

**ASA Practice Advisory for Perioperative Visual Loss Associated with Spine Surgery 2019 Update
Supplement 4 Evidence Tables – Research Studies**

Table 1. Study Overview

Study	Data Source	Country	Design	Total N	POVL N
Katz 1994	2 Academic Hospitals (1990-1992)	USA	RS	-	4
Stevens 1997	Hospital database (1985-1994)	USA	RS	3,450	7
Cheng 2000	AANS/CNS Survey (1997)	USA	Survey	24	24
Chang 2005	Hospital database (1983-2002)	USA	RS	14,102	4
Lee 2006	ASA POVL Registry (1991-2006)	USA	RS	83	83
Patil 2008	NIS (1993-2002)	USA	RS	4,728,815	4,452
Lee 2012	ASA POVL Registry (1991-2006)	USA	CC	395	51
Farag 2014	Hospital database (1995-2010)	USA	CC	2,532	6
Nandyala 2014	NIS (2002-2009)	USA	RS	541,485	105
De la Garza-Ramos 2016	NIS (2002-2011)	USA	RS	42,339	70
Rubin 2016	NIS (1998-2012)	USA	RS	2,511,073	481
Calway 2018	NIS (1998-2013)	USA	RS	4,828,126	363
Gabel 2018	AOSNACRN (2005-2011)	USA	RS	17,625	0
Shillingford 2018	SRS database (2009-2012)	USA	RS	167,972	21

POVL – perioperative visual loss, CC- case-control study, RS- retrospective study

AANS/CNS- American Association of Neurological Surgeons/Congress of Neurological Surgeons Survey, AOSNACRN- AOSpine North America Clinical Research Network, SRS-Scoliosis Research Society

Table 2. Study Summary and POVL Incidence

Study	Data Source	Total N	POVL N	Age (yrs) Mean (SD)	Male (%)	Incidence (per 1000 spine surgeries)								
						POVL	ION	AION	PION	RAO	CRAO	CRVO	CVL	Unspecified
Stevens 1997	Hospital database (1985-1994)	3,450	7	55(17)	43	2.0	1.2	0.3	0.9			0.3	0.3	0.3
Chang 2005	Hospital database (1983-2002)	14,102	4	25 (13)		0.3	0.3							
Patil 2008	NIS (1993-2002)	4,728,815	4,452	All ages		0.9	0.06				0.01			
Farag 2014	Hospital database (1995-2010)	2,532	6	59 (7)	67	2.4		1.2						1.2
Nandyala 2014	NIS (2002-2009)	541,485	105	38	53	0.2	0.06					0.04	0.1	0.004
De la Garza-Ramos 2016	NIS (2002-2011)	42,339	70	13 (3)	25	1.6							1.6	
Rubin 2016	NIS (1998-2012)	2,511,073	481	60	45	0.2	0.1					0.1		
Calway 2018	NIS (1998-2013)	4,828,126	363	≥ 18	46	0.1						0.1		
Gabel 2018	AOSNACRN (2005-2011)	17,625	0			0								
Shillingford 2018	SRS database (2009-2012)	167,972	21	35 (24)	43	0.1	0.05	0.02	0.02		0.03		0.03	0.02

POVL- perioperative visual loss, ION- ischemic optic neuropathy, AION- anterior ischemic optic neuropathy, PION- posterior ischemic optic neuropathy, RAO- retinal artery occlusion, CRAO- central retinal artery occlusion, CRVO- central retinal vein occlusion, CVL- cerebral visual loss

AOSNACRN- AOSpine North America Clinical Research Network, SRS-Scoliosis Research Society

Table 3a. Potential Patient Risk Factors

Study	Data Source	Total	POVL	Age (yrs)	Male	Hypertension	Diabetes	Obesity	PVD	Tobacco Use	CAD
		N	N	Mean (SD)	(%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Katz 1994	2 Academic Hospitals (1990-1992)	-	4	54(9)	25	2 (50)	2 (50)			1 (25)	1 (25)
Cheng 2000	AANS/CNS Survey (1997)	24	24	47(15)	79	1 (4)	5 (21)	1 (4)	2 (8)		
Lee 2006	ASA POVL Registry (1991-2006)	83	83	51(13)	41	13 (16)	44 (53)	38 (46)	8 (10)		34 (41)
Shillingford 2018	SRS database (2009-2012)	167,972	21	35(24)	24	2 (10)		2 (10)	2 (10)	2 (10)	5 (24)

POVL- perioperative visual loss, PVD- peripheral vascular disease, CAD- coronary artery disease

AANS/CNS - American Association of Neurological Surgeons/Congress of Neurological Surgeons Survey, SRS-Scoliosis Research Society

Table 3b. Potential Patient Risk Factors

Study	Data Source	Total	POVL	Hypertension	Diabetes	Stroke	Obesity	PVD	Tobacco Use	Transfusion	Anemia
		N	N	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Patil 2008	NIS (1993-2002) - Non-ION, Non-CRAO	4,728,815	4,134	1.4 (1.2-1.6)	1.3 (0.9-1.6)		1.4 (0.9-1.9)	2.5 (1.6-3.9)		2.8 (2.1-3.6)	1.2 (1.0-1.3)
Patil 2008	NIS (1993-2002) - ION only	4,728,815	271	2.6 (1.5-4.7)	3.6 (1.7-7.1)		3.7 (1.3-8.6)	8.3 (2.2-22.7)		5.5 (2.5-12.2)	6.3 (3.2-11.9)
Lee 2012	ASA POVL Registry (1991-2006)	395	51	1.6 (0.9-2.6)	2.2 (1.0-4.5)		2.2 (1.3-3.6)		0.9 (0.5-1.5)		
Nandyala 2014	NIS (2002-2009)	541,485	105		13.1 (3.6-47.4)						
De la Garza-Ramos 2016	NIS (2002-2011)	42,339	70							1.5 (0.9-2.5)	8.6 (5.4-13.8)
Rubin 2016 ^a	NIS (1998-2012)	2,511,073	481	1.1 (0.6-2.2)	1.07 (0.5-2.4)	7.4 (0.9-61.3)	2.4 (1.1-5.5)		1 (0.5-2.0)	2.7 (1.4-5.4)	
Calway 2018	NIS (1998-2013)	4,828,126	363	1.6 (0.9-2.8)	0.51 (0.2-1.0)	14.3 (4.5-45.3)	0.8 (0.3-1.8)	1.6 (0.4-5.5)	0.9 (0.5-1.8)	1.5 (0.8-2.9)	0.9 (0.2-3.8)

POVL- perioperative visual loss, PVD- peripheral vascular disease

^a Risk Ratio reported

Table 4. Perioperative Risk Factors

Study	Data Source	Total	POVL	Age (yrs)	Male	Estimated Blood Loss (ml)	Duration of Surgery (hr)	Hypotension	Transfusion	Facial/Ocular Edema
		N	N	Mean (SD)	(%)	Mean (SD)	Mean (SD)	N (%)	N (%)	N (%)
Katz 1994	2 Academic Hospitals (1990-1992)	-	4	54(9)	25	1625 (649)		3 (75)	2 (50)	
Stevens 1997	Hospital database (1985-1994)	3,450	7	55 (17)	43	5110 (3263)	6.7 (0.9)		4 (57)	
Cheng 2000	AANS/CNS Survey (1997)	24	24	47 (15)	79	793 (1142)	4.8 (3.5)		3 (12)	
Chang 2005	Hospital database (1983-2002)	14,102	4	25 (13)		4338 (3183)	6.5 (2.4)	3 (75)		2 (50)
Lee 2006	ASA POVL Registry (1991-2006)	83	83	50 (14)	72	median=2000 (100-2500)	9.8 (3.1)	17 (20)		1 (1)
Lee 2012	ASA POVL Registry (1991-2006)	395	80	51 (13)	69	3100 (3500)	9.6 (3)	23 (29)		
Farag 2014	Hospital database (1995-2010)	2,532	6	59 (7)	67	11817 (20421)	8.7 (1.9)			
Shillingford 2018	SRS database (2009-2012)	167,972	21	34 (24)	43	1410 (989)	4.4 (2.4)			7 (33)

POVL- perioperative visual loss

AANS/CNS - American Association of Neurological Surgeons/Congress of Neurological Surgeons Survey, SRS-Scoliosis Research Society

