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Clinical Research Article

A Prospective, Multicenter, Observational Study of Surgical vs Nonsurgical Management for Pituitary Apoplexy

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BACKGROUND

Pituitary Apoplexy: The Conventional Paradigm

- PA is caused by rapid hemorrhage and/or infarction of a pituitary tumor.
- Typical presentation includes headache, nausea, vomiting, visual symptoms, ocular motor palsies, and hormonal deficits.
- Historically, PA has been treated as a neurosurgical emergency requiring decompression plus corticosteroids.
- Retrospective series have questioned whether medical management alone can yield comparable short-term outcomes.
- The evidence base before this study was limited by single-center design, retrospective ascertainment, and variable outcome capture.

Clinical Controversy Before PASTOR(Pituitary Apoplexy Surgical Timing and Outcomes Registry)

- Some surgical series report excellent visual and oculomotor recovery after transsphenoidal decompression.
- Other retrospective reports suggest conservative treatment may be equally effective in selected patients.
- Prior studies often focused narrowly on presenting features or selected outcomes.
- Surgical expertise is an important confounder because pituitary surgery outcomes depend on center experience.
- A prospective, multicenter registry was designed to address these limitations

STUDY QUESTION

What Did the Authors Aim to Test?

1. identify differences in patient populations managed medically or surgically

2. measure whether time from onset of symptoms to surgery influenced outcomes

3. evaluate short- and long-term clinical and quality-of-life (QoL) outcomes;

METHODS

Design and Setting

- Study type: prospective, multicenter, international registry.
- Registry: Pituitary Apoplexy Surgical Timing and Outcomes Registry (PASTOR).
- Study period: November 2018 to February 2022.
- Sites: 12 hospitals across the United States, Canada, France, Japan, and Korea.
- Data capture used a centralized REDCap database.

Eligibility and Treatment Allocation

- Eligible patients: adults older than 18 years with diagnosed PA based on established clinical and radiographic features.
- Excluded: patients with hemorrhage or infarction on imaging but without clinical symptoms of PA.
- Enrollment was determined by site investigators without central oversight.
- Management decisions were made independently at each site.
- Study enrollment did not affect clinical management.

Baseline Data Collected

- Demographics and comorbidities.
- Symptoms at presentation and route of arrival to the treating center.
- Visual acuity, visual field status, and oculomotor palsy.
- Hormonal status and pituitary imaging features at admission.
- Hospital course, complications, ICU stay, and length of stay.

Clinical and Imaging Assessment

- Visual acuity and visual fields was graded semi-quantitatively by bedside examination.
- ability to read a smartphone was considered grossly normal acuity, and counting fingers but not reading a smartphone, followed by seeing a hand wave or only light perception, were graded as progressive levels of diminished acuity.
- Visual fields were graded as normal, mild temporal defect, severe temporal defect, or blind.
- Oculomotor palsies were graded as none, partial, or complete.
- Tumor diameter was the largest cross-sectional distance on pituitary MRI.
- Tumor volume was estimated with the $(X \times Y \times Z)/2$ method.
- Extent of pituitary gland and optic nerve compression was rated by the site investigator as none, moderate, or severe.

Pituitary Apoplexy Score

- PAS was calculated for each patient using published criteria.
- The score combines consciousness level, visual acuity, visual field deficits, and ocular paresis.
- Score range: 0 to 10, with higher scores indicating worse function.
- PAS was developed from retrospective data and is not validated to predict outcomes.
- The authors used PAS as a means to identify patients more likely to require surgery.
- Pathology and pituitary hormonal function (intact, deficient, or uncertain) were reported by each site without central review or standardized criteria

Table 1. Pituitary apoplexy score

	Comment	Points
Level of consciousness		
GCS 15	Normal	0
GCS 8-14	Altered (stupor, obtunded)	2
GCS <8	Comatose	4
Visual acuity		
Normal	No change from pre-PA acuity	0
Reduced, unilateral		1
Reduced, bilateral		2
Visual fields	Does not differentiate severity	
Normal		0
Defect, unilateral		1
Defect, bilateral		2
Ocular paresis	Does not differentiate severity	
Absent		0
Present, unilateral		1
Present, bilateral		2

Outcomes and Statistical Plan

- Patient demographics, symptoms at presentation, comorbidities, surgical vs medical management, visual, oculomotor, and hormonal function, and radiographic findings at presentation were recorded, as was pathology for surgical patients.

