Supplemental Table. A Summary of Relevant Published Cases Reporting the Anesthetic Management of Parturients with Intracranial Lesions

AUTHOR	# OF PATIENTS	LESIONS	MATERNAL HEALTH STATUS (PRE-DELIVERY)	DELIVERY MODE	ANESTHESIA TYPE	EXPLANATION OF ANESTHESIA CHOICE	ADVERSE MATERNAL OR FETAL OUTCOME PRESUMED DUE TO ANESTHETIC	OTHER RELEVANT INFORMATION
Space Occupying Lesions: Tumors &hemangiomas, etc.								
Annunziato[1]	1	Hemangio-pericytoma	diplopia	N/A	N/A	N/A	N/A	Recurrence of previously resected hemangio-pericytoma
Atanassoff[2]	1	Glioblastoma multiforme	Severe frontal headache, dysarthria, difficulty walking	C/S (abruption)	spinal	Spinal with small gauge needle chosen for reliable, fast onset block, minimal to no CSF leak. Concern about aspiration with GA, potential accidental dural puncture with large bore needle (and herniation), and slow onset of block with epidural	Improved headaches but persistent cranial nerve involvement	Glioblastoma multiforme originating from ponto-medullary junction extending to cerebellum. 4th ventricle narrowed but not obstructed. Tumor was excised weeks later
Beni-Adani[3]	1	acoustic neuroma	Headache and nausea (resolved with VP shunt), ataxia, cranial nerve weakness	C/S	GA	Pre-operative VP shunt with some symptomatic improvement "Awake extubation postoperatively" Detailed description of anesthetic options	none	Admission MRI (pre-VP shunt): 6 cm vestibular schwannoma with prominent displacement of brainstem, severe obstructive hydrocephalus Had resection of tumor 1 week later
Bharti[4]	1	Meningioma: cerebellopontine angle	Initial presentation was headache, vertigo,	C/S	GA	After initial improvement with VP shunt, pt developed	stable	CT findings included hydrocephalus

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			nausea and vomiting.			disorientation and confusion prompting C/S and GA.		Pre-op VP shunt placed with initial improvement, then some symptom recurrence
Boker[5]	1	Von Hippel-Lindeu disease (VHL)	Headaches and dizziness	C/S + craniotomy	GA	Enlarged cerebellar hemangioblastoma with significant local mass effects Multiple spine lesions	none	Combined C/S and posterior fossa craniotomy at 37 weeks.
Crosby, E[6]	1	Ischemic (vascular) lesions of the basal ganglia extending to posterior parietal and occipital regions	Acute cortical blindness	Urgent C/S	Spinal + A-line	No absolute contraindications to neuraxial anesthesia, e.g. evidence of abnormal bleeding or intracranial hypertension Neuraxial afforded ability to follow neurological exam	none	Preeclampsia/ HELLP, underlying diagnosis Post-op MRI: normal vessels Complete visual recovery
Demiraran[7]	1	Von Hippel-Lindau disease (VHL)	none	C/S	epidural	In VHL haemangioblastomas are not present in the epidural space. No symptoms of raised ICP	None	5x5 cm cerebellar hemangioma (also bilateral retinal lesions) Cerebellar lesions surgically treated post-partum.
Dyamanna[8]	1	Pituitary microadenoma	Improved visual changes	Elective C/S (breech)	GA	No mass effect, No increased ICP. Pt was offered regional but refused.	none	Blurred vision with constricted visual fields Generalized Headaches, Rx with bromocriptine with improved

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								symptoms
Erikson[9]	1	malignant rhabdoid tumor	Headache, nausea, blurry vision	C/S + craniotomy	N/A	N/A	N/A	Malignant Primary rhabdoid tumor, R occipital lobe. Rare, usually occur in infants and children Significant mass effect on lateral ventricle
Finfer[10]	3 cases							
	#1	melanoma	seizure	C/S	epidural	No symptoms or signs of increased ICP	died day 9	CT: multiple "intracranial deposits with surrounding oedema"
	#2	pituitary macroadenoma	headache	NSVD	epidural	No symptoms or signs of increased ICP		Pt had a known prolactin-secreting macroadenoma Plan was for no valsalva VD Post-partum CT showed tumor enlargement
	#3	meningioma	N/A	NSVD	epidural	N/A	none apparent	Sphenoidal ridge tumor (not known at time of delivery). 2 days later had blurred vision
French[11]	1	astroglial tumor	Complex partial seizures	C/S	GA + TAP Block+ A-line	Worsening clinical and radiological picture (likelihood of "raised intracranial pressure"	none	Low grade, left temporal lesion, mass effect and tonsillar herniation.
Innamaa[12]	1	Brain metastasis from lung primary cancer	seizure	C/S	"regional"	N/A	palliative	Initially diagnosed as eclampsia Post-partum work-up revealed lung

