.15	0.03	0.01	1.08 (0.68 - 1.71)	0.754
VSAT, BNT	0.15	0.00	0.00	1.01 (0.63 - 1.62)	0.978
VSAT, Category Fluency	0.17	0.08	0.04	1.23 (0.81 - 1.85)	0.334
VSAT, Phenomic Fluency	0.18	0.13	0.07	1.37 (0.93 - 2.03)	0.114
Overall	0.16	0.07	0.04	1.23 (0.73 - 2.09)	0.433

Notes: P(POCD), prevalence of post-operative cognitive decline; R, κ and RR are the tetrachoric correlation, kappa coefficient, and relative risk respectively, for post-operative cognitive decline and (or given) post-operative delirium, VSAT, Visual Search and Attention Test (VSAT); BNT, Boston Naming Test (BNT); Digit Symbol, RBANS Digit Symbol; Digit Span, WAIS Digit Span Forward and Backward; Category Fluency, Category Fluency; Phenomic Fluency, Phonemic Fluency. **All versions include** the following tests: Hopkins Verbal Learning Test, Revised (HVLT-R) Sum of learning trials, HVLT-R Delayed Recall, DKEFS Trail Making Test (part B time), DKEFS Trail Making Test (part B errors).

Table 5
Participant sociodemographic and clinical characteristics by POD and POCD

Characteristic	Total Mean or *n*	Total (SD or %)	No POD No POCD Mean or *n*	No POD No POCD (SD or %)	POD Only Mean or *n*	POD Only (SD or %)	POCD Only Mean or *n*	POCD Only (SD or %)	POD*POCD Mean or *n*	POD*POCD (SD or %)
Sum of weights [Nw (%)]	536	(100)	319	(100)	96	(100)	91	(100)	30	(100)
Age (years) [mean (SD)]	76·61	(5·08)	76·27	(4·97)	77·2	(5·1)	76·7	(5·4)	78·1	(4·8)
Sex [nw (%)]										
Men	226	(42·2)	129	(40·4)	37	(39)	47	(52)	13	(43)
Women	310	(57·8)	190	(59·6)	58	(60)	44	(48)	18	(60)
Marital status [nw (%)]										
Never married	26	(4·9)	19	(6·0)	2·8	(3)	2·8	(3)	1·2	(4)
Married or living with partner	319	(59·5)	188	(58·9)	55	(57)	58	(64)	18	(60)
Widowed	126	(23·5)	75	(23·5)	22	(23)	21	(23)	8·1	(27)
Divorced	59	(11·0)	34	(10·7)	16	(17)	6·2	(7)	2·6	(9)
Separated	6	(1·1)	3·5	(1·1)	0	(0)	2·5	(3)	0	(0)
Race [nw (%)]										
White	496	(92·5)	298	(93·4)	84	(88)	85	(93)	29	(97)
All other race and ethnicity groups	40	(7·5)	21	(6·6)	12	(13)	5·8	(6)	1·3	(4)
English a second language [nw (%)]										
English as first language	501	(93·5)	301	(94·4)	89	(93)	83	(91)	28	(93)
English not first language	35	(6·5)	19	(6·0)	6·9	(7)	7·5	(8)	2·1	(7)
Education (years) [mean (SD)]	14·96	(2·92)	15·20	(2·91)	14·93	(3·02)	14·41	(2·94)	14·1	(2·4)
Education level [nw (%)]										
Less than high school	23	(4·3)	9·4	(2·9)	5	(5)	7·6	(8)	1	(3)
High school graduate	132	(24·6)	72	(22·6)	25	(26)	25	(27)	9·9	(33)
Some college	130	(24·3)	79	(24·8)	19	(20)	22	(24)	10	(33)
Four years of college	94	(17·5)	57	(17·9)	17	(18)	16	(18)	3·7	(12)
More than four years of college	157	(29·3)	102	(32·0)	30	(31)	20	(22)	5·4	(18)
Any ADL Impairment [nw (%)]										
No	497	(92·7)	295	(92·5)	86	(90)	86	(95)	30	(100)
Yes	39	(7·3)	24	(7·5)	9·9	(10)	5·3	(6)	·091	(0)
Any IADL impairment [nw (%)]										
No	393	(73·3)	244	(76·5)	61	(64)	67	(74)	21	(70)
Yes	143	(26·7)	75	(23·5)	34	(35)	24	(26)	9·7	(32)
Activity level (MLTA, kcal) [mean (SD)]	790	(1203)	811	(1106)	806	(1667)	772	(1174)	556	(673)