- Hospital length of stay (LOS), LOS in the intensive care unit (ICU), hospital-related complications of treatment, including readmission rates, as well as the modified 5-point frailty index (mFI-5)
- Time from symptom onset to surgery and time from admission to surgery were recorded for surgical patients.

- Hormonal, visual, and oculomotor function, as well as patient responses to the Headache Impact Test (HIT-6) and the Short Form Health Survey (SF-36) QoL survey were recorded at 3 and 6 months

- Follow-up time points: 3 and 6 months; 3-month data were more complete.

- Group comparisons used Wilcoxon rank sum, chi-square, or Fisher exact tests.
- Two-sided $P < .05$ was considered statistically significant.

Outcomes and Statistical Plan

As there is a consensus among neurosurgeons that apoplexy requires surgery, we assumed a 2:1 ratio of surgical vs medical management in the overall cohort.

Power analysis indicated that collection data on 100 patients, of which 66% were surgical and 33% were medical, would provide an 80% chance of differentiating improved visual or hormonal outcomes at 3 months with statistical significance.

Study Population

- 100 consecutive PA patients were enrolled in 12 hospitals between November 2018 and February 2022,
- 3 were excluded for insufficient data.
- 97 patients were evaluable.
- 67 patients were treated surgically.
- 30 patients were treated medically without surgery.

RESULTS

Baseline Clinical Presentation

Baseline Characteristics Were Broadly Similar Between Groups

- Median age was comparable: 53 vs 50 years
- Sex distribution, admission route, BMI, and major comorbidities were not significantly different
- Headache was the most common presenting symptom in both groups
  Surgical: 94%
  Medical: 87%

followed by nausea, vomiting, and visual deterioration.

- Body mass index and comorbidities did not predict management strategy.
- Anticoagulant use and dopamine agonist use did not differ between groups.

Baseline Visual Findings: The Key Imbalance

- Visual acuity was numerically worse in the surgical group but not statistically different.
- Severe temporal visual field defects were significantly more common in the surgical group.
- Severe temporal defects: 33% surgical versus 10% medical; P = .017.

- There were more cases of vision loss and oculomotor palsy in the surgical group, although this difference was not statistically significant
- Blindness was reported in 3% of surgical patients and 0% of medical patients.
- Oculomotor palsies did not differ significantly between groups.

Baseline Hormonal Status

- Cortisol deficiency was the most common hormonal deficit in both groups.
- Gonadotroph and thyrotropin deficiencies were also common.
- No statistically significant differences in baseline hormonal deficiencies were identified between groups.
- More prolactinomas were present in the medical group, but the difference was not significant.

MRI Characteristics and Treatment Selection

- Maximal tumor diameter did not differ significantly between groups.
- Tumor volume did not differ significantly between groups.
- Optic nerve compression was more common and more severe in surgical patients.
- minimal or absent Pituitary gland compression was more often in medically managed patients.
- At presentation, **visual field defects and optic nerve compression** were the **main** significant differences.

PAS and Surgical Selection

- PAS ≥3 was more frequent among surgical patients P = 0.03
- There was a trend toward surgery among patients with PAS ≥4.
- Most patients in both groups had PAS <4.
- Higher PAS in the surgical group mainly reflected more severe visual field deficits.
- PAS helped describe severity but did not prove differential treatment benefit.