References

1. Calway T, Rubin DS, Moss HE, Joslin CE, Mehta AI, Roth S: Perioperative retinal artery occlusion in spinal fusion surgery in the National Inpatient Sample: 1998 to 2013. *J Neuro-ophthalmol* 2018; 38:36-41
2. Chang, SH, Miller NR: The incidence of visual loss due to perioperative ischemic optic neuropathy associated with spine surgery: The Johns Hopkins Hospital Experience. *Spine* 2005; 30:1299-1302
3. Cheng MA, Sigurdson W, Tempelhoff R, Laurysen C: Visual loss after spine surgery: a survey. *Neurosurg* 2000; 46:625-31
4. De la Garza-Ramos R, Samdani AF, Sponseller PD, Ain MC, Miller NR, Shaffrey CI, Sciubba DM: Visual loss after corrective surgery for pediatric scoliosis: Incidence and risk factors from a nationwide database. *Spine J* 2016; 16:516-22
5. Farag E, Abd-Elseyed AA, Dalton JE, Nada E, Parker BM: Postoperative vision loss after spine surgery: A single-institution case-control comparison. *Ochsner J* 2014; 14:179-83
6. Gabel BC, Lam A, Chapman JR, Oskouian RJ Jr, Nassr A, Currier BL, Sebastian AS, Arnold PM, Hamilton SR, Fehlings MG, Mroz TE, Riew KD: Perioperative vision loss in cervical spinal surgery. *Global Spine J* 2017; 7(1 Suppl):91S-95S
7. Katz DM, Trobe JD, Cornblath WT, Kline LB: Ischemic optic neuropathy after lumbar spine surgery. *Arch Ophthalmol* 1994; 112:925-31
8. Lee LA, Roth S, Posner KL, Cheney FW, Caplan RA, Newman NJ, Domino KB: The American Society of Anesthesiologists Postoperative Visual Loss Registry: analysis of 93 spine surgeries associated with postoperative visual loss. *Anesthesiology* 2006; 105:652-59
9. Lee LA, Roth S, Todd MM, Posner KL, Polissar NL, Neradilek MB, Torner J, Newman NJ, Domino KB, Lauer KK, Budithi R, Gollapudy S, Pajewski TN, Scalzo DC, Avitsian R, Brown MJ, Buenvenida S, Mashour GA, Moore LE, Samra SK, Lieberman J, Lane RK, Ramani R, Wagner J, Tempelhoff R, Monsey CM, Robicsek SA, Vu MM, Weeks J, Manninen PH, Fu ES, Sanchez-Yanes GC, Peterfreund RA, Albrecht MA, Sapire KJ, Baughman VL, Caplan RA, Cheney FW, Metzner J: Risk factors associated with ischemic optic neuropathy after spinal fusion surgery. *Anesthesiology* 2012; 116:15-24
10. Nandyala SV, Marquez-Lara A, Fineberg SJ, Singh R, Singh K: Incidence and risk factors for perioperative visual loss after spinal fusion. *Spine J* 2014; 14:1866-72
11. Patil CG, Lad EM, Lad SP, Ho C, Boakye M: Visual loss after spine surgery: a population-based study. *Spine* 2008; 33:1491-96
12. Rubin DS, Parakati I, Lee LA, Moss HE, Joslin CE, Roth S: Perioperative visual loss in spine fusion surgery: ischemic optic neuropathy in the United States from 1998 to 2012 in the Nationwide Inpatient Sample. *Anesthesiology* 2016; 125:457-64
13. Shillingford JN, Laratta JL, Sarpong NO, Swindell H, Cerpa M, Lehman RA, Lenke LG, Fischer C: Visual loss following spine surgery: what have we seen within the Scoliosis Research Society Morbidity and Mortality database? *Spine (Phila Pa 1976)* 2018; 43:1201-07
14. Stevens WR, Glazer PA, Kelley SSD, Leitman TM, Bradford DS: Ophthalmologic complications after spinal surgery. *Spine* 1997; 22:1319-24

Practice Advisory for Perioperative Visual Loss Associated with Spine Surgery 2019 Update
Evidence Tables – Case Report/Series Summary

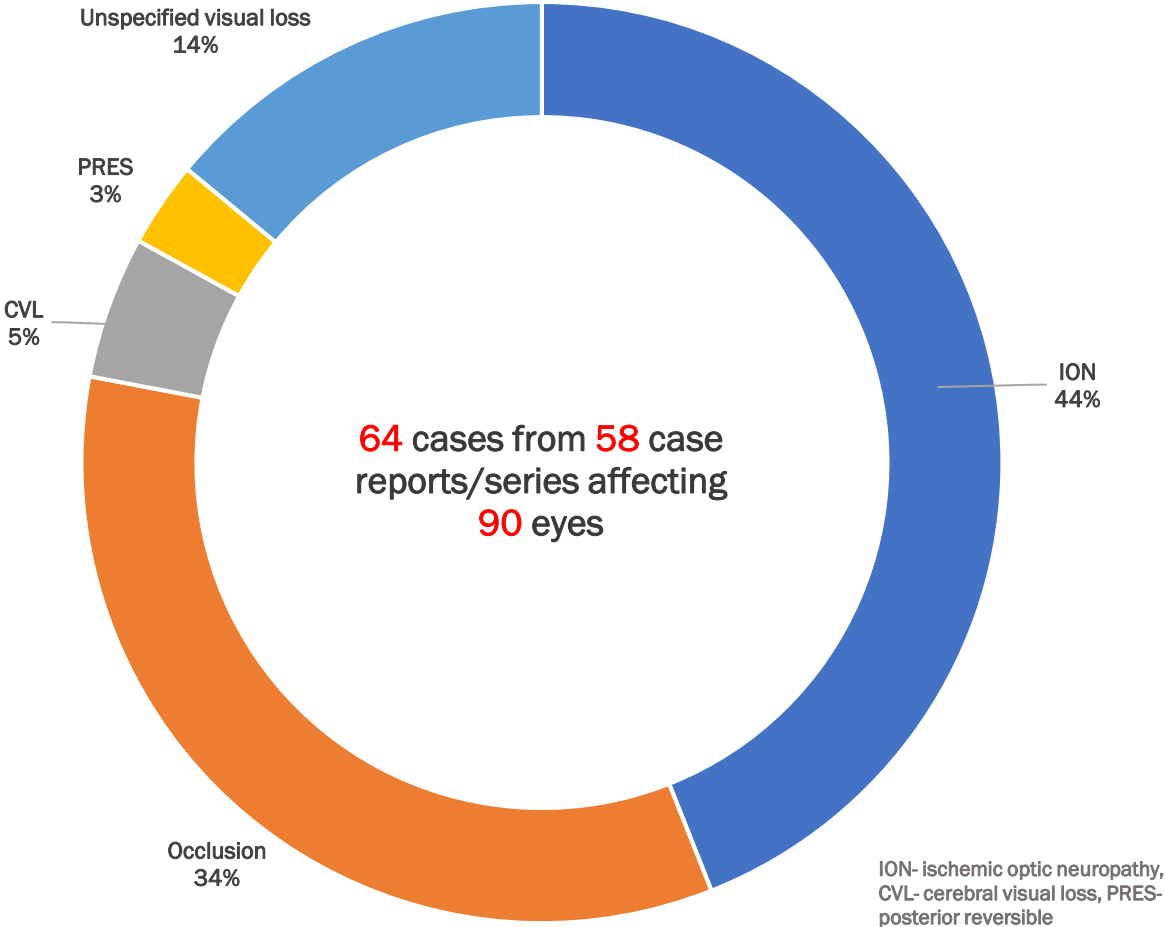


Figure 1. Distribution of POVL by Diagnosis

Table 5. Summary by Type of POVL

	Age (yr)		Male	Estimated Blood Loss (ml)		Duration of Procedure (hr)	
	N	Median (range)	N (%)	N	Median (range)	N	Median (range)
ION	28	49 (12-68)	22 (79)	24	2450 (350-16000)	26	7.5 (2-13)
Occlusion	21	30 (12-74)	13 (59)	10	825 (100-2150)	18	4 (2-8)
CVL	3	66 (38-67)	2 (67)	3	1500 (420-4800)	2	2.5 (1.75-3.25)
PRES	2	64 (51-78)	0	2	2100 (2000-2200)	2	8.75 (8.5-9)
Unspecified	14	50 (16-80)	5 (56)	6	1075 (200-2000)	15	4 (1-8)
Total	69	50 (12-80)	42 (66)	46	1500 (100-16000)	65	6 (1-13)

ION- ischemic optic neuropathy, CVL- cerebral visual loss, PRES- posterior reversible encephalopathy syndrome

Table 6. POVL Characteristics by Type

	Bilateral	Unilateral	Unspecified	Anterior	Posterior	Unspecified	Resolved	Not Resolved	Not Reported
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
ION	19 (68)	8 (29)	1 (4)	4 (14)	20 (71)	4 (14)	4 (14)	22 (79)	2 (13)
Occlusion	2 (9)	20 (91)	0	0	0	22 (100)	0	22 (100)	0
CVL	3 (100)	0	0	0	0	3 (100)	1 (33)	2 (67)	0
PRES	0	2 (100)	0	0	2 (100)	0	2 (100)	0	0
Unspecified	1 (11)	6 (67)	2 (22)	0	2 (22)	13 (78)	1 (11)	8 (89)	0
Total	25 (39)	36 (56)	3 (5)	4 (6)	24 (38)	36 (56)	8 (13)	54 (84)	2 (3)