SF12 physical composite T-score [mean (SD)]	35·5	(10·0)	36·3	(9·9)	33·7	(10·2)	35·8	(9·9)	32·5	(8·7)
Geriatric Depression Scale (GDS [0-15]) [mean (SD)]	2·40	(2·45)	2·26	(2·39)	2·77	(2·70)	2·33	(2·37)	3·0	(2·5)
Visual Impairment (over 20 70 after correction) (Inouye '93 Factor 1) [nw (%)]										
No	531	(99·4)	317	(99·7)	94	(99)	91	(100)	29	(97)
Yes	3	(0·6)	·91	(0·3)	1	(1)	·091	(0)	1	(3)
Cognitive Impairment (MMSE below 24) (Inouye '93 Factor 2) [nw (%)]										
No	506	(94·6)	307	(96·5)	86	(90)	86	(95)	27	(90)
Yes	29	(5·4)	11	(3·5)	9·8	(10)	4·6	(5)	3·2	(11)
Severe Illness (Apache II above 16) (Inouye '93 Factor 3) [nw (%)]										
No	506	(94·4)	315	(98·7)	83	(86)	85	(93)	23	(77)
Yes	30	(5·6)	4·2	(1·3)	13	(14)	5·8	(6)	7·2	(24)
BUN Creatinine 18+ (Inouye '93 Factor 4) [nw (%)]										
No	277	(51·7)	166	(52·0)	46	(48)	47	(52)	18	(60)
Yes	259	(48·3)	153	(48·0)	49	(51)	44	(48)	13	(43)
Delirium Risk Group (from Inouye 1993) [nw (%)]										
Low 0 Inouye 1993 Risk Factors	254	(47·4)	159	(49·8)	40	(42)	44	(48)	11	(37)
Intermediate 1-2 Inouye 1993 Risk Factors	277	(51·7)	159	(49·8)	52	(54)	47	(52)	19	(63)
High 3-4 Inouye 1993 Risk Factors	5	(0·9)	1	(0·3)	3·8	(4)	0	(0)	·18	(1)
Sugery type [nw (%)]										
Orthopedic	435	(81·2)	265	(83·1)	74	(77)	72	(79)	24	(80)
Vascular	32	(6·0)	13	(4·1)	8·5	(9)	8·7	(10)	1·5	(5)
Gastrointestinal	69	(12·9)	41	(12·9)	13	(14)	10	(11)	5·2	(17)
Anesthesia type [nw (%)]										
1	455	(84·9)	265	(83·1)	83	(86)	78	(86)	29	(97)
2	77	(14·4)	52	(16·3)	12	(13)	12	(13)	1	(3)
3	4	(0·7)	2·2	(0·7)	1	(1)	·82	(1)	0	(0)
Charlson Comorbidity Index [mean (SD)]	1·02	(1·25)	0·90	(1·18)	1·29	(1·33)	1·14	(1·30)	1·11	(1·42)
3MS Score [mean (SD)]	93·59	(5·32)	94·52	(4·78)	91·7	(5·7)	92·7	(5·8)	92·4	(5·8)
General cognitive performance (T) [mean (SD)]	57·74	(7·21)	58·9	(7·2)	54·7	(6·3)	57·5	(7·4)	55·5	(6·7)
Proxy IQCODE Impairment [>3.2] [nw (%)]										
No	413	(78·8)	259	(83·3)	67	(71)	69	(78)	18	(60)
Yes	111	(21·2)	52	(16·7)	28	(30)	20	(22)	11	(37)