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								primary and "multiple brain metastases with evidence of raised intracranial pressure and a mid-line shift"
Johnson[13]	1	meningioma	s/p seizure, right sided weakness, somnolent	C/S	GA	Somnolent patient. MRI: 7.8cmx4.6cm lesion left frontal lobe, effacement of left ventricle, significant mass effect, midline shift	Maternal Recovery	s/p tumor resection 6 days after C/S
Khong[14]	1	meningioma	No symptoms recognized	C/S (obstetric reasons)	regional	No recognized pathology pre-delivery	none	Post-delivery presented with déjà vu and auditory hallucinations. In retrospect, present pre-delivery MRI: 4x4cm extra-axial mass on right sphenoid, mass effect, vasogenic edema.
Mamelak[15]	1	Metastatic choriocarcinoma	Severe headaches, nausea, progressive somnolence progressing to obtundation, papilledema	C/S (at 30 weeks) + craniotomy	GA	N/A	none	CT 6x5cm hemorrhagic mass in R occipital region with vasogenic edema, subfalcine herniation, midline shift, brainstem compression. Pt made dramatic recovery

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Smith[16]	1	capillary haemangioma	Severe headache, photophobia, agitation	C/S+ MRI under anesthesia	GA	5.3x3.5x4.6cm mass in L temporal region with significant local mass effects, uncal and trans-tentorial herniation, displacement of brain stem.	none	Tumor resection 3 weeks later Pt did well.
*Terauchi[17]	1	Dysembryonic neuroepithelial tumor	Temporary loss of consciousness Partial seizures	C/S	CSE	N/A	none	cystic lesion diagnosed in R temporal lobe via MRI at 27 weeks Pt was seizure-free s/p tumor resection 2 months post-partum
Tewari[18]	8 Cases							
	#1	Anaplastic astrocytoma	Mental Status changes, gait disturbances	Emergency C/S	GA	N/A	N/A	R cerebellum, 5 x4 cm, maternal death, herniation
	#2	Anaplastic Astrocytoma (recurrent)	Coma	Emergency C/S	GA	N/A	N/A	R parietal lesion, 6 x 4 cm Maternal death from herniation
	#3	Glioblastoma multiforme	Mental status changes, urinary incontinence	Emergency C/S	GA	N/A	N/A	R frontoparietal lesion, 9 x 6.5 x 6 cm. Alive with disease and significant neurologic deficit
	#4	Anaplastic astrocytoma	Quadriplegia, brain death	Emergency C/S	GA	N/A	N/A	L temporal, corpus callosum, midbrain, cervical and thoracic cord lesion, 6x6cm Maternal death

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								from herniation
	#5	Glioblastoma multiforme	Obtundation	Emergency C/S	GA	N/A	N/A	L temporal-parietal-occipital lesion , 7x6x4 cm Alive with disease and significant neurologic deficit
	#6	Metastatic breast cancer (recurrent)	Nausea, vomiting, vertigo	Emergency C/S	GA	N/A	N/A	L cerebellar lesion: 4x4x3cm Maternal death
	#7	Glioblastoma multiforme	Seizures	Elective C/S	GA	N/V	N/V	R temporal and frontal lobe, corpus callosum lesion, 3.5x2x3cm Subsequent craniotomy and post-op radiation Alive, in remission
	#8	Glioblastoma multiforme	Personality change, seizures	Elective C/S	GA	N/A	N/A	L frontal lobe lesion, 6x6 cm Subsequent craniotomy and post-op radiation Alive, in remission
Van Calenbergh[19]	1	Astrocytoma	Vomiting, headache	NSVD	N/A	N/A	Recovery	N/Vat 14 weeks, initially diagnosed as hyperemesis gravidarum MRI showed cystic lesion extending to R cerebellar hemisphere. Hydrocephalus. Tumor resected.

