

# Surgical outcome in an elderly population with intracranial meningioma

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## Abstract

Thirty seven patients aged 70 and over (mean = 74 years) with an intracranial meningioma who had craniotomy between the years 1978-88 were reviewed. There were 20 women and 17 men. Resection was total in 28 (76%) and subtotal in 9 (24%) cases and each tumour was histologically verified. The location of the tumours were: base of skull 11, convexity 10, parasagittal 9, falx 6, and tentorial 1. The most frequent associated diseases were: hypertension (35%), chronic ischaemic heart disease (22%) chronic obstructive pulmonary disease (19%), and diabetes (14%). The Karnofsky Scale (KS) score before surgery ranged from 30 to 90 (mean = 59). It was less than 40 in ten patients. The length of anaesthesia during the surgical procedure varied from 4 to 12 hours and was not related to the outcome. There were two perioperative deaths (mortality = 5.4%). There were major complications in 8 patients and minor complications in 7 patients. In a mean follow up period of 29 months (shortest 6 and longest 96 months) the results were: excellent (KS 90-100) 39%, good (KS 70-80) 49%, fair (KS 60) 6%, and poor (KS 40-50) 6%. The difference between the mean preoperative KS value (KS = 59) and the mean postoperative KS value (KS = 80) was statistically significant ( $P < 0.001$ ). The results support a more aggressive therapeutic approach to the elderly patient with an intracranial meningioma.

It is calculated that by the year 2000 there will be twice as many people in the world over the age of 80 as there were in 1970.<sup>1</sup> In Israel, the average life-span has increased almost 10% since the early 1950s; a male can expect to reach 72.5 years on average, while females can expect to live 76.2 years.<sup>2</sup> The increase in the proportion of women among the aged is occurring in almost all countries.<sup>1</sup> This increased life expectancy together with the availability of safe and effective screening tests such as CT and MRI, will result in an increase in referral to neurosurgeons of elderly patients with an intracranial tumour.

There are recent advances in noninvasive diagnostic procedures, neuroanaesthesia, surgical techniques, and intensive care management, nevertheless many doctors have reservations about the performance of major

neurosurgical procedures in the elderly, even for a benign, potentially curable lesion such as meningioma. Previous reports have included as elderly, patients in the fifth and sixth decade<sup>3</sup> while in others, only patients aged over 65.<sup>4-6</sup> We have studied the outcome of surgery for a meningioma in patients aged 70 and over, arbitrarily assuming that this group will be representative of a steadily increasing geriatric population.

## Clinical materials and methods

Thirty seven consecutive patients aged 70-86 years (mean = 74) with an intracranial meningioma had craniotomy at Hadassah University Hospital between 1978-88. There were 20 women (54%) and 17 men (46%) (fig1). All the patients were symptomatic before operation and, except for one case with a tuberculoma sellae meningioma, the tumour size was larger than 3 cm in all cases. Smaller meningiomas diagnosed in relatively asymptomatic patients in this age group were considered incidental findings and were not treated surgically. The most frequent symptoms and signs present at the time of admission are summarised in table 1. Motor weakness (73%), mental disturbances (38%), and epileptic seizures (22%) headed the list. In no case was papilloedema present at the time of diagnosis. The preoperative neuroradiological evaluation included CT scan in all patients and cerebral angiography in certain cases mainly those with a base of skull or parasagittal tumour. The tumours were located as follows: base of skull 11 (30%) cases, convexity 10 (27%) cases, parasagittal 9 (24%) cases, falx 6 (16%) cases, and tentorial 1 (3%) cases. In 5 cases the tumour was a recurrent lesion. The preoperative neurological status was assessed retrospectively from the medical records using the Karnofsky Scale (KS) score<sup>7</sup> and then compared with the postoperative status using the same scale at the last follow up examination

Table 1 Most frequent symptoms and signs in 37 elderly patients with an intracranial meningioma