ION- ischemic optic neuropathy, CVL- cerebral visual loss, PRES- posterior reversible encephalopathy syndrome

Table 7. Potential Patient Risk Factors by Type of POVL

	Hypertension	Diabetes	Obesity	Ocular Conditions ^a	Atherosclerosis	Tobacco Use	None/Healthy	Other ^b	Not Reported
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
ION	11 (39)	9 (32)	5 (18)	2 (7)	5 (18)	2 (7)	6 (21)	4 (14)	1 (4)
Occlusion	5 (23)	5 (23)	1 (5)	1 (5)	1 (5)	0	7 (32)	6 (27)	3 (14)
CVL	1 (33)	0	1 (33)	0	0	1 (33)	0	1 (33)	0
PRES	2 (100)	0	2 (100)	0	0	0	0	0	0
Unspecified	3 (33)	2 (22)	1 (11)	0	0	0	3 (33)	2 (22)	1 (11)
Total	22 (34)	16 (25)	10 (16)	3 (5)	6 (9)	3 (5)	16 (25)	13 (20)	5 (8)

ION- ischemic optic neuropathy, CVL- cerebral visual loss, PRES- posterior reversible encephalopathy syndrome

^a Congenital myopathy, hyperopia, hypermetropia

^b Horner's syndrome, Flammer syndrome, anemia, depression, trauma, sickle cell trait

Table 8. Intraoperative Management of Patients Diagnosed with POVL by Type

	ION N (%)	Occlusion N (%)	CVL N (%)	PRES N (%)	Unspecified N (%)	Total N (%)
Deliberate hypotension techniques in high-risk patients without preoperative chronic hypertension	8 (29)	4 (18)	0	0	0	12 (19)
Deliberate hypotension techniques in high-risk patients with well-controlled preoperative chronic hypertension	8 (29)	0	0	0	0	8 (13)
Colloid and/or crystalloids administration	16 (57)	6 (27)	1 (33)	2 (100)	2 (22)	27 (40)
Regular assessment and documentation of the eyes of prone-positioned patients	4 (14)	0	0	0	0	4 (6)
Avoidance of direct pressure on the eye (e.g., headrests, sheet rolls, other equipment)	2 (7)	1 (5)	0	0	1 (11)	4 (6)
Periodic monitoring of hematocrit or hemoglobin	0	0	0	0	1 (11)	1 (2)
Prolonged use of high-dose alpha-adrenergic agonists	0	1 (5)	0	0	0	1 (2)
Positioning of head level with or higher than the heart in high-risk patients	0	0	0	0	0	0
Placing head in a neutral forward position in high-risk patients	0	0	0	0	0	0
Staging of procedures anticipated to be high-risk	0	0	0	0	0	0
Total	28	22	3	2	9	64

ION- ischemic optic neuropathy, CVL- cerebral visual loss, PRES- posterior reversible encephalopathy syndrome

Table 9. Postoperative Management of Patients Diagnosed with POVL by Type

	ION N (%)	Occlusion N (%)	CVL N (%)	PRES N (%)	Unspecified N (%)	Total N (%)
Assessing a high-risk patient's vision when the patient becomes alert	0	0	0	0	0	0
MR imaging	17 (61)	17 (77)	3 (100)	1 (50)	9 (100)	47 (73)
Adjusting hemoglobin or hematocrit levels upward in patients for whom ION is suspected	0	0	0	0	0	0
Increasing blood pressure in patients for whom ION is suspected	0	0	0	0	0	0
Administering arterial oxygenation in patients for whom ION is suspected	0	0	0	0	0	0
Administering antiplatelet agents, steroids, or intraocular pressure lowering agents	5 (18)	10 (45)	0	0	2 (22)	17 (27)
Total	28	22	3	2	9	64

ION- ischemic optic neuropathy, CVL- cerebral visual loss, PRES- posterior reversible encephalopathy syndrome

Table 10. Perioperative Outcomes by Type of POVL

	Anemia N (%)	Transfusion N (%)	Hypotension N (%)	Facial edema N (%)	Prolonged procedure ^a and substantial blood loss ^b N (%)	Prolonged procedure ^a only N (%)	Substantial blood loss ^b only N (%)
ION	0	12 (43)	2 (7)	11 (39)	19 (68)	5 (18)	4 (14)
Occlusion	0	6 (27)	3 (14)	12 (55)	4 (18)	8 (36)	2 (9)
CVL	0	1 (33)	0	0	0	0	2 (67)
PRES	0	2 (100)	1 (50)	0	2 (100)	0	0
Unspecified	1 (7)	3 (33)	2 (22)	3 (33)	4 (27)	4 (44)	0
Total	1 (1)	25 (38)	8 (13)	26 (41)	29 (38)	17 (27)	8 (13)

ION- ischemic optic neuropathy, CVL- cerebral visual loss, PRES- posterior reversible encephalopathy syndrome

a - Prolonged procedure is defined as ≥ 4 hours

b - Substantial blood loss is defined as ≥ 800 ml

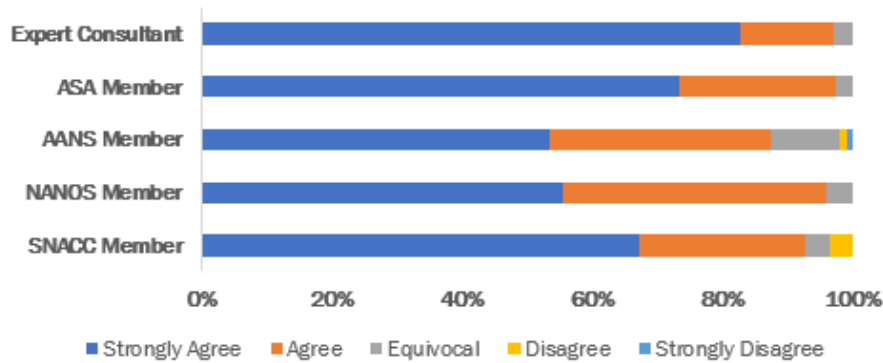
References

1. Agarwal N, Hansberry DR, Goldstein IM: Cerebral visual loss following posterior lumbar decompression and fusion. *J Clin Neuroscience* 2014; 21:155-9
2. Akpınar E, Okutan MO, Gürbüz MS, Bitirgen G: Unilateral vision loss without ophthalmoplegia as a rare complication of spinal surgery. *J Neurosci Rural Pract* 2017; 8:288-90
3. Alexandrakis G, Lam BL: Bilateral posterior ischemic optic neuropath after spinal surgery. *Am J Ophthalmol* 1999; 127:354-5
4. Amorim Correa JL, Acioly MA: The enigma of orbital compartment syndrome after lumbar spine surgery in the prone position: Case report and literature review. *World Neurosurg* 2018; 110:309-14
5. Bekar A, Tureyen K, Aksoy K: Unilateral blindness due to patient positioning during cervical syringomyelia surgery: Unilateral blindness after prone position. *J Neurosurg Anesthesiol* 1996; 8:227-9
6. Bojinova RI, Konieczka K, Todorova MG: Unilateral loss of vision after spinal surgery in a patient with Flammer syndrome. *Klin Monatsbl Augenheilkd* 2016; 233:429-31
7. Bradish CF, Flowers M: Central retinal artery occlusion in association with osteogenesis imperfecta. *Spine* 1987; 12:193-94
8. Brown RH, Schauble JF, Milier NR: Anemia and hypotension as contributors to perioperative loss of vision. *Anesthesiology* 1994; 80:222-6
9. Chalam KV, Shah VA: Severe bilateral posterior ischemic optic neuropathy as a complication of spinal surgery. *Eye* 2005; 19:367-8
10. Chung MS, Son JH: Visual loss in one eye after spinal surgery. *Korean J Ophthalmol* 2006; 20:139-42
11. Dilger JA, Tetzlaff, JE, Bell GR, Kosmorsky GS, Agnor RC, O'Hara JF: Ischaemic optic neuropathy after spinal fusion. *Can J Anaesth* 1998; 45:63-6
12. Dunker S, Hsu HY, Sebag J, Sadun AA: Perioperative risk factors for posterior ischemic optic neuropathy. *Am Coll Surg* 2002; 194:705-10
13. Goni V, Tripathy SK, Goyal T, Tamuk T, Panda BB, Shashidhar BK: Cerebral visual loss following spinal surgery: very rare cause of perioperative vision loss. *Asian Spine J* 2012; 6:287-90
14. Grossman W, Ward WT: Central retinal artery occlusion after scoliosis surgery with a horseshoe headrest. *Spine* 1993; 18:1226-8
15. Hassani V, Mohsen Homaei M, Mahdi Zamani M, Safari S, Nadi S, Shahbazi A, Alizadeh Zendehtood S, Rahimizadeh A, Hossein Lashkari M: Human erythropoietin effect in postoperative visual loss following spine surgery: a case report. *Anesth Pain Med* 2014; 4:e7291
16. Hoff JM, Varhaug P, Midelfart A, Lund-Johansen M: Acute visual loss after spinal surgery. *Acta Ophthalmol* 2010; 88:490-2
17. Hoski JJ, Eismont FJ, Green BA: Blindness as a complication of intraoperative positioning. *J Bone Joint Surg* 1993; 75:1231-2
18. Huber JF, Grob D: Bilateral cerebral visual loss after lumbar spine surgery. *Spine* 1998; 23:1807-9
19. Ibrahim TF, Sweis RT, Nockels RP: Reversible postoperative blindness caused by bilateral status epilepticus amauroticus following thoracolumbar deformity correction: Case report. *J Neurosurg Spine* 2017; 27:63-7
20. Jampol LM, Goldbaum M, Rosenberg M, Bahr R: Ischemia of ciliary arterial circulation from ocular compression. *Arch Ophthalmol* 1975; 93:1311-7
21. Kamming D, Clarke S: Postoperative visual loss following prone spinal surgery. *Br J Anaesth* 2005; 95:257-60
22. Kasodekar VB, Chen JL: Monocular blindness: a complication of intraoperative positioning in posterior cervical spine surgery. *Singapore Med J* 2006; 47:631-3
23. Katz DA, Karlin LI: Visual field defect after posterior spine fusion. *Spine (Phila Pa 1976)* 2005; 30:E83-5

