

Full Length Research Paper

Meningiomas: Quality of life before and after surgery

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Evaluation of the quality of life before and after the development at three, six and twelve months intervals from meningioma resection was considered. A prospective study was carried out with 29 patients carrying benign meningioma, whose ages ranged from 28 to 76 years old. In order to evaluate the quality of life, two instruments were used: the Nottingham Health Profile (NHP) and the Innsbruck Health Dimensions Questionnaire for Neurosurgical Patients (IHD-NS). Meaningful differences were found between the NHP and the IHD-NS total score, when comparing the evaluations before and after intervention. A significant improvement in pain, emotional reaction, physical ability, sleepiness, communication, physical condition, independence and the psychological condition domains was noticed. It was possible to observe that patients who had meningiomas in the left hemisphere have shown higher symptomatology, but those were also the ones who have shown significant reduction of the symptoms after the surgical intervention. Patients who undertook surgical intervention for the meningioma resection presented a significant improvement in their quality of life. A meaningful improvement took place up to the first three months. There was then a tendency to stabilize between three to six months (because of a rise in the Emotional Reactions Domain) and thereafter there was a reduction in new symptom taking place up to twelve months from intervention. Taking this study into consideration it seems beneficial to recommend psychotherapy intervention after three months from surgery.

Key words: Quality of life, intracranial tumor, meningioma, psychology.

INTRODUCTION

Over the last decades we have observed a growing interest in Quality of Life (QOL), to evaluate not only the effectiveness and efficiency, but also the impact of certain treatments, and the physical and psychosocial impact that these diseases exert on people.

Meningiomas are extra-axial meninges tumors, with a slow growth rate, and most of them are benign. They are

most often diagnosed in female patients, with ages ranging from 20 to 60 years old (Black, 1993). They may be symptomatic or asymptomatic, depending on their location, size and degree of cerebral edema. When symptomatic they can cause motor deficits, aphasia, visual loss, seizures, intracranial hypertension, and cognitive deficits, amongst others (Santana et al., 2002; Figueiredo et al., 1998). Treatment for the meningioma is surgical, whereas the approach and extension of the resection depends on the tumor's location. After surgical treatment, studies point out that the patient lives between 8 to 10 years more (Chan and Thompson, 1984;

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Mirimanoff et al., 1985; Simpson, 1957), and the QOL improves (Arienta et al., 1992; Chan and Thompson, 1984; Hernández and Rodriguez, 2004; Kalkanis et al., 2000; Mohsenipour et al., 2001; Neil-Dwyer et al., 2000; Sachsenheimer et al., 1992; Yamashiro et al., 2007) and the death rate ranges from 7 to 14% in different levels (Rachlin and Roseblum, 1991).

The concept of QOL is diverse and complex as it involves objective and subjective aspects, being physical, social and emotional. Authors state that QOL "is not only the level of function but also the level of satisfaction within this" (Chibnall and Tait, 1990). It would be a "multidimensional construct that reflects the individual's daily function ability, social support, emotional understanding and lack of psychological discomfort" (McDonough et al., 1996). An important definition in literature about the term, points to the term QOL as the "state of well-being that includes the ability to perform daily activities and the satisfaction performances and control of the disease and / or treatment of related symptoms (Gotay and Moore, 1992).

Numerous studies indicate that factors such as age (Sachsenheimer and Bimmler, 1992), size, location (Kozler et al., 2007; Salo et al., 2002), histology, excision grade and the pre-operative condition (Chan and Thompson, 1984), are all matters of great importance when considering the QOL together with the period the patient lives after meningioma surgery. It is also shown that modifications in physical conditions, energy level (Mohsenipour et al., 2001), depressive symptoms and behavioral disturbances (Mohsenipour et al., 2001; Sachsenheimer and Bimmler, 1992; Wertenbroek et al., 2006) may occur, however the surgical intervention does not have a negative impact on the QOL, even in asymptomatic patients, as long as there are no complications during surgery (Yamashiro et al., 2007). As an element of interference in the QOL evaluation, authors refer to the presence of other diseases and the senescence effects (Mohsenipour et al., 2001).

Most studies in literature that evaluate the QOL are based on clinical observation and indices (Karnofsky et al., 1948). There are few studies that use specific scales for assessing the QOL and no studies of prospective evaluation where the patient was evaluated before surgery and systematically reassessed after the procedure.