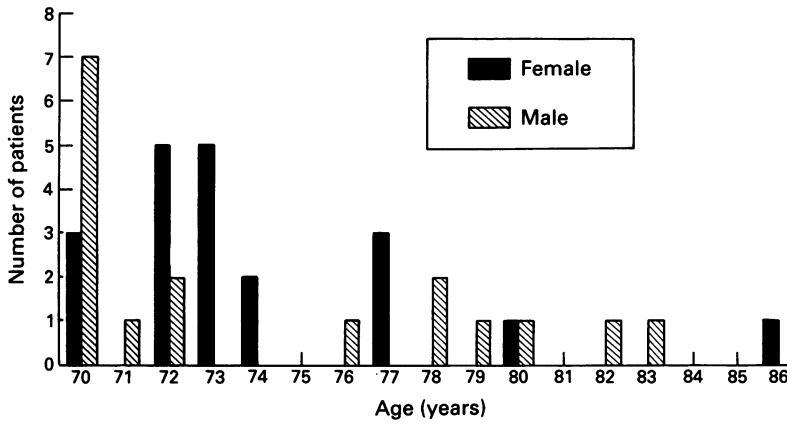
Symptoms and signs	Number	Patients percentage
Motor weakness	27	73
Personality changes or dementia	14	38
Seizures	8	22
Headaches	7	20
Disturbances of gait	6	16
Visual field defect	5	13
Dysphasia	4	11

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Received 14 September 1990 and in final revised form 11 May 1991.

Accepted 3 June 1991



Distribution of intracranial meningiomas

Figure 1 Histogram showing the age range and sex distribution of the 37 patients at the time of treatment.

(fig 2). The Karnofsky rating scale is summarised in table 2. Associated diseases were found in 27 (73%) patients. The most relevant are summarised in table 3. In 9 (24%) patients the medical history was not relevant. Four patients had received x ray therapy for tinea capitis (ringworm of the scalp) in childhood. The surgical risk was carefully evaluated in all patients by the staff neuroanesthetist and when necessary by appropriate consultants. Special attention was given to the evaluation of the cardiovascular, respiratory and renal function. All diabetic patients, including those routinely managed with diet and oral hypoglycaemics, were given regular doses of insulin in the immediate pre and postoperative period. The only patient in which a preoperative Swan-Ganz catheterisation was performed (case 30) presented with a history of severe cardiac problems, including 4 myocardial infarctions (MI), the last one 7 years before admission. The preoperative management in all patients included steroids and anticonvulsant medication.

We recorded the length of anaesthesia and the time taken to achieve extubation to assess the influence of these parameters on the surgical outcome (table 4). The values of the KS before and after operation were compared

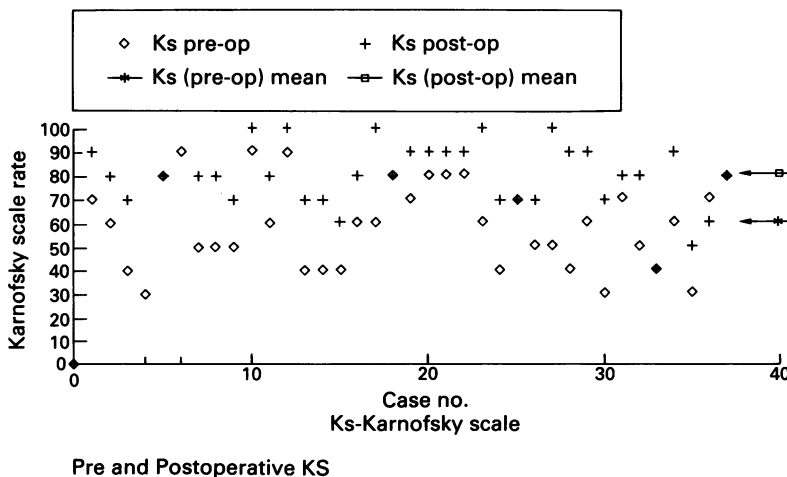


Figure 2 Pre and postoperative Karnofsky scale rate in 37 elderly patients. The arrows at the right side of the figure point to the level of the mean values.

Table 2 Karnofsky rating scale<sup>7</sup>

Score	Finding
100	Normal; no complaints; no evidence of disease
90	Able to carry on normal activity; minor signs or symptoms of disease
80	Normal activity with effort; some signs or symptoms of disease
70	Cares for self; unable to carry on normal activity or to do active work
60	Requires occasional assistance but is able to care for most of his needs
50	Requires considerable assistance and frequent medical care
40	Disabled; requires special medical care and assistance
30	Severely disabled; hospitalisation is indicated, although death is not imminent
20	Very sick; hospitalisation necessary; active supportive treatment necessary
10	Moribund; fatal processes progressing rapidly
0	Dead

Table 3 Associated diseases in elderly patients with a meningioma

Disease	Number	Patients percentage
Hypertension	13	35
Ischaemic heart disease	8	22
Chronic obstructive pulmonary disease	7	19
Diabetes	5	14
Chronic heart failure	4	11
State after myocardial infarction	3	8
Cardiac arrhythmia	2	5
Squamous cell carcinoma	2	5
No associated disease	10	27

using Student's paired *t* test, and were considered significantly different if  $p < 0.05$ .