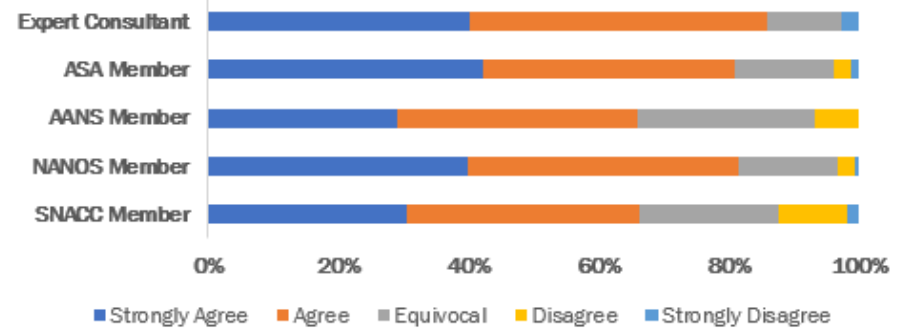
24. Katzman SS, Moschonas CG, Dzioba RB: Amaurosis secondary to massive blood loss after lumbar spine surgery. *Spine* 1994; 19:468-9
25. Kim JW, Hills WL, Rizzo JF, Egan RA, Lessell S: Ischemic optic neuropathy following spine surgery in a 16-year-old patient and a ten-year old patient. *J Neuroophthalmol* 2006; 26:30-3
26. Kueper J, Loftus ML, Boachie-Adjei O, Lebl D: Posterior reversible encephalopathy syndrome: temporary visual loss after spinal deformity surgery. *Am J Orthop (Belle Mead NJ)* 2015; 44:E465-8
27. Kumar N, Jivan S, Topping N, Morrell AJ: Blindness and rectus muscle damage following spinal surgery. *Am J Ophthalmol* 2004; 138:889-91
28. Lee AG: Ischemic optic neuropathy following lumbar spine surgery. *J Neurosurg* 1995; 83:348-9
29. Lee LA, Lam AM: Unilateral blindness after prone lumbar spine surgery. *Anesthesiology* 2001; 95:793-5
30. Lee SH, Chung I, Choi DS, Shin IW, Kim S, Kang S, Kim JY, Chung YK, Sohn JT: Visual loss due to optic nerve infarction and central retinal artery occlusion after spine surgery in the prone position: A case report. *Medicine (Baltimore)* 2017; 96:e7379
31. Leibovitch I, Sasson R, Laforest C, Selva D: Ischaemic orbital compartment syndrome as a complication of spinal surgery in the prone position. *Ophthalmology* 2006; 113:105-8
32. Locastro A, Novak KD, Biglan AW: Central retinal artery occlusion in child after general anesthesia. *Am J Ophthalmol* 1991; 112:91-2
33. Manfredini M, Ferrante R, Gildone A, Massari L: Unilateral blindness as a complication of intraoperative positioning for cervical spinal surgery. *J Spinal Disord* 2000; 13:271-2
34. Mertens E, Smets RM, Sys J, Michielsen J, Verstreken J, Tassignon MJ: Central retinal artery occlusion after back surgery: a case report. *Bull Soc Belge Ophtalmol* 1995; 255:127-31
35. Mishra RK, Mahajan C, Bindra A, Goyal K: Postoperative visual loss following dorsal root entry zone rhizotomy: a dreaded complication after a benign procedure. *Saudi J Anaesth* 2016; 10:449-52
36. Mohan K, Rawall S, Nene A: Visual loss after spine surgery. *Indian J Orthopaed* 2012; 46:106-8
37. Montero JA, Ruiz-Moreno JM, Galindo A, Fernandez-Muñoz M: Release hallucinations and visual loss as first manifestations of postoperative unilateral blindness. *Eur J Ophthalmol* 2007; 17:844-6
38. Murphy MA: Bilateral posterior ischemic optic neuropathy after lumbar spine surgery. *Ophthalmology* 2003; 110:1454-7
39. Nakra D, Bala I, Pratap M: Unilateral postoperative visual loss due to central retinal artery occlusion following cervical spine surgery in prone position. *Paediatr Anaesth* 2007; 17:805-8
40. Nathan ST, Jain V, Lykissas MG, Crawford AH, West CE: Transient cerebral visual loss as a complication of posterior spinal surgery in a pediatric patient. *J Pediatr Orthop B* 2013; 22:416-9
41. Ooi EI, Ahem A, Zahidin AZ, Bastion ML: Unilateral visual loss after spine surgery in the prone position for extradural haematoma in a healthy young man. *BMJ Case Rep* 2013; doi: 10.1136/bcr-2013-200632:
42. Park JY, Lee IH, Song CJ, Hwang HY: Diffusion mr imaging of postoperative bilateral acute ischemic optic neuropathy. *Korean J Radiol* 2012; 13:237-9
43. Pin-On P, Boonsri S: Postoperative visual loss in orthopedic spine surgery in the prone position: a case report. *J Med Assoc Thai* 2015; 98:320-4
44. Quraishi NA, Wolinsky J-P, Gokaslan ZL: Transient bilateral post-operative visual loss in spinal surgery. *Eur Spine J* 2012; 21 Suppl 4:S495-S498
45. Raj A, Arya SK, Sood S: Unilateral visual loss due to central retinal artery occlusion with total ophthalmoplegia following cervical spine surgery in prone position. *Nepal J Ophthalmol* 2015; 7:191-3
46. Reddy A, Foroozan R, Edmond JC, Hinckley LK: Dilated superior ophthalmic veins and posterior ischemic optic neuropathy after prolonged spine surgery. *J Neuroophthalmol* 2008; 28:327-8
47. Ripart J, Desmots JM: Loss of vision after anaesthesia for nonophthalmic surgery: A persistent problem. *Eur J Anaesthesiol* 2009; 26:524-6
48. Roth S, Nunez R, Schreider BD: Unexplained visual loss after lumbar spinal fusion. *J Neurosurg Anesth* 1997; 9:346-8
49. Roth S, Tung A, Ksiazek S: Visual loss in a prone-positioned spine surgery patient with the head on a foam headrest and goggles covering the eyes: An old complication with a new mechanism. *Anesth Analg* 2007; 104:743-50
50. Samdani AF, Rutter L, Betz RR, Mulcahey MJ: Vision loss after spinal fusion for scoliosis in a child with spinal cord injury. *J Spinal Cord Med* 2009; 32:591-4
51. Shifa J, Abebe W, Bekele N, Habte D: A case of bilateral visual loss after spinal cord surgery. *Pan African Med J* 2016; 23:119
52. Stang-Veldhouse KN, Yeu E, Rothenberg DM, Mizen TR: Unusual presentation of perioperative ischemic optic neuropathy following major spine surgery. *J Clin Anesth* 2010; 22:52-5
53. Sys J, Michielsen J, Mertens S, Verstreken J, Tassignon MJ: Central retinal artery occlusion after spine surgery. *Eur Spine J* 1996; 5:74-5
54. West J, Askin G, Clarke M, Vernon SA: Loss of vision in one eye following scoliosis surgery. *Br J Ophthalmol* 1990; 74:243-4
55. Wolfe SW, Lospinuso MF, Burke SW: Unilateral blindness as a complication of patient positioning for spinal surgery. *Spine* 1992; 17:600-5
56. Yilmaz M, Kalemci O: Visual loss after lumbar discectomy due to cortical infarction: Case report. *J Neurosci* 2013; 30:422-6
57. Yu YH, Chen WJ, Chen LH, Chen WC: Ischemic orbital compartment syndrome after posterior spinal surgery. *Spine (Phila Pa 1976)* 2008; 33:E569-72
58. Zimmerer S, Koehler M, Turtschi S, Palmowski-Wolfe A, Girard T: Amaurosis after spine surgery: survey of the literature and discussion of one case. *Eur Spine J* 2011; 20:171-6