Table 2. Patient characteristics at initial presentation

	Surgery (n = 67)	Medical (n = 30)	*P*
Age, median (IQR), y	53 (40-62)	50 (35-72)	.8
Sex, n (%)			.2
Female	23 (34)	6 (20)	
Male	44 (66)	24 (80)	
Arrival at treating center, n (%)			
Direct admit	38 (57)	17 (57)	>.9
Transfer	29 (43)	13(43)	>.9
Work status prior to admission[a]			.02
Working	37 (55)	6 (20)	
Not working	13 (20)	9 (30)	
Unknown	17 (25)	15 (50)	
Symptoms, n (%)			
Headache	63 (94)	26 (87)	.2
Nausea	40 (60)	17 (57)	.8
Vomiting	27 (40)	15 (50)	.4
Vision loss	32 (48)	11 (37)	.3
Diplopia	24 (36)	6 (20)	.12
Diminished consciousness	7 (10)	2 (6.7)	.7
Weight gain	2 (3)	1 (3.3)	>.9
Weight loss	0 (0)	1 (3.3)	.3
Fatigue	26 (39)	8 (27)	.2
Photophobia	11 (16)	2 (6.7)	.3
History			
Known pituitary adenoma, n (%)	10 (15)	4 (13)	>.9
Other brain tumor, n (%)	0 (0)	0 (0)	
Other endocrine tumor, n (%)	1 (1.5)	0 (0)	>.9
Traumatic brain injury, n (%)	0 (0)	0 (0)	
Obesity, n (%)	15 (22)	4 (13)	.3
BMI, n (%)			.6
<20	2 (3.2)	1 (3.6)	
20-24	15 (24)	8 (29)	
25-30	22 (35)	6 (20)	
>30	24 (38)	13 (46)	
Heart disease, n (%)	10 (15)	8 (27)	.2
Hypertension, n (%)	25 (37)	7 (23)	.2
Diabetes, n (%)	19 (28)	5 (17)	.2
Renal insufficiency, n (%)	4 (6.0)	0 (0)	.3
Sinusitis, n (%)	3 (4.5)	0 (0)	.6
Pregnancy, n (%)	1 (1.5)	1 (3.3)	.5
Recent surgery, n (%)	3 (4.5)	1 (3.3)	>.9
Anticoagulant use, n (%)	18 (28)	7 (23)	.8
Dopamine agonist use, n (%)	0 (0)	0 (0)	>.9
Visual acuity, n (%)			.2
Read smartphone	49 (75)	23 (96)	
Count fingers	11 (17)	1 (4.2)	
Hand wave	4 (6.2)	0 (0)	
Light perception	1 (1.5)	0 (0)	

(*continued*)

Table 2. Continued

	Surgery (n = 67)	Medical (n = 30)	*P*
Visual fields, n (%)			
Full	37 (55)	21(70)	.2
Mild temporal defect	6 (8.9)	3 (10)	>.9
Severe temporal defect	22 (33)	3 (10)	.017
Blind	2 (3.0)	0 (0)	>.9
Oculomotor palsy, n (%)			
Partial	18 (27)	7 (24)	>.9
Complete	9 (13.4)	2 (6.7)	.5
mFI-5			>.9
0	35 (53)	16 (53)	
1	18 (27)	7 (23)	
2	10 (15)	6 (20)	
3	2 (3.0)	1 (3.3)	
4	1 (1.5)	0 (0)	
PAS, n (%)			.091
0	18 (27)	15 (50)	
1	14 (21)	10 (33)	
2	17 (26)	3 (10)	
3	8 (12)	2 (6.7)	
4	6 (9.1)	0 (0)	
5	1 (1.5)	0 (0)	
6	1 (1.5)	0 (0)	
7	1 (1.5)	0 (0)	
Clusters, n (%)			
PAS 0-3	57 (86)	30 (100)	
PAS ≥4	9 (14)	0 (0)	
PAS 0-3 vs PAS ≥4			.053
PAS 0-2	49 (74)	28 (93)	
PAS >3	17 (26)	2 (6.7)	
PAS 0-2 vs PAS ≥3			.030
Hormone hypersecretion, n (%)[b]			
Growth hormone	0 (0)	1 (3.3)	.3
Cortisol	1 (1.5)	0 (0)	>.9
Prolactin	3 (4.5)	4 (13)	.2
Thyrotropin	0 (0)	0 (0)	
Hormone deficiency, n (%)[c]			
Cortisol			>.9
Intact	17 (26)	9 (30)	
Deficient	44 (67)	19 (63)	
Uncertain	5 (7.6)	2 (6.7)	
Thyrotropin	34 (52)	13 (43)	.4
Gonadotroph hormones	33 (52)	16 (53)	.9
Growth hormone	13 (21)	4 (14)	.4
Vasopressin	5 (7.6)	6 (20)	.092
MRI characteristics			
Tumor size, median (IQR)			
Maximum diameter, cm	2.6 (2.1-3.2)	2.4 (1.90-2.8)	.12
Volume, cc	5 (2-10)	4 (2-6)	.2
Acute blood, n (%)	46 (79)	19 (76)	.8
Infarcted tissue, n (%)	30 (48)	8 (31)	.34
Cavernous sinus invasion, n (%)[d]	17 (28)	6 (25)	.9