Preoperative sedation with diazepam ranged from 0 to 10 mg depending on the general and neurological status. Intra-anaesthetic monitoring consisted of EKG, pulse oximetry (from 1986), capnography, direct intra-arterial catheter blood pressure measurement, urine output, and muscle twitch response to peripheral nerve stimulation.

Anaesthesia was induced with intravenous thiopentone, a narcotic, a non depolarising muscle relaxant and lidocaine. Following oro-tracheal intubation, patients were hyperventilated to a PaCO<sub>2</sub> of 28 to 30 mmHg and anaesthesia was with nitrous-oxide/oxygen and halothane or isoflurane. Mannitol 20% and dexamethasone were administered if indicated. Intraoperative prophylactic antibiotics consisted of gentamicin 2 mg/kg and vancomycin 10 mg/kg. Intraoperatively fluid replacement was with lactated Ringer's solution, whole blood or Hemacel (gelatine fragments), given according to haemodynamic findings, blood loss and urine output.

Postoperatively, intracranial pressure (ICP) was monitored, according to a protocol previously reported.<sup>8</sup>

**Results**

**Operative Mortality** Two patients died soon after operation, for an operative mortality rate of 5.4%. One patient with a foramen magnum meningioma and lower cranial nerve palsies died from aspiration pneumonia. The other patient, after sub-total removal of a tuberc-