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Space Occupying Lesions: Cysts								
Brice[20]	2 cases							
	#1	Arachnoid cyst	good	Vaginal Delivery- vacuum assisted for obstetric indications	Epidural	No contraindication to regional anesthesia or valsalva	none	Temporal cyst 6x6x5.7cm
	#2	Arachnoid cyst	headache	Vaginal Delivery	none	No contraindication to regional anesthesia or valsalva	none	Temporal fossa cyst 4x2cm. epidural was planned but she delivered precipitously
Imarengiaye[21]	1	Epidermoid cyst	seizure	C/S	GA	Anesthetic Goals: Control of ICP Aspiration Prophylaxis Multimodal pain control Hemodynamic stability NOT candidate for neuraxial	none	5cm lobulated, extra-axial temporal mass with midline shift, brainstem compression
Rupasinghe[22]	1	Arachnoid cyst	good	C/S (pt request)	Spinal	No imaging or clinical signs or symptoms of increased ICP	none	12 cm intracranial arachnoid cyst in posterior fossa. Valsalva ok as far as cyst rupture.
Arnold Chiari Malformations (ACMs)								
Barton[23]	1	ACM	Headaches precipitated by coughing	Vaginal Delivery	ADP	N/A	Nystagmus beginning 2 weeks post-partum, progressing to	MRI showed ACM. Subsequent surgery with progressive resolution of

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							unsteady gait at 1 year	symptoms
Chantigian[24]	12 pts, 30 deliveries	ACM						
	1 pt, 3 deliveries	ACM	N/A	Vaginal Delivery x 3	Local + inhalation	N/A	N/A	s/p cervical-occipital exploration/ decompression prior to pregnancies
	1 pt, 1 delivery	ACM	N/A	NSVD	Local + inhalation	N/A	N/A	Initial presentation prior to pregnancy: obstructive hydrocephalus, (headaches, papilledema). s/p ventriculo-atrial shunt with revision 2 years later.
	1 pt, 1 delivery	ACM+ syringomyelia	C/S	C/S	GA		N/A	Initially presented with ataxia and left-sided weakness. Underwent suboccipital craniectomy and decompression, laminectomy and syringe-subarachnoid shunt. Then revision of craniectomy.
	1 pt, 3 deliveries	ACM	N/A	C/S x 3	CSA followed by epidural blood patch, spinal x 2		Developed postural headache relieved by epidural blood	At the time of ACM diagnosis (prior to pregnancy), pt had arm and leg

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							patch after CSA	tingling.
	1 pt, 6 deliveries	ACM + syringomyelia	N/A	NSVD x 6	Local + inhalation	N/A	N/A	ACM diagnosed between 2nd and 3rd delivery when pt presented with headaches and upper extremities sensory loss. Had suboccipital craniectomy/decompression.
	1 pt, 3deliveries	ACM	N/A	NSVD #1, C/S #2 prior to ACM diagnosis and craniectomy, then NSVD #3	Epidural for #1, GA for #2, Epidural for #3	N/A	N/A	ACM diagnosed years after 2nd pregnancy: symptoms were headache and right arm numbness/ paresthesias
	1 pt, 2 deliveries	ACM	N/A	NSVD x 2	Local for #1, then Epidural	N/A	N/A	Initially presented with headaches, diagnosed with ACM between two pregnancies
	1 pt, 3 deliveries	ACM	N/A	NSVD x 3	Inhalation x3	N/A	N/A	ACM diagnosed after pregnancies when pt presented with gait disturbance, vertigo, ataxia
	1 pt, 2 deliveries	ACM	N/A	NSVD x 2	Inhalation x 2	N/A	N/A	ACM diagnosed after pregnancies when pt presented with headaches, extremity hyperreflexia
	1 pt, 3	ACM +	N/A	NSVD x 3		N/A	N/A	ACM diagnosed