(*continued*)

Table 2. Continued

	Surgery (n = 67)	Medical (n = 30)	*P*
Sinusitis, n (%)	11 (18)	3 (9.7)	
Pituitary gland compression, n (%)			<.001
Moderate	19 (31)	8 (34)	
Severe	39 (63)	11 (48)	
Minimal/none	4 (6.5)	12 (39)	
Optic nerve compression, n (%)			<.001
Moderate	16 (25)	3 (9.6)	
Severe	26 (41)	2 (6.5)	
Minimal/none	22 (34)	26 (84)	

Hospital Course and Perioperative Outcomes

- Hospital length of stay did not differ between surgical and medical groups.
- Mean LOS: 6.0 ± 4.5 days surgical versus 7.0 ± 6.9 days medical; P > .9.
- Surgical patients averaged approximately one additional ICU day.
- Most surgical patients underwent endoscopic transsphenoidal surgery.
- Nearly all surgical and all medical patients were discharged home.

Complications and Pathology

- Surgical complications included CSF leak, arginine vasopressin deficiency, delayed epistaxis, sinusitis, and hyponatremia.
- Medical complications included arginine vasopressin deficiency and hyponatremia.
- Surgical pathology showed pituitary adenoma in 94% of cases.
- Rathke cleft cyst was found in 4.5% of surgical cases.
- Many surgical specimens showed necrotic tissue or hemorrhage.

Medication Use During Admission

- Corticosteroids were used in 76% of surgical and 63% of medical patients.
- Thyroid replacement was used in 49% of surgical and 20% of medical patients.
- Antibiotic use was higher in the surgical group, consistent with operative prophylaxis.
- Desmopressin, fluid restriction, and hypertonic saline were more common in the surgical group.
- but these differences were not significant.

Hormonal Recovery at 3 Months

- No significant differences in hormonal recovery were observed between groups.
- Neither surgical nor medical management substantially reversed hormonal deficits.
- Cortisol recovery: 11.6% surgical versus 10.5% medical.
- Thyrotropin recovery: 8.9% surgical versus 8.3% medical.
- Gonadotroph recovery: 6.1% surgical versus 6.3% medical.

Table 4. Hormonal recovery at 3 months after initial presentation

	Surgery (n = 67)		Medical (n = 30)		*P*
	Deficient at onset	Recovered (3 mo)	Deficient at onset	Recovered (3 mo)	
Cortisol	44	5 (11.6%)	19	2 (10.5%)	>.9
Thyrotropin	34	3 (8.9%)	13	1 (8.3%)	.8
Gonadotroph hormones	33	2 (6.1%)	16	1 (6.3%)	.4
Vasopressin	5	1 (20%)	6	0 (0%)	.8

Visual Outcomes at 3 Months

- Visual fields were full in 78% of surgical and 71% of medical patients; P = .7.
- No blindness was reported at 3 months in either group among patients with available data.
- Severe temporal defects persisted in 3.4% surgical and 4.8% medical patients.
- Stratification by severe baseline visual field defect did not show surgical superiority.

Oculomotor Outcomes

- Oculomotor palsies largely resolved in both groups:
- At 3 months, partial palsy persisted in 8.5% surgical and 4.8% medical patients.p>0.9
- Complete palsy persisted in only one surgical patient and no medical patients.
- At 6 months, no oculomotor palsies were reported among medically managed patients with available data.
- and partial palsy was reported in 4 of the 54 (7.4%) patients with data in the surgical group.