Table 4 Intracranial meningiomas in the elderly

Case number	Patient sex/age	Previous medical history	Duration of symptoms	Tumour location	KS (Preop)	Tumour resection	Length of anaesthesia	Extubation (as)	Postoperative course	Discharge (as)	KS (Postop)	Follow up period
1	M/70 y	COPD; CIHD; MI; Diabetes	1 year	Convexity	70	Total	8 hours	Immediate	Uneventful	11 days	90	8 y
2	F/73 y	Not relevant	3 years	Convexity	60	Total	6 hours	Immediate	Uneventful	13 days	80	4 y
3	F/70 y	Not relevant	1½ years	Falx	40	Total	5½ hours	3 days	Transient quadriparesis DVT; Pneumonia	6 weeks	70	7 y
4	F/72 y	COPD	1 year	Foramen magnum	30	Total	10 hours	No	Aspiration pneumonia MI; Death	—	—	—
5	M/72 y	Hypertension	5 months	Falx (r)	80	Total	4½ hours	Immediate	Uneventful	10 days	80	6 y
6	M/71 y	Hypertension	6 months	Tuberculum sellae	90	Subtotal	NA	No	Brain oedema; Epidural haematoma; Cardiac arrhythmia; Death	—	—	—
7	F/73 y	Not relevant	2 months	Tentorial (r)	50	Total	7 hours	Few hours	Uneventful	13 days	80	8 y
8	F/80 y	Not relevant	4 months	Parasagittal	50	Total	4 hours	Few hours	Uneventful	8 days	80	4 y
9	F/70 y	CIHD	2 months	Sphenoid wing	50	Subtotal	4 hours	Few hours	Uneventful	10 days	70	4 y
10	F/72 y	Not relevant	6 months	Olfactory groove	90	Total	5 hours	Few hours	Transient hyponatraemia	26 days	100	5 y
11	F/73 y	Hypertension; CIHD	1 year	Convexity (r)	60	Total	7 hours	Few hours	Uneventful	10 days	80	5 y
12	M/72 y	Hypertension CHF	4 months	Convexity	90	Total	4 hours	Immediate	Uneventful	5 days	100	5 y
13	M/70 y	Hypertension CIHD	1 month	Convexity (r)	40	Total	NA	Few hours	Postop haematoma; Transitory hemiparesis; Wound infection	6 weeks	70	1 y
14	M/70 y	Not relevant	4 years	Falx	40	Total	8 hours	Few hours	PE; Pneumonia; Upper gastrointestinal bleeding	6 weeks	70	3 y
15	F/77 y	Hypertension CIHD; Diabetes	1½ years	Convexity	40	Total	4 hours	Few hours	Pneumonia—Status epilepticus; Hemiparesis	23 days	60	3 y
16	F/73 y	Not relevant	1 year	Convexity	60	Total	5 hours	Few hours	Uneventful	10 days	80	1 y
17	F/77 y	CHF	6 months	Petrous bone	60	Total	9 hours	12 hours	Uneventful	11 days	100	3 y
18	F/77 y	Hypertension; CHF	8 months	Petroclival	80	Subtotal	10 hours	12 hours	Uneventful	15 days	80	1 y
19	F/72 y	COPD	2 months	Parasagittal	70	Total	5 hours	Few hours	Uneventful	8 days	90	1 y
20	F/72 y	Not relevant	4 years	Falx	80	Total	6 hours	Immediate	Uneventful	8 days	90	2 y
21	M/76 y	Scalp radianon in childhood; Squamous cell carcinoma	2 months	Convexity	80	Total	6 hours	Few hours	CSF leak	21 days	90	2 y
22	M/78 y	Hypertension; Diabetes; Peptic ulcer	6 weeks	Subfrontal	80	Total	5 hours	Immediate	Uneventful	14 days	90	2 y
23	F/74 y	Squamous cell carcinoma; COPD	3 months	Falx	60	Total	5 hours	Immediate	Uneventful	10 days	100	1½ y
24	M/79 y	TBC; Toxic hepatitis; COPD	7 weeks	Parasagittal	40	Total	6 hours	Few hours	Uneventful	8 days	70	10 months
25	F/74 y	Scalp radiation in childhood	5 years	Parasagittal (r)	70	Subtotal (radical)	6 hours	Immediate	Hydrocephalus; VP shunt	18 days	70	1 y
26	M/70 y	Hypertension; Hypercholesterolemia; COPD	1 month	Convexity	50	Total	5 hours	Few hours	Transient hemiparesis	14 days	70	1 y
27	F/73 y	Hypertension Cardiac arrhythmia; Varicose veins	1 month	Parasagittal	50	Subtotal (radical)	6½ hours	48 hours	First 24 hours unconscious; Severe brain oedema	10 days	100	1 y
28	M/70 y	CIHD; MI × 2; CHF	2 years	Parasagittal	40	Total	5 hours	Few hours	Uneventful	8 days	100	9 months
29	M/78 y	CIHD; Diabetes; Obesity	3 years	Olfactory groove	60	Total	12 hours	24 hours	First 24 hours metabolic acidosis; Atrial fibrillation	11 days	90	8 months
30	M/70 y	CIHD; MI × 4; Left ventricle aneurysm; Hypertension; Diabetes; Nephrolithiasis	6 months	Convexity	30	Total	8½ hours	20 days	Status epilepticus; Septic shock × 3; Unconscious 3 weeks	37 days	90	7 months
31	F/72 y	Scalp radiation in childhood	5 years	Parasagittal	70	Subtotal (radical)	5½ hours	Immediate	Uneventful	14 days	70	8 months
32	M/83 y	Cardiac arrhythmia	1½ year	Falx	50	Total	6 hours	Immediate	Uneventful	10 days	80	7 months
33	M/80 y	Chronic alcoholicist; COPD	1 year	Sphenoid wing	40	Total	5½ hours	Immediate	Uneventful	12 days	40	7 months
34	M/82 y	Not relevant	1½ year	Parasagittal	60	Subtotal (radical)	9 hours	Few hours	Uneventful	20 days	90	6 months
35	F/86 y	Scalp radiation childhood	5 months	Sphenoid wing	30	Subtotal	5 hours	10 days	Post op haematoma; Septic shock; Hemiparesis	40 days	50	6 months
36	M/70 y	Hypertension	10 months	Parasagittal	70	Total	6½ hours	Immediate	Moderate monoparesis	15 days	60	6 months
37	F/70 y	Hypertension	5 months	Tuberculum sellae	80	Total	10 hours	12 hours	Uneventful	10 days	80	6 months

as = after surgery; CHF = Congestive heart failure; CIHD = Chronic ischaemic heart disease; COPD = Chronic obstructive pulmonary disease; CSF = Cerebro-spinal fluid; DVT = Deep vein thrombosis; IADH = Inappropriate antidiuretic hormone secretion; KS = Karnofsky scale; MI = Myocardial infarct; NA = Not available; PE = Pulmonary emboli; postop = postoperative; preop = preoperative; r = recurrent; TBC = Tuberculosis; VP shunt = Ventriculo-peritoneal shunt; y = years.

ulum sellae meningioma, had severe peritumoural brain oedema and a postoperative epidural haematoma. Both patients were operated on during the first year of this study.