Proxy IQCODE [mean (SD)]	3·117	(0·238)	3·089	(0·214)	3·169	(0·284)	3·114	(0·208)	3·25	(0·33)
Brain tissue fraction [mean (SD)]	0·717	(0·050)	0·726	(0·048)	0·714	(0·058)	0·703	(0·044)	0·688	(0·052)
Anesthesia type [nw (%)]										
1	455	(84·9)	265	(83·1)	83	(86)	78	(86)	29	(97)
2	77	(14·4)	52	(16·3)	12	(13)	12	(13)	1	(3)
3	4	(0·7)	2·2	(0·7)	1	(1)	·82	(1)	0	(0)
Estimated Blood Loss (EBL) (cc) [mean (SD)]	344	(877)	297	(622)	443	(1110)	279	(280)	721	(2325)
Duration of Surgery (minutes) [mean (SD)]	143·8	(76·6)	133	(67)	166	(88)	153	(87)	157	(79)
Duration of Anesthesia (minutes) [mean (SD)]	193	(81)	182	(73)	219	(96)	202	(85)	204	(77)
Days from baseline to Visit 1 [mean (SD)]	39·6	(11·0)	38·3	(8·2)	43·0	(18·0)	39·5	(9·6)	43·2	(9·2)
Days from baseline to Visit 2 [mean (SD)]	89·2	(24·7)	87·8	(24·9)	88·8	(24·1)	91·4	(24·6)	98	(24)
Days from baseline to Visit 6 [mean (SD)]	218·2	(39·8)	217·2	(39·5)	218	(43)	219	(37)	228	(40)

3 Concordance of POCD from months 1 to 2 to 6

In this section, we examine the number of people who have POCD at both 1 month and 2 months, or POCD at all 3 time points (1, 2, and 6 months). Next we test if those individuals with persistent POCD for either 1 and 2 months or 1, 2, and 6 months were more likely to have been delirious in the hospital.

```
.
. freq pocd_1and2

Persistant
  POCD at
 months 1
    and 2 |      Freq.      Percent        Cum.
----------+-----------------------------------
        0 |        465        85.95       85.95
        1 |         76        14.05      100.00
----------+-----------------------------------
    Total |        541       100.00
. freq pocd_1and2 if pocd_2m!=.

Persistant
  POCD at
 months 1
    and 2 |      Freq.      Percent        Cum.
----------+-----------------------------------
        0 |        459        85.79       85.79
        1 |         76        14.21      100.00
----------+-----------------------------------
    Total |        535       100.00
. freq pocd_1and2 if pocd_2m!=. & pocd_6m!=.

Persistant
  POCD at
 months 1
    and 2 |      Freq.      Percent        Cum.
----------+-----------------------------------
        0 |        449        86.02       86.02
        1 |         73        13.98      100.00
----------+-----------------------------------
    Total |        522       100.00

.
. freq pocd_1and2and6

Persistant
  POCD at
months 1,
 2, and 6 |      Freq.      Percent        Cum.
----------+-----------------------------------
        0 |        508        94.60       94.60
        1 |         29         5.40      100.00
----------+-----------------------------------
    Total |        537       100.00
. freq pocd_1and2and6 if pocd_2m!=. & pocd_6m!=.

Persistant
  POCD at
months 1,
 2, and 6 |      Freq.      Percent        Cum.
----------+-----------------------------------
        0 |        494        94.46       94.46
        1 |         29         5.54      100.00
----------+-----------------------------------
    Total |        523       100.00

.
```

```
. tab pocd_1and2 vdsagesdeliriumever , chi2

Persistant  |
  POCD at   |  Ever Delirious in Hospital by
  months 1  |       Interview OR Chart
    and 2   |       0         1         2 |     Total
------------+------------------------------+----------
         0  |     318        43       104 |       465
         1  |      42        12        22 |        76
------------+------------------------------+----------
     Total  |     360        55       126 |       541

          Pearson chi2(2) =   5.6559   Pr = 0.059

. tab pocd_1and2and6 vdsagesdeliriumever , chi2

Persistant  |
  POCD at   |  Ever Delirious in Hospital by
 months 1,  |       Interview OR Chart
  2, and 6  |       0         1         2 |     Total
------------+------------------------------+----------
         0  |     338        51       119 |       508
         1  |      18         4         7 |        29
------------+------------------------------+----------
     Total  |     356        55       126 |       537

          Pearson chi2(2) =   0.4659   Pr = 0.792

.
. *** restricting to patients who completed all 3 months assessment
.
. tab pocd_1and2 vdsagesdeliriumever if pocd_2m!=. & pocd_6m!=. , chi2

Persistant  |
  POCD at   |  Ever Delirious in Hospital by
  months 1  |       Interview OR Chart
    and 2   |       0         1         2 |     Total
------------+------------------------------+----------
         0  |     306        42       101 |       449
         1  |      40        12        21 |        73
------------+------------------------------+----------
     Total  |     346        54       122 |       522

          Pearson chi2(2) =   5.7934   Pr = 0.055

. tab pocd_1and2and6 vdsagesdeliriumever if pocd_2m!=. & pocd_6m!=. , chi2

Persistant  |
  POCD at   |  Ever Delirious in Hospital by
 months 1,  |       Interview OR Chart
  2, and 6  |       0         1         2 |     Total
------------+------------------------------+----------
         0  |     328        50       116 |       494
         1  |      18         4         7 |        29
------------+------------------------------+----------
     Total  |     346        54       123 |       523

          Pearson chi2(2) =   0.4402   Pr = 0.802

.
```