Table 5. Visual field and oculomotor palsy outcomes at 3 months

	Surgical (n = 59)	Medical (n = 21)	*P*
Visual fields, n (%)			.7
Full	46 (78)	15 (71)	
Mild temporal	5 (11)	2 (11)	
Severe temporal	2 (3.4)	1 (4.8)	
Blind	0	0	
Oculomotor palsy, n (%)			>.9
None	53 (90)	20 (95)	
Partial	5 (8.5)	1(4.8)	
Complete	1 (1.5)	0	

Tumor Regression With Medical Management

- MRI at 2–3 months was available for most medically managed patients.
- After exclusions, 24 patients were analyzed for apoplectic tissue volume.
- Tumor volume regression occurred in all but one patient.
- Median volume fell from 3.6 cm^3 at onset to 1.4 cm^3 at 2–3 months; P = .0002.
- The paper reports substantial spontaneous regression of apoplectic tumor volume.

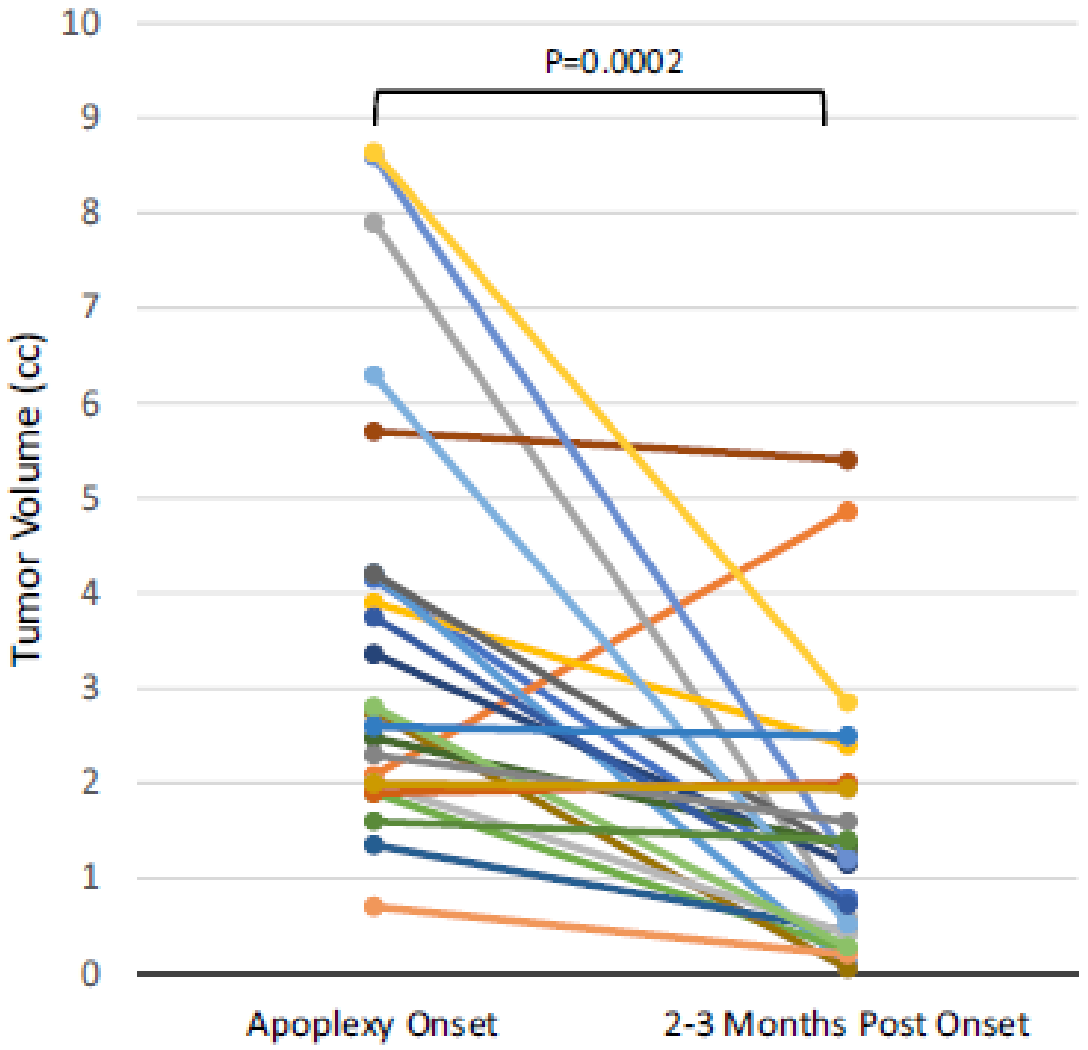

Figure 2. Change in volume of apoplectic tissue in medically managed patients by 2 to 3 months after symptom onset. Volumes were measured using the (A × B × C)/2 approximation method. Each line represents one patient (n = 24). There was a significant 61% median reduction in volume over time (*P* = .0002), with only one patient showing volume enlargement.