The current study aimed the thorough verification of the QOL in patients with meningiomas before and after surgical procedure. Neurosurgical studies indicate an improvement in clinical symptoms after intervention and therefore report improvement in QOL, based on professional evaluation. However, the concept of QOL encompasses not only issues related to the disease but also subjective aspects, those related to the perception of the person in relation to his/her current state (Schiestel

and Ryan, 2009). Therefore, this study aims to understand the QOL in its broadest sense, at different times of patient treatment and with specific instruments for such evaluation.

PATIENTS AND METHODS

104 cases of supratentorial meningiomas were surgically treated between 2005 and 2009. The main approaches for tentorial meningiomas were parietooccipital, and temporal craniotomies, and for parasagittal and convexity, the craniotomy was performed in the high point where the tumor is placed and the craniotomy is accomplished surrounding the complete border of tumor and dural tail. For left ventricular tumor the approach is parieto occipital avoiding deep speech areas and in the right side is temporal through the middle and superior girus.

For the present study 29 voluntary patients of both genders were selected and operated on during the period between 2005 and 2009 (17 women – 59% and 12 men – 41%), whose ages ranged from 28 to 76 years old, amongst them were 14 up to 55 years old (48%) and 15 being 55 years old or more (52%). As to their educational level, 17 patients had up to 8 years of study (59%) and 12 patients more than 8 years of study (41%).

These patients were surgically treated (22 patients with Complete Resection – 76% and 7 patients with Partial Resection – 24%) and in all cases anatomopathological examination showed meningioma grade 1 (WHO, 1993). They were all supratentorial, 16 patients on the right side (55%) and 13 on the left side (45%).

Patients that presented meningiomas grade 2 and 3 (WHO, 1993), infratentorial, neurofibromatosis, intra-axial tumors, recidivism, co morbidities that affected the encephalon and a history of depression and high scores in the HAD (Botega et al., 1995) diagnosis aid rate for depression and anxiety, were excluded from the sample. Patients that showed lighter symptoms of depression stayed in the study.

In order to investigate the patients' symptoms and thus their QOL, four prospective evaluations were made, before surgery, after three months (to minimize the impact of secondary alterations to immediate postsurgical) and six to twelve months from intervention. The data collection was kept at the Tumor Group's outpatient clinic, at the Department of Neurology of the São Paulo Medical School Teaching Hospital -, from 2006 to 2009. All patients have signed a Free Informed Term of Consent (FITC).

The choice of instruments was based on the article "Quality of Life in Patients after meningioma resection," published by Mohsenipour et al. (2001) in which the author developed an assessment tool for neurosurgical patients QOL. With the objective of using the Innsbruck Health Dimensions Questionnaire for Neurosurgical Patients (IHD-NS) and of adapting a cultural change for the Brazilian population, we chose to use the Nottingham Health Profile (NHP), as a tool for general assessment of QOL, as this showed good correlation with the instrument IHD-NS. The following instruments were applied:

- Nottingham Health Profile (NHP) (Teixeira-Samela et al., 2004) – generic instrument to appraise the QOL, which provides a simple means to measure the individuals' physical, social and emotional health. This is a tool adapted for the Brazilian population. It's development is based on the classification of disability as described by the World Health Organization (WHO) and is considered to be clinically valid in distinguishing patients with different levels of dysfunction and to detect significant changes in the patients health overtime.

Table 1. Average and standard deviation in the four moments of the NHP Total Score.

	Before	3 months	6 months	12 months	Friedman (p)
Average	9.07	5.66	5.14	4.07	
Standard deviation	9.01	5.68	5.40	4.53	0.00003 *
N	29	29	29	29	

Table 2. Average and standard deviation in the four moments of the IHD-NS Total Score.

	Before	3 months	6 months	12 months	Friedman (p)
Average	11.66	8.52	7.24	6.76	
Standard deviation	5.31	5.06	5.16	5.06	<0.0001 *
N	29	29	29	29	

-Questionário de Dimensões de Saúde para Pacientes Neurocirúrgicos de Innsbruck DSI – NC (Santos et al., 2008) (Innsbruck Health Dimensions Questionnaire for Neurosurgical Patients IHD-NS, Mohsenipour et al., 2001) – instrument developed to evaluate neurosurgical patients quality of life. This is composed of aspects, physical, social and emotional. The trans-cultural instrument proved to have quality, consistency and to be trustworthy in the Portuguese version and included a high agreement index with no erratic items in its composition (Santos et al., 2008).