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	deliveries	syringomyelia			Epidural x1, Local for #2 and #3			after pregnancies when pt presented with headaches, left arm weakness, Pt subsequently had suboccipital craniectomy
	1 pt, 2 deliveries	ACM	N/A	NSVD x 2	Epidural x 2	N/A	N/A	ACM diagnosed after pregnancies when pt presented with headaches and left arm weakness
	1 pt, 1 delivery	ACM	N/A	C/S	GA	N/A	N/A	ACM diagnosed after pregnancy when pt reported low back pain, lower extremity numbness/ weakness.
Landau[25]	1	ACM	Stable	C/S	spinal	Pt requested neuraxial. In setting of surgical decompression of ACM, neurosurgical team felt that" dural puncture would neither impair CSF flux nor precipitate bulbar compression"	stable	Elective repeat C/S Surgically corrected ACM
Sicuranza[26]	1	ACM	Severe Headaches	C/S	GA	Pt was s/p previous surgery for tethered cord, decision not to proceed with neuraxial anesthesia. Known favorable	none	ACM diagnosed and decompressed after her first pregnancy with vaginal delivery; also resection of

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						airway from previous GA's.		filum terminale.
Abouliesh[27]	(2 patients, total)					Normal spread of spinal medication despite Increased ICP.		
	1 pt, 2 deliveries	BIH	Recurrent headaches	C/S x 2	GA for #1, spinal for #2	Pregnancy #1:BIH diagnosed. Serial LPs for papilledema. GA for C/S for term IUFD. Pregnancy #2, elective repeat C/S. No contraindication to spinal	none	pt better post-partum on both occasions.
	1 pt, her 2nd delivery is described	BIH	No symptoms	C/S (Breech)	GA	Spinal NOT chosen because of need for X-RAY to document shunt position and concern for inadequate spinal anesthesia	none	Lumbo-peritoneal shunt in situ
Aly[28]	1	(BIH) IIH	Nausea, headache, visual disturbances	Vaginal Delivery with forceps	CSA + CSF drainage (25 cc)	Concern for inadequate spread/duration of subarachnoid medication in light of serial LP's	stable	Rx: serial LP's (30 cc twice weekly) and bed rest. Pt c/o same intermittent headache pre-delivery, intrapartum and post-partum.
Bagga[29]	3 cases	BIH/IIH						
	#1	BIH (unconfirmed)	none	NSVD	N/A	N/A	stable	Pt presented in early pregnancy with occasional N/V.Bilateral papilledema. No diagnostic LP done. Treated with

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								medication (paracetomol). Delivered at term.
	#2	BIH/IIH	Much improved	TAB and then BTL (obstetric indications)	GA	increased venous pressure may be caused by increased ICP	none	Presented at 12 weeks with headache, visual changes, papilledema. CSF pressure 220 mm H20 (<250 needed for diagnosis of BIH). Still treated with acetazolamide
	#3	BIH/IIH	vomiting	C/S	GA	Underwent GA to "prevent consequences of further (increase in) ICP during uterine contractions and prolonged bearing down efforts as papilledema was still present"	none	Pt presented in pregnancy(twin gestation) with Headache, blurred vision, papilledema. CSF pressure 110 mm H20) (< 250 needed for diagnosis of BIH).
Bedard[30]	1	BIH/IIH	none	Labor to C/S	Epidural (replaced)	Deteriorating airway exam over the course of labor Initial epidural placement was targeted at L4,5 Replacement above scar, T12-L1	none	Preexisting LP shunt at L3,4 Pt needed epidural replacement prior to C/S for inadequate block
Bedson[31]	1	BIH/IIH	none	C/S (fetal and maternal indication)	CSE	Concern was to avoid increasing ICP Herniation not thought to be a risk with dural puncture Pt favored regional	none	