Quality of Life and Return to Work

- SF-36 and HIT-6 scores were similar between treatment groups at 3 months.
- Quality-of-life scores were slightly lower in the medical group, but not significantly different.
- Return to work was similar at 3 months.
- 6-month quality-of-life data were less complete.
- Available 6-month data did not suggest major changes from 3-month outcomes.

Table 6. Quality of life outcomes

	3 Mo			6 Mo		
	Surgical n = 67	Medical n = 30	*P*	Surgical n = 67	Medical (n = 30)	*P*
SF-36 score, median (IQR)	2742 (2140-3082)	2305 (1655-2526)	.1	2605 (1280-3070)	2550 (1714-3168)	.3
Missing data, n	19	16		23	17	
HIT-6 score, median (IQR)	38 (36-39)	42 (37-55)	.2	44 (36-54)	40 (36-50)	.6
Missing data, n	18	15		22	16	
Return to work	30 (81%)	6 (100%)	.07	28 (76%)	6 (100%)	.2

Abbreviations: HIT-6, Headache Impact Test; IQR, interquartile range; SF-36, Short Form Health Survey.

Early vs Late Surgery

- Timing was analyzed from symptom onset and from admission/transfer to the treating center.
- Cutoffs included 2, 3, and 4 days from symptom onset.
- Clinical outcomes at 3 months were not affected by surgery timing after symptom onset.
- Outcomes were also unchanged regardless of timing from admission/transfer to surgery.
- The study found no clear benefit to early surgery regardless of how “early” was defined.

Table 7. Demographics, clinical presentation, and 3-month outcomes based on time from symptom onset to surgery