Both questionnaires were conducted by the author seeking to minimize the impact of lower school education and the question of misunderstandings. It is worth emphasizing that the patients QOL is directly related to the presence and severity of symptoms, therefore, the more severe the symptoms are, the worse the QOL is and a reduction in the symptoms will indicate an improvement in the QOL.

For statistical analysis the non-parametric Friedman tests were applied, to compare moments; and Mann-Whitney tests to compare groups. The level of significance was 5%.

RESULTS

QOL analysis before and after surgery through NHP and IHD-NS, indicated the following results:

As regards education and sex no significant differences were observed. As to age both groups presented significant improvement DSI(NC), however only the group up to 55 years showed significant improvement in PSN. The group 55 years up had a tendency to improve. When analyzing the QOL and the tumor location, significant differences are not noticeable; however we realize that patients with meningioma on the left hemisphere present more symptoms, although they seem to show a more intense improvement than the patients with meningioma on the right hemisphere in one of the scales (NHP). Concerning the resection grade, it was not established as

being relevant.

Differences between the groups (total and partial resection)

We noticed that patients who were submitted to a total resection presented a solid improvement of their QOL, dissimilar to the partial resection group.

After studying the total scores of both scales, that represent the individual QOL, gathering all the domains evaluated from NHP and from IHD-NS, relevant differences were noticed when taking into account the patients` development before and after surgery. Through multi comparisons it was observed that the QOL improves significantly after surgery, that is to say, in the first three months, and continues to improve after six months from intervention (Tables 1 and 2).

When analyzing the patients evolution, comparing the before, and the after three, six and twelve months evaluations, in the domains that compose the NHP scale (Table 3), we observe a statistically meaningful improvement in the following domains: pain, emotional reaction, sleepiness and physical abilities. We do not notice relevant differences in energy level and social isolation domains.

In the IHD-NS scale (Table 4), the communication, physical condition, independence and psychological condition domains, presented statistically meaningful improvement. Relevant differences were not evident in the autonomic nervous system function nor in the social isolation domain.

DISCUSSION

Few studies are presented in the literature relating to

Table 3. Average and standard deviation in the four moments of the NHP Domains.

	NHP – Energy Level Domain				Friedman (p)
	Before	3 months	6 months	12 months	
Average	0.48	0.45	0.52	0.41	
Standard deviation	0.74	0.83	0.91	0.82	0.7212
NHP – Pain domain					
Average	1.90	1.24	0.66	0.38	
Standard deviation	2.64	1.92	1.42	0.94	0.0001 *
NHP – Emotional reactions domain					
Average	2.90	1.62	2.10	1.55	
Standard deviation	2.27	1.82	2.30	1.84	0.0005 *
NHP – Sleepiness domain					
Average	1.07	0.38	0.28	0.45	
Standard deviation	1.58	0.82	0.75	0.83	0.0014 *
NHP – Social isolation domain					
Average	1.24	0.86	0.90	0.76	
Standard deviation	1.86	1.13	1.40	1.27	0.1849
NHP – Physical abilities domain					
Average	1.48	1.10	0.69	0.52	
Standard deviation	3.02	1.54	1.20	1.06	0.0050 *

Individual analysis of each NHP domain shows significant improvement of the symptoms in Pain, Emotional Reactions, Sleepiness and Physical Abilities, pre-surgical, 3 months, 6 months and 12 months after surgery evaluations are compared.

people with meningiomas and QOL and the methodology used to measure the quality of life, without classifying the periods of the evaluation and the Karnofsky (Karnofsky et al., 1948) index used as an evaluation system, disabled greater correlations within this study.

Elements such as, the presence of other diseases and the senescence process effects, pointed out by Mohsenipour et al. (2001), were also difficult to isolate in our results, as the QOL instruments do not allow the distinction from the presented disease.