ASA Practice Advisory for Perioperative Visual Loss (POVL) Associated with Spine Surgery 2019 Update
Evidence Tables – Survey Results

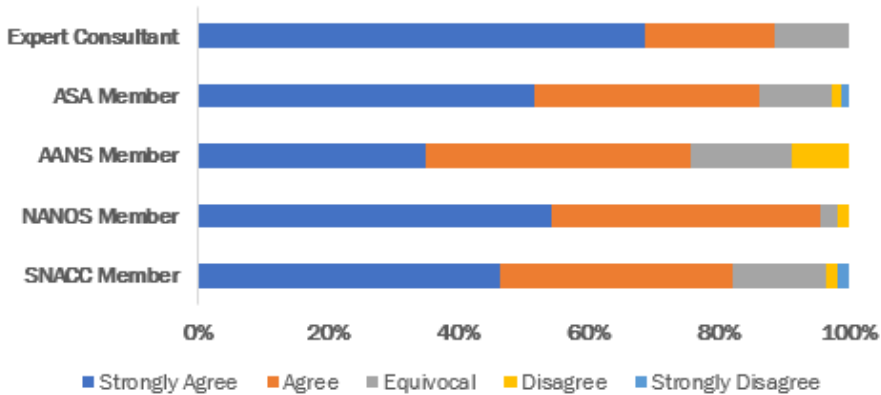
Review a patient's preoperative history and perform an appropriate examination to identify patients with conditions such as preoperative anemia, vascular risk factors, obesity, and tobacco use



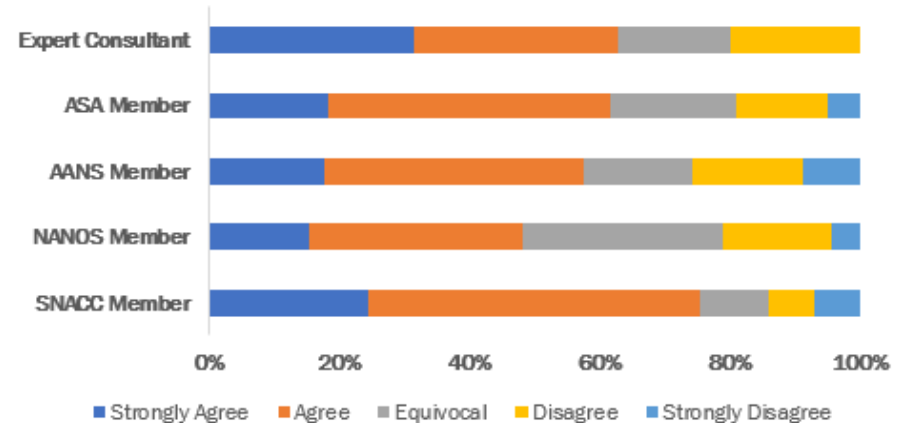
Inform patients that certain preoperative conditions may increase their risk of POVL in spine surgery. These include, but are not limited to those who are male, obese, have vascular disease risk factors such as hypertension and peripheral vascular disease, or have diabetic retinopathy.



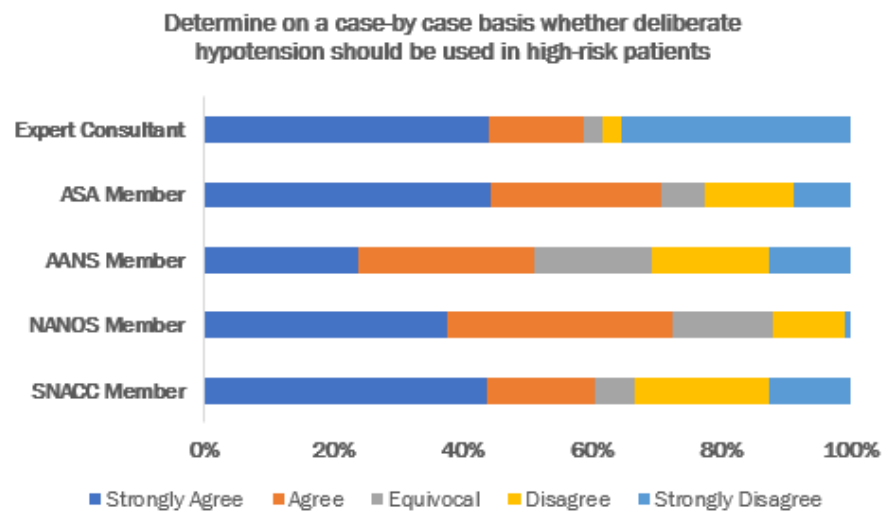
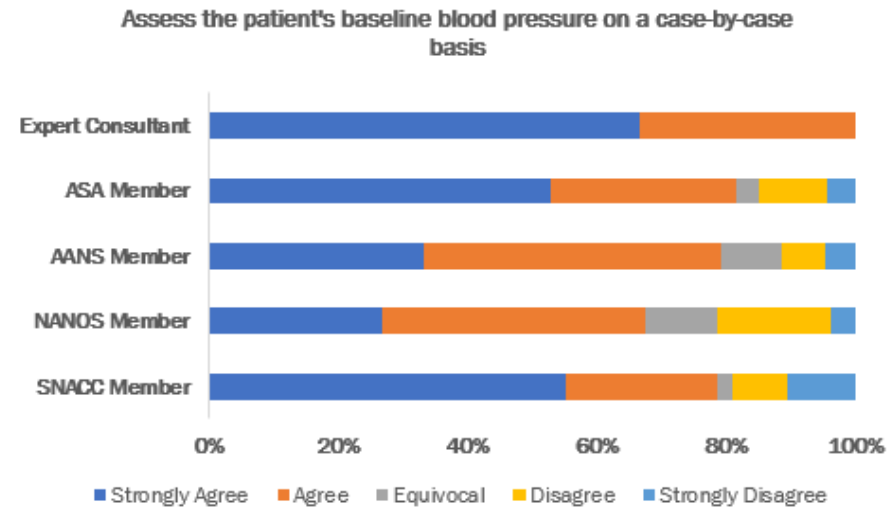
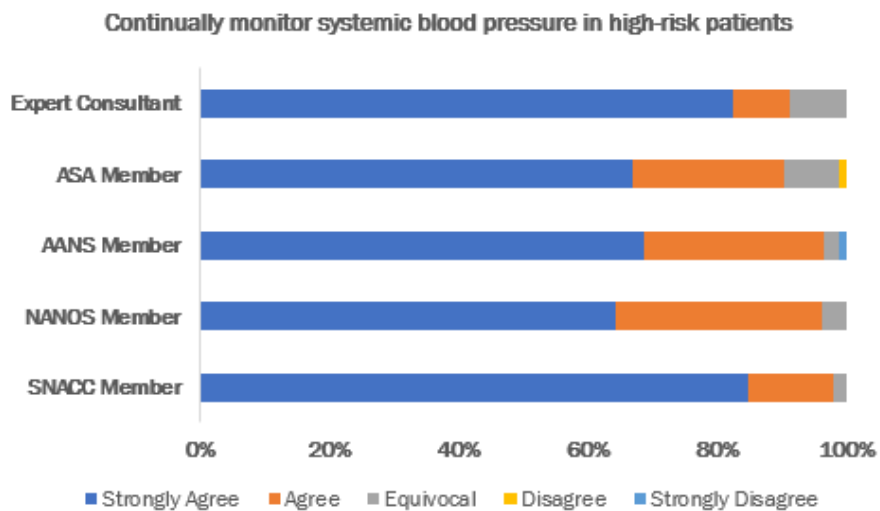
Inform patients in whom prolonged procedures, substantial blood loss, or both are anticipated that there maybe an increased risk of POVL