	2-d cutoff			3-d cutoff			4-d cutoff		
	≤2 d (n = 7)[a]	>2 d (n = 60)	*P*	≤3 d (n = 12)	>3 d (n = 55)	*P*	≤4 d (n = 17)	>4 d (n = 50)	*P*
Demographics and clinical presentation									
Age, median, (IQR), y	62 (42-64)	52 (40-62)	.7	54 (43-64)	53 (40-62)	.7	51 (41-62)	54 (40-62)	.9
Sex, n (%)			.7			.7			>.9
Female	3 (43)	20 (33)		5 (42)	18 (33)		6 (35)	17 (34)	
Male	4 (57)	40 (67)		7 (58)	37 (67)		11 (65)	33 (66)	
Symptoms, n (%)									
Headache	6 (86)	57 (95)	.4	10 (83)	53 (96)	.14	15 (88)	48 (96)	.3
Vision loss	3 (43)	29 (48)	>.9	5 (42)	27 (49)	.6	7 (41)	25 (50)	.5
Oculomotor palsy	3 (43)	21 (35)	.7	5 (42)	19 (35)	.7	8 (47)	16 (32)	.3
Diminished consciousness	0 (0)	7 (12)	>.9	0 (0)	7 (13)	.3	1 (5.9)	6 (12)	.7
Nausea	5 (71)	35 (58)	.7	8 (67)	32 (58)	.7	11 (65)	29 (58)	.6
Vomiting	4 (57)	23 (38)	.4	5 (42)	22 (40)	>.9	7 (41)	20 (40)	>.9
Weight gain	0 (0)	2 (3.3)	>.9	0 (0)	2 (3.6)	>.9	0 (0)	2 (4.0)	>.9
Weight loss	0 (0)	0 (0)		0 (0)	0 (0)		0 (0)	0 (0)	
Fatigue	2 (29)	24 (40)	.7	4 (33)	22 (40)	.8	5 (29)	21 (42)	.4
Photophobia	0 (0)	11 (18)	.6	1 (8.3)	10 (18)	.7	2 (12)	9 (18)	.7
History, n (%)									
Heart disease	1 (14)	9 (15)	>.9	2 (17)	8 (15)	>.9	2 (12)	8 (16)	>.9
Hypertension	3 (43)	22 (37)	>.9	6 (50)	19 (35)	.3	7 (41)	18 (36)	.7
Diabetes	4 (57)	15 (25)	.094	6 (50)	13 (24)	.084	7 (41)	12 (24)	.2
Known pituitary adenoma	1 (14)	9 (15)	>.9	1 (8.3)	9 (17)	.7	3 (18)	7 (14)	.7
BMI, n (%)			.3			.13			.3
<20	1 (14)	1 (1.8)		1 (8.3)	1 (2.0)		1 (5.9)	1 (2.2)	
20-25	1 (14)	14 (25)		1 (8.3)	14 (27)		2 (12)	13 (28)	
26-30	3 (43)	19 (34)		7 (58)	15 (29)		8 (47)	14 (30)	
>30	2 (29)	22 (39)		3 (25)	21 (41)		6 (35)	18 (39	
mFI-5, n (%)			.4			.6			.8
0	3 (50)	32 (53)		5 (45)	30 (55)		8 (50)	27 (54)	
1	1 (17)	17 (28)		3 (27)	15 (27)		5 (31)	13 (26)	
2	1 (17)	9 (15)		2 (18)	8 (15)		2 (12)	8 (16)	
3	1 (17)	1 (1.7)		1 (9.1)	1 (1.8)		1 (6.2)	1 (2.0)	
4	0 (0)	1 (1.7)		0 (0)	1 (1.8)		0 (0)	1 (2.0)	
Visual acuity, n (%)			>.9			.8			.8
Read smartphone	1 (14)	10 (17)		10 (83)	39 (74)		12 (71)	37 (77)	
Count fingers	0 (0)	1 (1.7)		1 (8.3)	10 (19)		4 (24)	7 (15)	
Hand wave	0 (0)	4 (6.9)		1 (8.3)	3 (5.7)		1 (5.9)	3 (6.2)	
Light perception	6 (86)	43 (74)		0 (0)	1 (1.9)		0 (0)	1 (2.1)	
PAS, n (%)			.6			.2			.4
0-3	7 (100)	50 (85)		12 (100)	45 (83)		16 (94)	41 (84)	
≥4	0 (0)	9 (15)		0 (0)	9 (17)		1 (5.9)	8 (16%)	
Tumor size, median (IQR)									
Maximum diameter, cm	2.80 (2.32-3.03)	2.60 (2.10-3.20)	.8	2.80 (2.32-3.05)	2.50 (2.10-3.20)	.7	2.60 (2.08-2.90)	2.60 (2.12-3.20)	.6
Volume, cc	7 (3-10)	5 (2-9)	.7	8 (3-10)	5 (2-8)	.4	5 (3-10)	5 (2-9)	.7
Outcomes at 3 mo									
Visual fields, n (%)									
Full	5 (100)	41 (76)	.6	8 (80)	38 (78)	>.9	11 (65)	26 (52)	.4
Mild temporal	1 (14)	12 (20)	>.9	3 (25)	10 (18)	.7	3 (18)	10 (20)	>.9
Severe temporal	1 (14)	21 (35)	.4	3 (25)	19 (35)	.7	4 (24)	18 (36)	.3

(continued)