Though the sample size does not allow further analysis concerning location, we may compare the before and after surgery QOL with the meningioma side. In spite of the fact that we do not find relevant differences in either scale, we noticed that patients with meningioma on the left hemisphere presented larger symptomatology, which means, a worsening of QOL as opposed to patients with meningioma on the right hemisphere. This difference is related to the fact that the meningioma is possibly in contact with noble areas of the brain, the language area for instance, causing a worse QOL due to a greater

impact in the patients' interpersonal relations and daily routine (Kozler et al., 2007). We also observed that patients with meningiomas on the left hemisphere seem to present a larger reduction of the symptoms after surgery, probably because of the removal of the tumor that was having an impact against the noble areas causing more intense symptoms. The meningioma location is a matter of greater importance for the QOL study and must be better explored in ulterior studies, as stated in the Chan and Tompson's study (Chan and Thompson, 1984).

As to the meningioma resection grade, meaningful differences were not noticed between the groups (Partial and Total Resection), however, it was observed that those who have a total resection presented a significant improvement in their QOL, dissimilar to the partial resection group. Probably the group with partial resection did not show significant improvement as they continues to present lesions and taking into consideration that the instruments evaluated the QOL and relate to the persons perception of him/herself and their actual condition, we

Table 4. Average and standard deviation in the four moments of the IHD-NS Domains.

IHD-NS – communication domain					
	Before	3 months	6 months	12 months	Friedman (p)
Average	2.00	1.52	1.41	1.24	
Standard deviation	0.93	0.91	1.05	0.95	0.0008 *
IHD-NS – Physical condition domain					
Average	3.07	1.41	1.48	1.55	
Standard deviation	2.37	1.59	1.70	2.03	0.0005 *
IHD-NS –Autonomic nervous system function domain					
Average	0.66	0.55	0.45	0.45	
Standard deviation	0.67	0.69	0.63	0.51	0.3203
IHD-NS – Independence domain					
Average	1.93	1.86	1.38	1.34	
Standard deviation	1.16	1.33	0.94	0.94	0.0330 *
IHD-NS – Psychological condition domain					
Average	2.76	2.07	1.76	1.52	
Standard deviation	2.01	2.07	1.92	1.66	0.0025 *
IHD-NS –Social isolation domain					
Average	0.90	1.00	0.72	0.66	
Standard deviation	1.23	1.10	1.25	1.01	0.2320

Individual analysis of each IHD-NS domain shows significant improvement of the symptoms in Communication, Physical Condition, Independence and Psychological Condition, pre-surgical, 3 months, 6 months and 12 months after surgery evaluations are compared.

can also consider the impact of emotional questions and reactions to the fact that they continue to present a tumor or rather, the situation has not been fully resolved and fails in the expectation of a total solution after surgical intervention.

When analyzing patients general QOL in both instruments general (NHP) and specific (IHD-NS), gathering every domain in its composition, we verified that patients submitted to a surgical intervention for meningioma removal presented relevant improvement of QOL as a whole (Figures 1 and 2). These discoveries are strengthened by studies found in literature, which point out meaningful symptom reduction (Sachsenheimer and Bimmler, 1992) and QOL improvement (Arienta et al., 1992; Kalkanis et al., 2000; Miao et al., 2010) after meningioma surgery.

It is also noted in the scale total score analysis, that greater symptoms reduction takes place up to the first three months, between three and six months the situation tends to settle and then new symptom reductions occur up to twelve months (Figures 1 and 2).

From the qualitative point of view, during the six months surgery interval, it may be observed that the

majority of the patients referred to an important improvement after surgery, but that some difficulties remained and they were still not able to resume their normal activities. These comments make us consider that these patients have great expectations about the surgery, believing it to be complete banishment of the symptoms, and the important improvement after the procedure reinforces these expectations. Nonetheless, when noticing that some difficulties and/or symptoms remain, these patients become saddened and discouraged and their symptoms end up having an influence on their perception of the general situation, since the QOL gathers factors such as: perception, satisfaction and well-being (Chibnall and Tait, 1990; Gotay and Moore, 1992; Guiteras and Bayés, 1993).