**Tumour removal** The extent of tumour resected was mainly influenced by its location not its size. The extent of resection was judged to be total in 28 (76%) patients and subtotal in 9 (24%). The patients with subtotally removed tumours included 4 patients with a parasagittal lesion invading the superior sagittal sinus who

had a radical excision but without resection of the invaded but patent sagittal sinus.

**Length of anaesthesia** The length of anaesthesia during the surgical procedure ranged from 4 to 12 hours (mean 6.4) and no correlation was found between this feature and the outcome of the operation. Extubation in most of the cases (15/37) was carried out in the neurosurgical intensive care unit, a few hours (< 6) after surgery. Immediate extubation in the operating room was the next most frequent

Table 5 Postoperative complications in 15 (40.5%) of 37 patients with intracranial meningioma

Complications	Number of cases
<b>Major</b>	
Pneumonia	4
Postoperative haematoma	3
Permanent motor weakness	3
Severe brain oedema	2
Cardiac arrhythmia	2
Status epilepticus	2
Septic shock	2
Myocardial infarct	1
Pulmonary embolism	1
<b>Minor</b>	
Transitory motor weakness	3
Deep vein thrombosis	1
Transitory hyponatremia	1
Wound infection	1
Cerebrospinal fluid leak	1
Hydrocephalus	1
Transitory metabolic acidosis	1

practice (12/37). Controlled ventilation was maintained for longer periods in those patients having some kind of complication (table 4).

**Complications** The postoperative complications are summarised in table 5. There were 20 major complications in 8 patients (including those who died) and 9 minor complications in 7 patients. Except for the two patients who died (cases 4 and 6), and the three with a persistent motor weakness (cases 15, 35 and 36), all the other patients improved during the follow up period. The time of discharge from the hospital was closely related to the postoperative status and ranged from 5 to 42 days after operation (mean 16.5) table 4.

**Follow up evaluation** Thirty five of the 37 patients who survived the early postoperative period have been followed for a mean of 29 months postoperatively (range 6 to 96 months). The quality of survival was assessed and graded according to the Karnofsky Scale (KS) score.<sup>7</sup> At the latest evaluation the results were: excellent (KS 90-100) 39%, good (KS 70-80) 49%, fair (KS 60) 6%, and poor (KS 0-50) 6%. The mean preoperative KS value was 59 and the mean postoperative KS value 80. The difference was statistically significant ( $p < 0.001$ ). Two patients with a postoperative KS of 80 (cases 8 and 18) died from myocardial infarction four and one year after surgery respectively).

## Discussion

It is recognised that the incidence of intracranial meningiomas increase in the ageing population.<sup>3 9 10</sup> With the introduction of CT,

the diagnosis of an asymptomatic, incidental meningioma is not infrequent in the elderly patient. From 300 tumours found incidentally at necropsy, 33% were meningiomas and they occurred most frequently among individuals who were in the seventh or eighth decade of life.<sup>11</sup> The diagnosis of brain tumour in the elderly patient may be complicated because of difficulties inherent in distinguishing between neurological changes owing to age and those resulting from the lesion itself.<sup>6</sup> Healthy elderly people frequently have a stooped posture and a slowed gait with some Parkinsonian features. Hand steadiness is reduced, postural tremor is frequent and coordination and balance are impaired.<sup>12</sup> Dementia which was present in 14 (38%) of our patients (table 1) is not infrequent in the aged and the differentiation from Alzheimer's disease is vital. The absence of signs of rise ICP is not helpful due to cerebral atrophy which leads to a paucity of symptoms and signs of intracranial hypertension in the elderly patient with a brain tumour. The absence of papilloedema was a consistent feature in this study.

There are few studies in the literature that deal with the outcome of surgery in older patients with an intracranial meningioma. In most of these series the lower age limit ranged from 60-65; only two studies, previous to ours, discuss specifically the results in the "truly" elderly patient aged 70 and over (table 6). In Cushing's series of 295 intracranial meningiomas approximately one third first came under observation during the fifth decade with an average age of 46.6 years. Three patients were older than 70; one 86 year old patient died two days after surgery (case 66) and the other two patients aged 72 and 74 years (cases 99 and 281) survived five and six years after operation respectively.<sup>13</sup> More recently, Awad *et al.*<sup>14</sup> reported an operative mortality of 6.7% with the best outcome in patients without advanced neurological symptoms pre-operatively and in patients with meningioma located over the cerebral convexity. In the latter series, 16 (21%) patients were asymptomatic and no patient was severely disabled before operation. In our series, all the patients were symptomatic before operation and except for one case with a tuberculum sellae meningioma (case 6) the tumour size was larger than 3 cm in all cases. Smaller lesions in relatively asymptomatic patients in this age group were considered incidental findings and were not treated surgically. Seizures alone were not an indication for surgery.