Table 7. Continued

	2-d cutoff			3-d cutoff			4-d cutoff		
	≤2 d (n = 7)[a]	>2 d (n = 60)	*P*	≤3 d (n = 12)	>3 d (n = 55)	*P*	≤4 d (n = 17)	>4 d (n = 50)	*P*
Hormone status, n (%)[a]									
Cortisol			.4			>.9			.8
Deficient	1 (25)	14 (28)		2 (25)	13 (28)		3 (23)	12 (29)	
Recovered	2 (50)	32 (64)		5 (62)	29 (63)		8 (62)	26 (63)	
Uncertain	1 (25)	4 (8.0)		1 (12)	4 (8.7)		2 (15)	3 (7.3)	
Thyrotropin						.5			>.9
Deficient	1 (25)	23 (46)		3 (38)	21 (46)		6 (46)	18 (44)	
Recovered	3 (75)	24 (48)		4 (50)	23 (50)		6 (46)	21 (51)	
Uncertain	0 (0)	3 (6.0)		1 (12)	2 (4.3)		1 (7.7)	2 (4.9)	
Gonadotroph hormones			.2			.4			.6
Deficient	1 (25)	23 (46)		3 (38)	21 (46)		6 (46)	18 (44)	
Recovered	2 (50)	26 (52)		4 (50)	24 (52)		6 (46)	22 (54)	
Uncertain	1 (25)	1 (2.0)		1 (12)	1 (2.2)		1 (7.7)	1 (2.4)	
Growth hormone			>.9			>.9			>.9
Deficient	3 (75)	35 (71)		6 (75)	32 (71)		10 (77)	28 (70)	
Recovered	1 (25)	13 (27)		2 (25)	12 (27)		3 (23)	11 (28)	
Uncertain	0 (0)	1 (2.0)		0 (0)	1 (2.2)		0 (0)	1 (2.5)	
Oculomotor palsy, n (%)									
Partial	0 (0)	5 (8.3)	>.9	0 (0)	5 (9.1)	.6	3 (18)	2 (4.0)	.10
Complete	0 (0)	1 (1.7)	>.9	0 (0)	1 (1.8)	>.9	0 (0)	1 (1.8)	.9
QoL measures									
SF-36, median (IQR)	2858 (2832-2886)	2670 (2128-3092)	.6	2850 (2770-2908)	2645 (2140-3100)	>.9	2770 (2448-2886)	2710 (2128-3104)	.7
HIT-6, median (IQR)	36 (36-41)	38 (36-49)	.4	36 (36-45)	39 (36-49)	.3	42 (36-54)	38 (36-48)	.8
Return to work, n (%)	2 (67)	24 (59)	>.9	3 (50)	23 (61)	.7	9 (69)	21 (57)	.4

Principal Findings of the Registry

- This multicenter, international prospective registry identified three main findings.
- Demographics, comorbidities, presenting symptoms, and imaging findings were largely similar between surgically and medically managed patients.
- Outcomes at 3 months of follow-up were also largely similar between treatment groups.
- Timing of surgery did not appear to correlate with outcomes at 3 months.
- The findings help clarify conflicting results from previous single-center retrospective studies.

Visual Outcomes and Surgical Selection

- Surgical patients had more severe visual field deficits and greater optic nerve compression at presentation.
- These findings suggest that visual field deficits and optic nerve compression were the principal factors influencing selection of surgical treatment.
- Despite worse baseline visual status, visual outcomes at 3 and 6 months were similar between groups.
- Stratified analysis of severe visual deficits did not demonstrate superior visual recovery with surgery.

Tumor Regression and Effect of Surgical Timing

- Significant regression of apoplectic tumor volume occurred within 2–3 months in medically managed patients.
- Mean tumor volume reduction was approximately 66%.
- Similar observations have been reported in previous retrospective studies.
- No association was observed between earlier surgery and improved outcomes.
- Findings were consistent with a recent meta-analysis evaluating surgical timing.

Oculomotor and Endocrine Recovery

- Recovery of oculomotor function was similar in both treatment groups.
- Recovery of anterior pituitary function was limited (6.1–11.6%).
- No difference in hormonal recovery was observed between surgical and medical management.
- Timing of surgery did not influence endocrine outcomes.

Clinical Implications and Limitations

- Surgery remains indicated for progressive deterioration of consciousness or worsening visual deficits despite corticosteroid therapy.
- In clinically stable patients, pituitary apoplexy may not represent a neurosurgical emergency.
- Major limitations included lack of central review and absence of randomization.
- A randomized trial would be required to definitively determine the independent effect of surgery on outcomes.

Conclusion

- Medical and surgical management yielded similar 3-month outcomes.
- Surgery could not be shown to provide superior outcomes despite more severe baseline visual deficits.
- Timing of surgery did not affect outcomes.
- Significant spontaneous tumor regression occurred in medically managed patients.
- Surgery is not always necessary to relieve mass effect in pituitary apoplexy.