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						over GA.		
Douglas[32]	1	BIH	Headache, central vision loss	NSVD	Epidural	Epidural allowed titration of block. Potential to avoid general anesthesia if C/S needed	none	BMI 67, angina on exertion, asthma, diabetes (insulin dependent)
Heckathorn[33]	1	BIH/IIH	none	C/S+BTL	Spinal (via indwelling spinal drain/catheter	single shot spinal via preexisting spinal catheter after it was withdrawn several cm	none	CSF drain placed for intractable symptoms of BIH
Karmaniolou[34]	Review (See individual cases listed separately in this Table)	BIH	See individual cases	See individual cases	See individual cases	In BIH there is no inherent contraindication to either spinal or epidural anesthetic techniques. GA should be used only if absolutely necessary, and if used techniques to minimize the risk of increased ICP with induction should be added.	Uncal herniation has not been reported to occur in patients with BIH who have had spinal or epidural anesthesia.	Extensive Review of Idiopathic intracranial hypertension (BIH). Conclusions: C/S not necessarily indicated Neuraxial anesthesia can be used uneventfully for VD and C/S
Koontz[35]	9 pts with 7 deliveries	BIH	Headache	Vaginal Delivery (6 low forceps)	Spinal x 2; pudendal or local for the others	"There seems to be no contraindication to expertly administered epidural or spinal anesthesia in these patients."	none	Five pts had initial onset of symptoms. Rapid improvement of symptoms in all pts after delivery
Kaul[36]	1	BIH+shunt	none	Inadvertent dural puncture during epidural placement converted to CSA.	Continuous Spinal Anesthesia	Pt had unfavorable airway exam. Goal was epidural placement above or below L2,3 (the site of LP shunt). Resulted in spinal catheter	PDPH	Peri-delivery, pt received Enoxaparin 40mg daily. Pt developed PDPH and required epidural blood patch (24 hours after Enoxaprin

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				Intermittent spinal doses with fast washout of drug		recognized by positive test dose (dense T5 block)		was stopped)
Kim[37]	1	BIH	Improved headache and vision	labor to C/S	epidural	dx in pregnancy due to visual symptoms. LP shunt placed at L4,5. Plan: epidural above level of shunt.	none	Pt ultimately induced for preeclampsia
Palop[38]	1	BIH	Headaches, papilledema	NSVD	Epidural	GA can increase ICP unless hyperventilation is used. “Herniation does not occur in patients who have benign intracranial hypertension”.	None.	Pt’s condition improved after delivery
Powell[39]	1	BIH	Visual changes, nausea, vomiting, increased clumsiness	C/S +BTL	GA	N/A	none	Induced becomes of increased symptoms. Symptoms resolved within 24 hours of delivery.
Worrrell[40]	1	BIH/IIH	fine	labor	epidural		none	
Aneurysms								
D'Haese[41],	1	ruptured right internal carotid artery aneurysm (SAH)	Initial presentation: Frontal headache, nausea, vomiting and nasal congestion	Combined C/S and aneurysm clipping	GA + arterial line	Presentation of worsening headache and nuchal rigidity	none	A second (unruptured) L internal carotid artery aneurysm was also identified
Whitburn[42]	1	Ruptured anterior communicating artery (SAH)	Recovered to mild headache and neck stiffness at time of delivery	Elective Combined C/S and aneurysm clipping	GA + arterial line	Goals were to balance needs of RSI with minimizing valsalva, and maternal Blood Pressure to optimize	none	48 hours later, pt developed L hemiparesis secondary to vasospasm

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						perfusion of brain and fetus		
Powell[43]	1	Infectious intracranial aneurysm (SAH)	s/p SAH from mycotic aneurysm (pt with history of IV drug use), hemodialysis dependent	C/S (abruption)	N/A	"well controlled anesthetic conditions"	none	Pt remained dialysis-dependent; able to ambulate with a cane
Le[44]	1	AVM	Sudden onset of severe headache, neck pain, nausea and vomiting	C/S	CSE	Moderate hydrocephalus, but absence of herniation and "no signs of elevated intracranial pressure as evidenced by unaltered mental status". Chose neuraxial to minimize hemodynamic perturbations	none	Pre-delivery CT: L inferior intraparenchymal hemorrhage; moderate hydrocephalus, no herniation.
Sharma[45]	1	AVM	Seizures controlled with medication	Elective C/S	Epidural + arterial line	"Clinical features of raised intracranial pressure or cerebral ischemia were absent on neurologic examination"	none	Use of low-dose aspirin therapy, decision to proceed with C/S, avoiding hyper- and hypotension and hypercarbia in these patients,
Viscomi[46]	1	Residual AVM deep in temporal lobe-s/p resection	Residual aphasia s/p recovery from antepartum subarachnoid hemorrhage	Elective induction: Vaginal delivery (forceps/non-valsalva)	Epidural (arterial line refused)	Cited lack of available dose to guide management. Goal was to minimize hemodynamic stress and to avoid valsalva	none	Given worsening symptoms, elected to do craniotomy. Had residual ateriovenous malformation when underwent delivery 10 weeks later.
Abouleish[47]	1	Moyamoya	none	C/S	CSE	Chosen for "better analgesia and more hemodynamic stability	None	Former cocaine abuse leading to stroke.