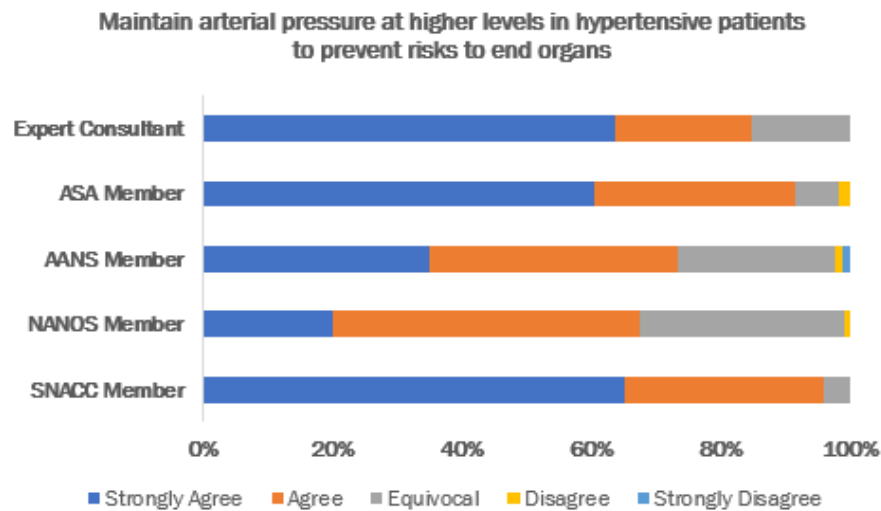
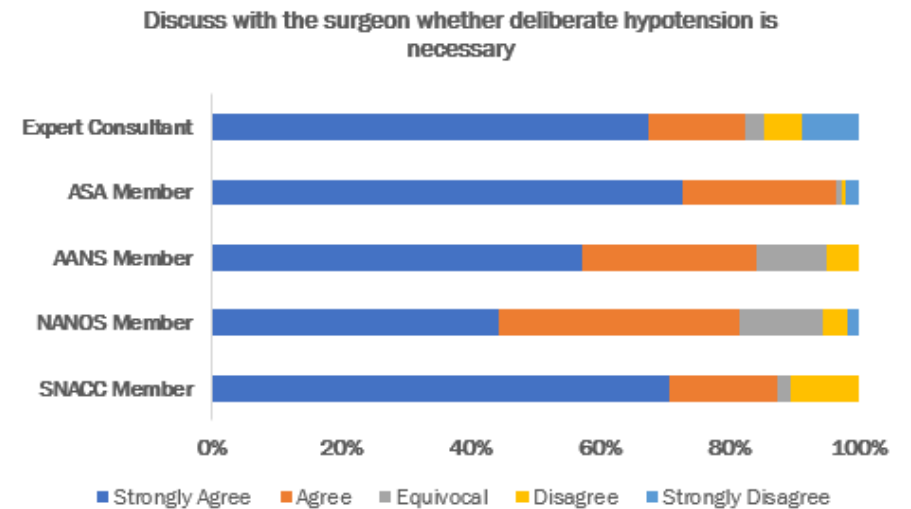
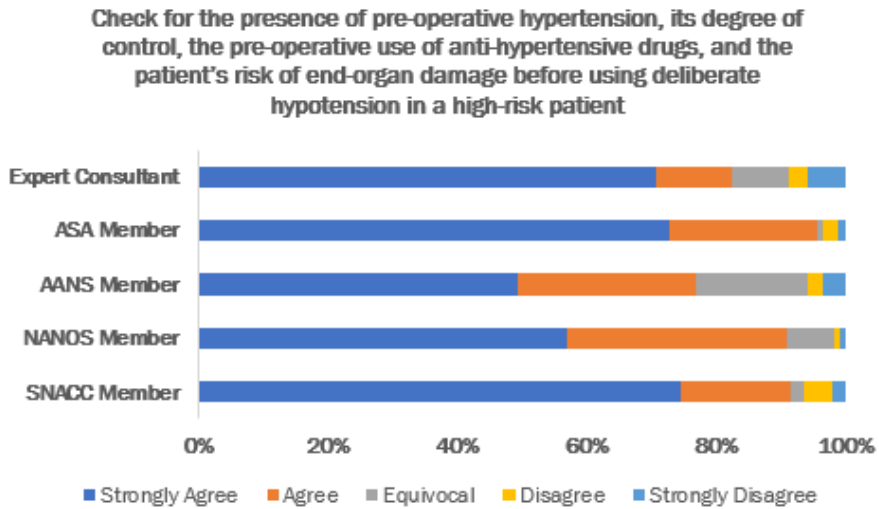
Determine on a case-by-case basis whether or not to inform patients who are not anticipated to be "high-risk" for visual loss



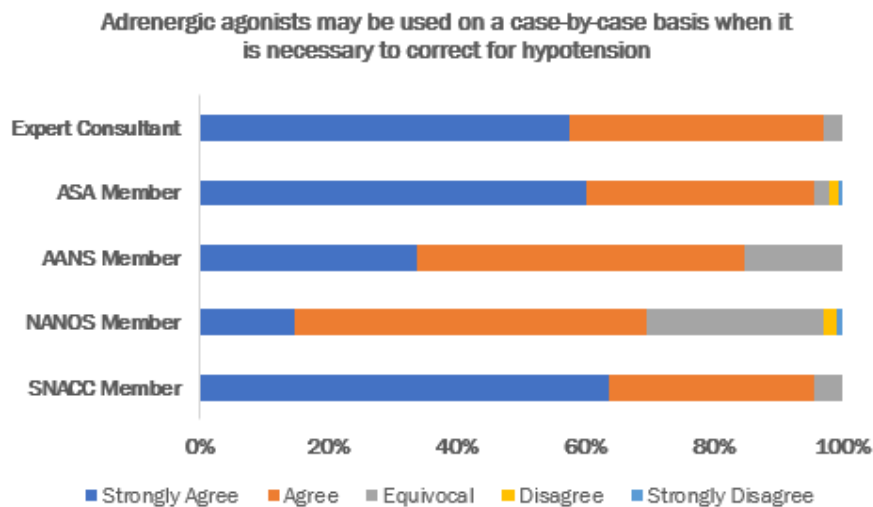
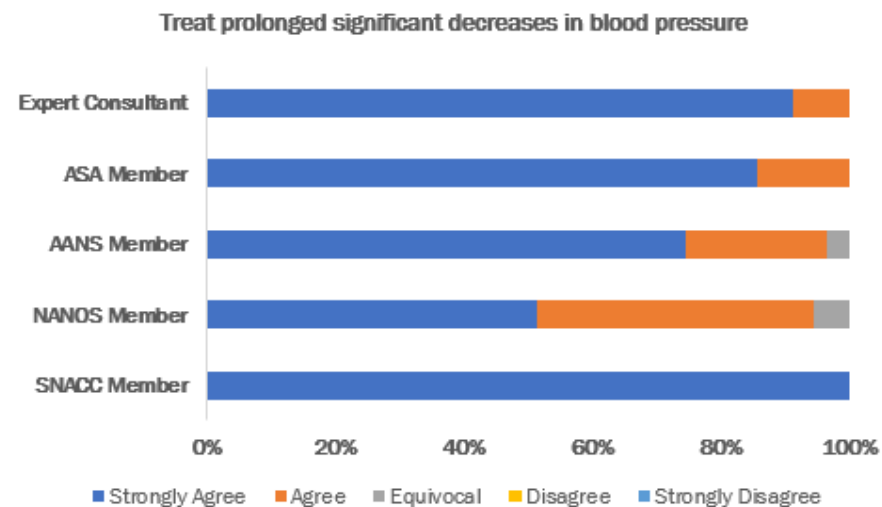
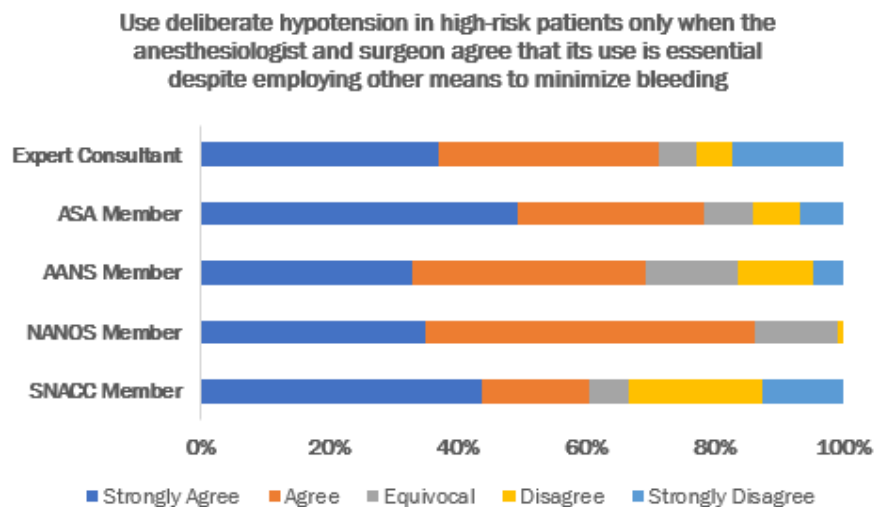
Figures 2-5. Preoperative Patient Evaluation and Preparation Survey Results by Group