4 Cross-tabs of POCD at months 1, 2, and 6

```
.
. *** cross-tabs
.
. *concordance of POCD at months 1 and 2
. tab pocd_1m pocd_2m if timefr==0

POCD at 1 |    POCD at 2 month
    month |   No POCD      POCD |     Total
----------+----------------------+----------
  No POCD |       265        30 |       295
     POCD |       164        76 |       240
----------+----------------------+----------
    Total |       429       106 |       535

.
. *concordance of POCD at months 1 and 6
. tab pocd_1m pocd_6m if timefr==0

POCD at 1 |    POCD at 6 month
    month |   No POCD      POCD |     Total
----------+----------------------+----------
  No POCD |       268        23 |       291
     POCD |       177        57 |       234
----------+----------------------+----------
    Total |       445        80 |       525

.
. *concordance of POCD at months 2 and 6
. tab pocd_2m pocd_6m if timefr==0

POCD at 2 |    POCD at 6 month
    month |   No POCD      POCD |     Total
----------+----------------------+----------
  No POCD |       381        42 |       423
     POCD |        62        38 |       100
----------+----------------------+----------
    Total |       443        80 |       523

.
```

5 SIMPLE cross-tabs of delirium and POCD

```
.
. *** basic cross tabs of delirium and POCD
.
. *pocd and delirium cross-tabs at 1 month
. use w1311.dta, replace
. del
(113 real changes made)
(265 real changes made)
. tab pocd vdsagesdeliriumever
```

Post-opera tive cognitive decline	Ever Delirious in Hospital by Interview OR Chart		Total
	0	1	
No POCD	248	53	301
POCD	171	76	247
Total	419	129	548

```
.
. *pocd and delirium cross-tabs at 2 month
. use w1312.dta, replace
. del
(111 real changes made)
(261 real changes made)
. tab pocd vdsagesdeliriumever
```

Post-opera tive cognitive decline	Ever Delirious in Hospital by Interview OR Chart		Total
	0	1	
No POCD	330	100	430
POCD	80	26	106
Total	410	126	536

```
.
. *pocd and delirium cross-tabs at 6 month
. use w1316.dta, replace
. del
(112 real changes made)
(261 real changes made)
. tab pocd vdsagesdeliriumever
```

Post-opera tive cognitive decline	Ever Delirious in Hospital by Interview OR Chart		Total
	0	1	
No POCD	342	104	446
POCD	62	19	81
Total	404	123	527

```
.
```