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						than either GA or spinal		Subsequent L temporal artery to middle cerebral artery anastomosis
Dutta[48]	1	Moyamoya		C/S	Epidural	Chosen to maximize normothermia, normocapnia, and normotension	none	Presented in 5th month with intracranial bleed with recovery (no neurologic deficit)
Komiyama[49]	1 + 29 published cases	Moyamoya						
	7	Moyamoya	variable	C/S	GA	Patient status	variable	1 pt. in this category had antepartum cerebral hemorrhage with poor outcome.
	3	Moyamoya	variable	C/S	Spinal	none	variable	
	2	Moyamoya		“abortion”	GA or sedation			
	1	Moyamoya		Vaginal	epidural			
	1	Moyamoya		vaginal	local			
	7	Moyamoya		N/A	N/A	N/A	N/A	Either mode of delivery or anesthesia or both unknown
Llorente[50]	1	Moyamoya	none	C/S	Spinal + A-line + CVP	Chosen to avoid hypertensive response to intubation, to follow neurologic status in awake pt.	None	Initially presented with intraventricular hemorrhage requiring respiratory support, recovered prior to delivery
Month[51]	1	CVST (superior sagittal, R transverse	Intense frontal headache,	C/S	spinal	In setting of what authors acknowledged	none	Intravenous heparin therapy

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		sigmoid sinuses thrombosis extending into R internal jugular)	photophobia, nausea			was degree of increased ICP, they felt "spinal anesthesia would confer greater benefit than risk"		was held and PTT normalized prior to spinal placement.
May[52]	5	BIH	Severe headache in 4 pts	4 Elective C/S, 1 emergency C/S	2 spinals, 2 CSE, 1 GA	N/A	No change	Pt with emergency C/S had seizure during labor. She was treated with serial LPs, and with diuretics
	2	Cerebellar tonisillar herniation: unknown etiology	N/A	"Elective" C/S	GA	N/A	N/A	N/A
	2	Arnold Chiari Malformation (ACM)		1 Elective C/S, 1 vacuum Vaginal Delivery	1 GA, 1 epidural	N/A	N/A	N/A
	2	"Cerebrovascular accidents"	N/A	1 NSVD, 1 Elective C/S	1 epidural, 1 CSE	N/A	N/A	N./A
	1	Cerebral metastasis (breast cancer)		Elective C/S	Spinal			
	1	Cavernous angioma of brainstem		Elective C/S	GA			
	1	Frontal lobe tumor		Elective C/S	Epidural			
	1	Glioma grade II		Elective C/S	GA			
	1	Pituitary adenoma		Vaginal Delivery (vacuum assisted)	Epidural	"no plan"		
	1	Pituitary marcoadenoma		Vaginal Delivery (vacuum assisted)	Epidural	"no plan"		
	1	Meningiona (s/p excision and		NSVD	Epidural	"treat as normal"		

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		reduction)						

ACM, Arnold Chiari Malformation; ADP, accidental dural puncture; AVMs, arteriovenous malformations; BIH, benign intracranial hypertension; BTL, bilateral tubal ligation; BMI, body mass index; C/O, complaint of; C/S, cesarean delivery; CSA, continuous spinal anesthesia; CSE, combined spinal-epidural (anesthesia); CSF, cerebrospinal fluid; CT, computed tomography; CVST, cerebral venous sinus thrombosis; Dx, diagnosis; GA, general anesthetic; HELLP, hemolysis, elevated liver enzymes, low platelets; ICP, intracranial pressure; IIH, idiopathic intracranial hypertension; IUFD, intrauterine fetal demise; L, left; LP, lumbar puncture; MRI, magnetic resonance imaging; N/A, not applicable; NSVD, normal spontaneous vaginal delivery; N/V, nausea/vomiting; Post-op, postoperative; PDPH, post dural puncture headache; Pt, patient; PTT, partial thromboplastin time; R, right; RSI, rapid sequence induction; S/p, status post; SAH, subarachnoid hemorrhage; TAB, therapeutic abortion; TAP, transverse abdominis plane block; VHL,Von Hippel-Lindau; VP shunt, ventriculoperitoneal shunt.

* Anesthetic management information obtained via personal communication with author (accessed 8/2012).

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