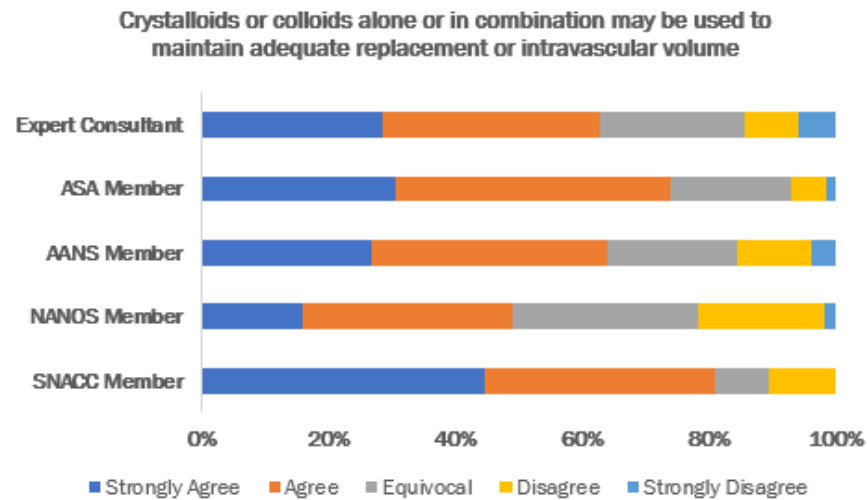
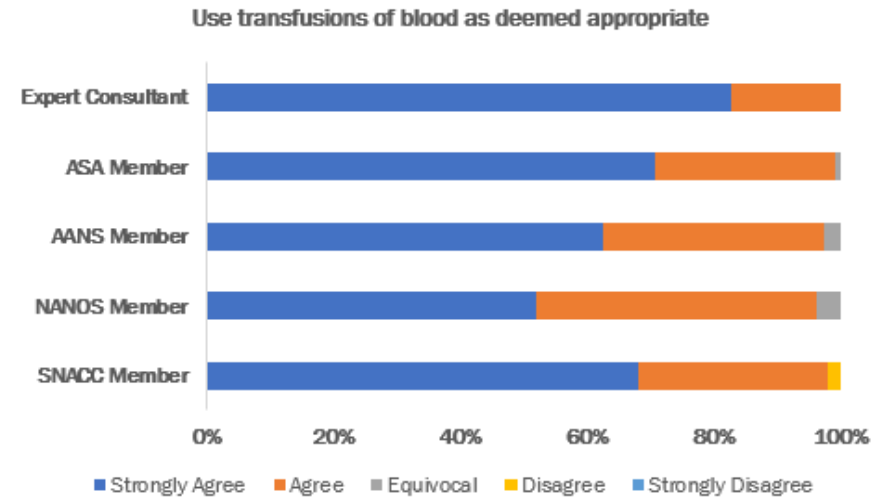
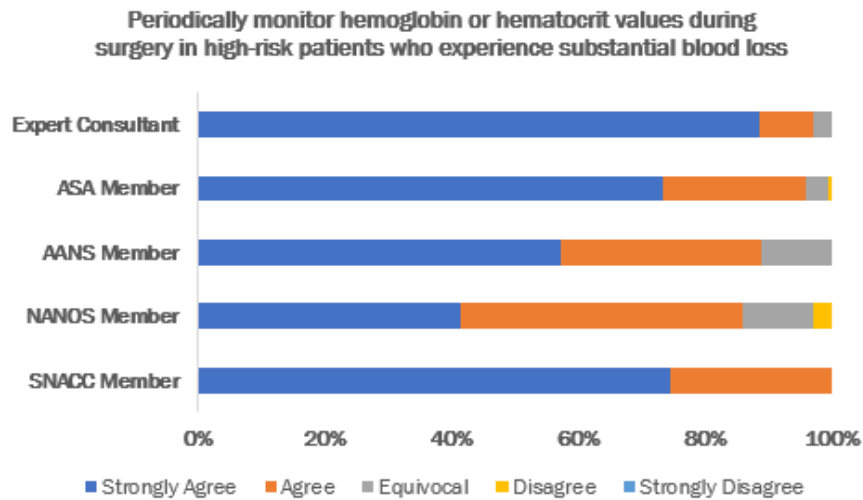
Figures 6-8. Intraoperative Blood Pressure Management Survey Results by Group



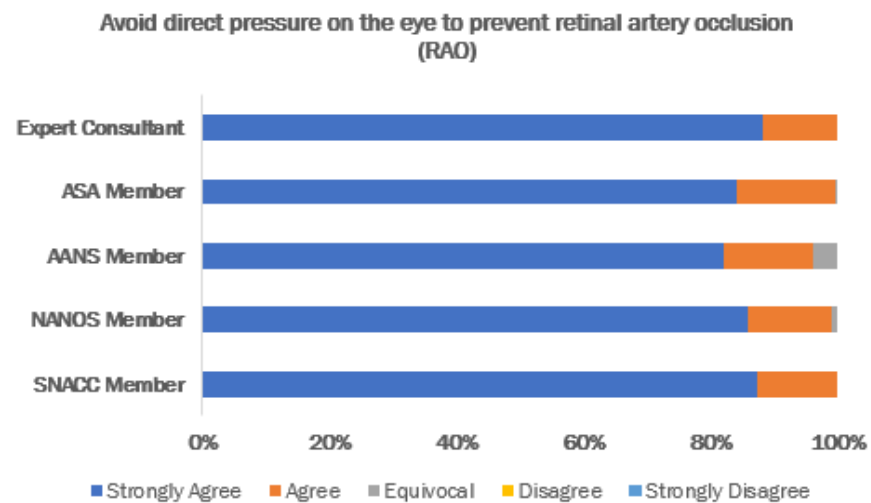
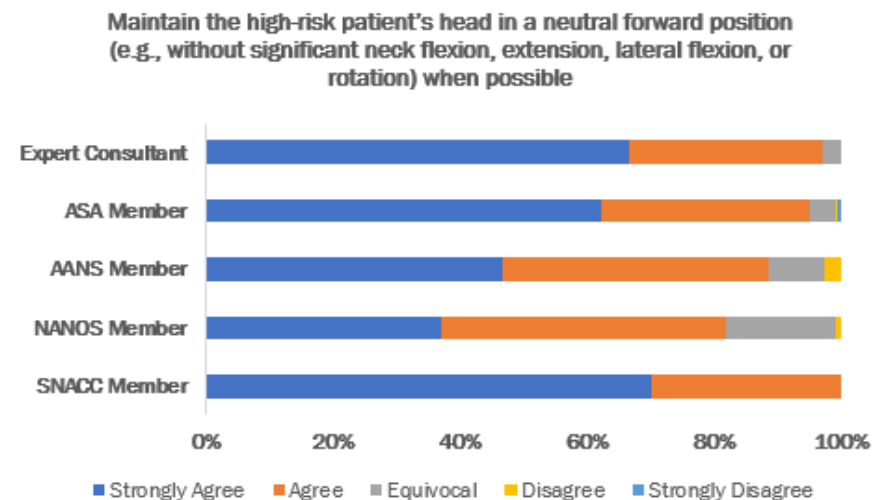
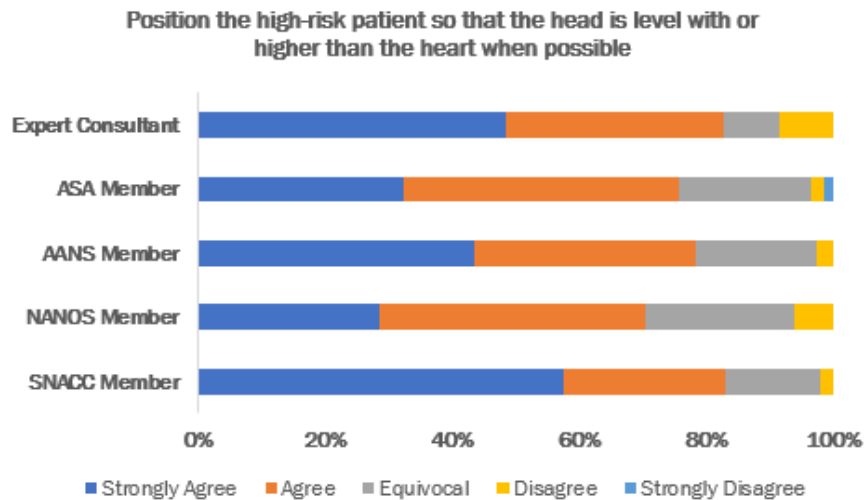
Figures 9-11. Intraoperative Blood Pressure Management Survey Results by Group