The high operative mortality reported in most previous studies (table 6) has led to reservations about operations upon an elderly patient with an intracranial meningioma. Results found in a review of the literature that prompted us to review our own experience which showed only two operative deaths, a mortality rate of 5.4%. Both deaths reflected complications from operation: aspiration pneumonia caused by postoperative lower cranial nerves palsy (case 4) and the combined effect of a postoperative epidural haematoma and brain oedema (case 6).

Table 6 Series of intracranial meningiomas in the elderly reported in the literature

Authors and Year (reference)	Patient's age (years)	Number of patients operated	Operative mortality*
Cushing and Eisenhardt, 1938 <sup>13</sup>	> 60	17	17.6%
Stewart <i>et al.</i> , 1975 <sup>3</sup>	> 65	9	11.1%
Tomita and Raimondi 1981 <sup>6</sup>	> 65	14	7.1%
Papo 1983 <sup>17</sup>	> 65	29	55.1%
Diemath <i>et al.</i> , 1984 <sup>4</sup>	> 65	29	13.7%
Entzian <i>et al.</i> , 1984 <sup>3</sup>	> 59	61	29.5%
Mehdorn <i>et al.</i> , 1984 <sup>18</sup>	> 70	15	40.0%
Djindjian <i>et al.</i> , 1988 <sup>19</sup>	> 70	30	37.0%
Awad <i>et al.</i> , 1989 <sup>14</sup>	> 60	75	6.7%
Umansky <i>et al.</i> , 1990	> 70	37	5.4%

\*Up to 90 days after surgery

There were postoperative complications in 13 of the surviving 35 patients for an overall operative morbidity of 37%. Most complications (table 5) were related to surgical manipulation, for example, postoperative haematoma, permanent motor weakness, severe brain oedema, and status epilepticus. Obviously, these complications are not related to the age of the subjects. Cardiovascular disease was the most common associated illness but did not generally affect the results and only three patients had a cardiac complication in the postoperative period.

In survivors, the quality of life as assessed at the last follow up examination was excellent (KS 90–100) in 39%; good (KS 70–80) in 49%; fair (KS 60) in 6%; and poor (KS 40–50) in 6%. In general, those patients with a low KS rate (KS < 40) on admission presented a more complicated postoperative course than those who were in good physical condition before surgery.

Emergency surgery is more risky in the elderly;<sup>15</sup> none of our patients experienced operation on an emergency basis. Each had meticulous preoperative evaluation of the cardiovascular, respiratory, metabolic, and renal function. During operation, special attention was given to the maintenance of an adequate intravascular volume to avoid hypotension.

Residual tumour was left when removal was risky and in none of the patients with a parasagittal meningioma with partial superior sagittal sinus invasion, was the sinus or any significant cortical draining vein sacrificed.

There is a general belief that the elderly patient will not tolerate a long procedure as well as a young patient.<sup>16</sup> In our study, the length of anaesthesia during the surgical procedure varied from 4 to 12 hours (mean = 6.4) and did not correlate with the surgical outcome. Extubation was performed less than 6 hours after surgery in 73% of the cases. Longer periods of ventilation were required in patients with some kind of complication (table 4).

After operation, the patients were treated in a neurosurgical intensive care unit (NICU) and intracranial pressure was monitored according to a protocol previously reported.<sup>8</sup> This was to detect those patients in whom intracranial hypertension may precede clinical deterioration, especially when clinical examination is difficult because of the effects of anaesthesia or operation. Intracranial pressure measurement can never replace vigilant clinical monitoring but may, however, complement it.<sup>8</sup>

Early mobilisation, starting as soon as one day after operation, should benefit function in the elderly patient and prevent deep vein

thrombosis, but also will exert a profound psychological effect so necessary at this age.

In summary, age alone is not a contra-indication for surgery. Patients in a poor preoperative neurological condition (KS < 40) had a more complicated postoperative course, but retained a good chance for improving their quality of life. On the other hand, major complications were closely related to surgical manipulation, a factor which is not age dependent. From our results, we strongly support a more aggressive therapeutic approach for the elderly patient with an intracranial meningioma. Careful perioperative management, well conducted anaesthesia, and meticulous surgical technique will allow more neurosurgical procedures to be carried out quite safely in the ageing population.

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