Figures 12-14. Intraoperative Blood Pressure Management Survey Results by Group

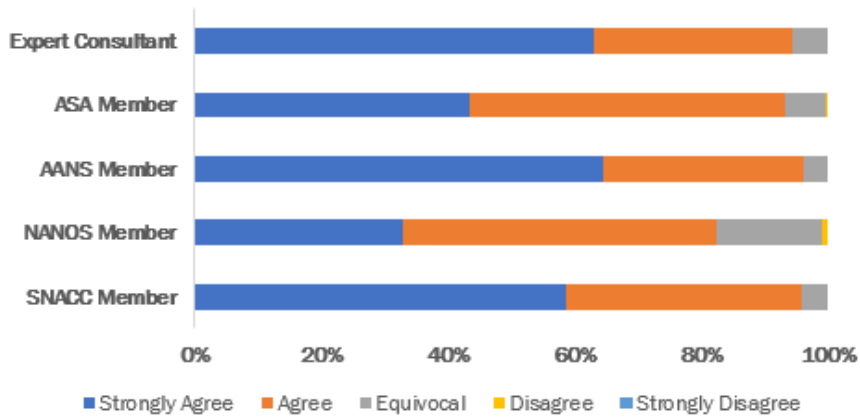


Figures 15-17. Intraoperative Management of Blood Loss and Administration of Fluids Survey Results by Group

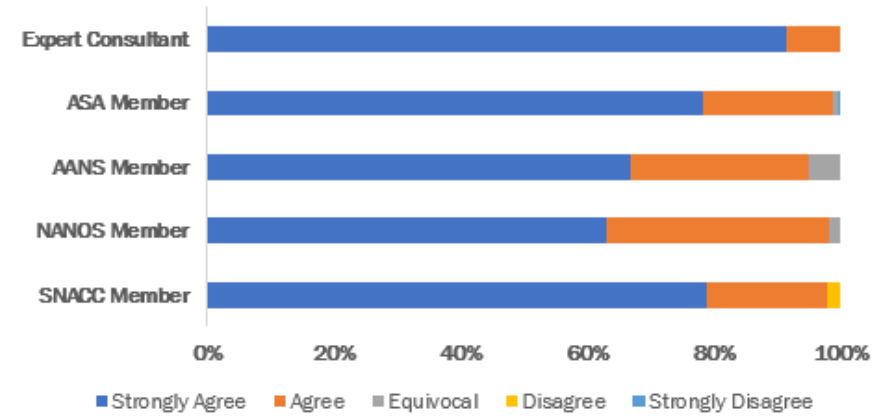


Figures 18-20. Intraoperative Management of Patient and Head Positioning Devices Survey Results by Group

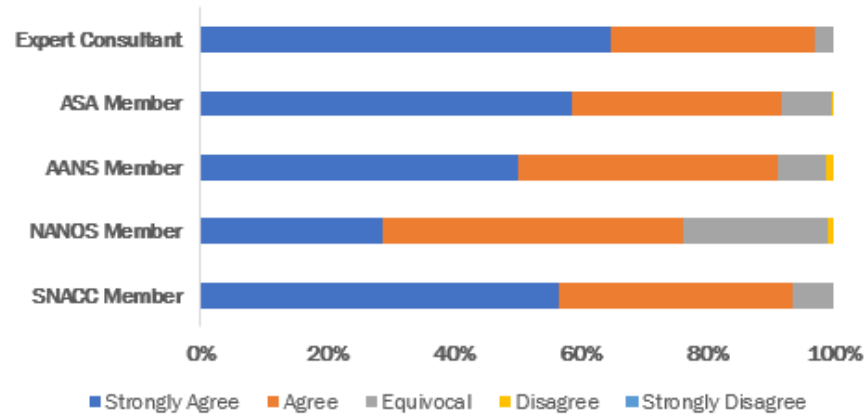
A head holder may be applied by the spine surgeon in patients in whom head positioning is challenging



Check the position of the eyes periodically during surgery to ensure the head has not moved and there is no eye compression

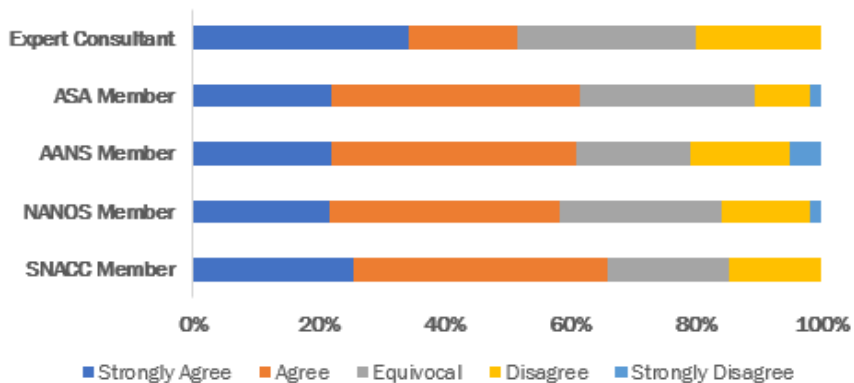


Staged spine procedures may be used on a case-by-case basis for high-risk patients

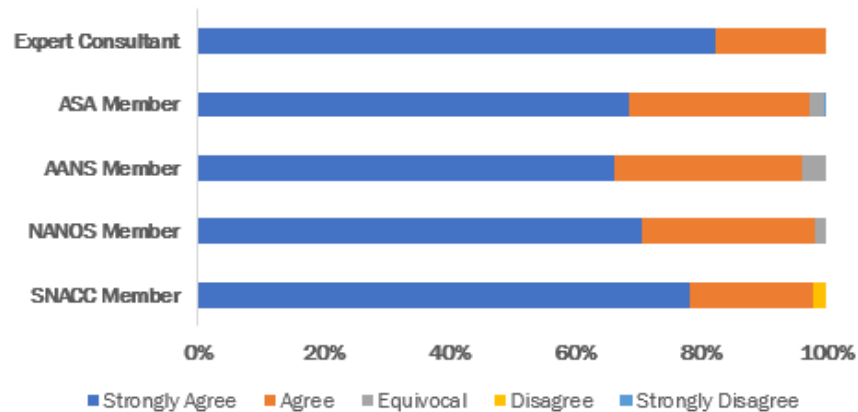


Figures 21-23. Intraoperative Management of Patient and Head Positioning Devices Survey Results by Group

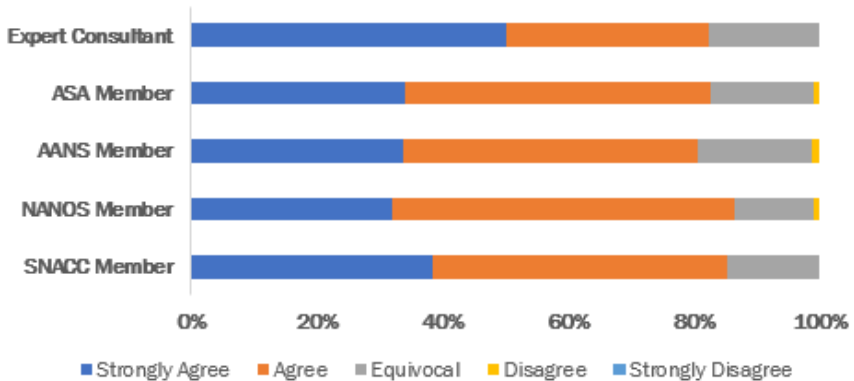
For the high-risk patient, conduct an ophthalmological assessment when the patient becomes alert (e.g., in the recovery room, intensive care unit, or nursing floor)



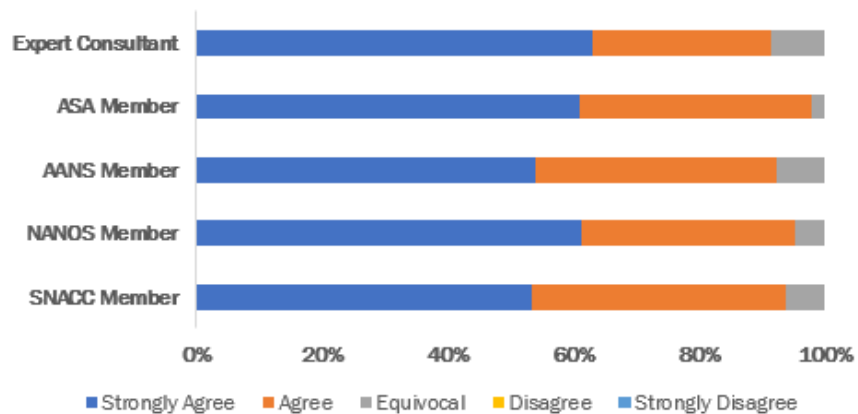
If there is concern regarding potential visual loss, obtain an urgent ophthalmologic consultation to determine its cause



CT or MRI may be used on a case-by-case basis to rule out intracranial causes of visual loss as well as to visualize an abnormal (e.g., enhancing) optic nerve



Additional management may include optimizing hemoglobin or hematocrit values, hemodynamic status, and arterial oxygenation



Figures 24-27. Postoperative Management Survey Results by Group