The intenseness of the emotional difficulties after six months surgery, was evident in the Emotional Reactions Domain from NHP scale (things are getting me down, depressing me/ I forgot how to have fun/ I feel extremely annoyed/ the days seem too long/ I am losing my temper easily lately/ I feel like losing control/ the concerns are keeping me up all night/ I feel life is not worth living/ I wake up feeling depressed), and where the symptoms

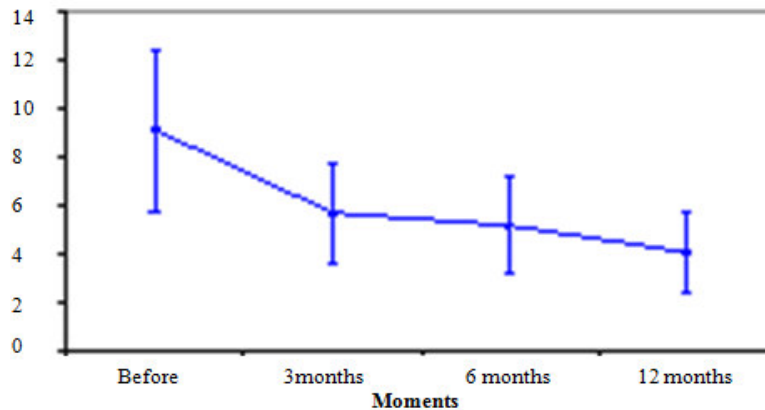


Figure 1. Analysis of the four moments in the NHP Total Score (before and after three, six and twelve months from surgery). Analyzing NHP total score in relation to QOL, comprising all the domains evaluated, significant differences have been observed in regards to its development at the four moments: pre-surgical, 3 months, 6 months and 12 months after surgery (Table 1 and Figure 1).

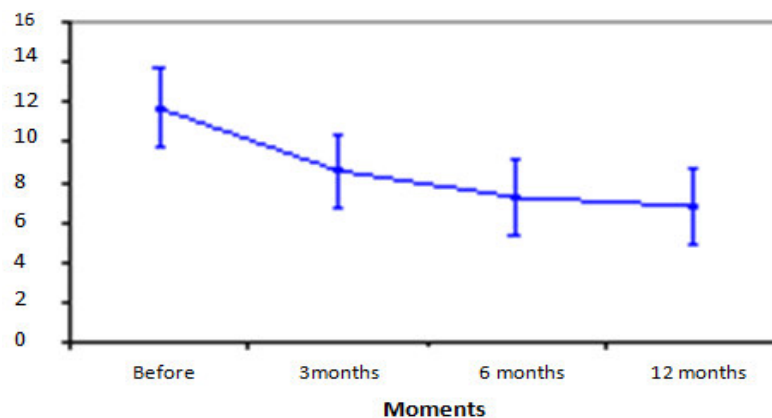


Figure 2. Analysis of the four moments in the IHD-NS Total Score (before and after three, six and twelve months from surgery). Analyzing IHD-NS total score in relation to QOL, comprising all the domains evaluated, significant differences have been observed in regards to its development at the four moments: pre-surgical, 3 months, 6 months and 12 months after surgery (Table 2 and Figure 2).

get considerably higher (Table 3). The symptoms possibly show an affect on the Energy Level domain (I get tired all the time/ everything demands too much effort / I get powerless easily) (Table 3) and, therefore, the instrument global score, justifying the tendency to stabilize the situation between three and six months after the meningioma resection (Figure 1). It seems relevant to consider a psychotherapeutic intervention hypothesis after three months from surgery, aiming to prevent emotional and effective changes, and regular evaluations of these symptoms to, if it is necessary to undergo medical treatment. High depressive symptomatology was encountered by Sachsenheimer and Bimmler (1992),

before as well as after surgical intervention.

It is noteworthy that between six and twelve months a new reduction of the symptoms took place, possibly linked to the acceptance of some pre-existing difficulties, as observed in interviews (Figure 1).

These findings were not noted in the psychological areas of IHD-NS probably due to the fact that although the instruments are composed of similar domains, they are designed for different questions in relation to the emotional state.

When comparing the QOL before surgery with the NHP twelve months evaluation, we notice meaningful improvement, in total score (Table 1) that reflects global

QOL, as well as, in the domains (Pain, Emotional reaction, Sleepiness and Physical Abilities). As the first post-surgical evaluation was performed after three months of the intervention it was not possible to observe the impact of the surgery or side effects such as craniotomy pain or peri-incisional edema. There was an observed improvement in the Pain domain at the three month evaluation but this was probably related to the removal of the tumor. Evidence of significant improvements were also observed in Social Interaction and Energy Level domains. The improvement was less evident in the Energy Level domain (Table 3). Mohsenipour et al. (2001) also testified to variances in this domain.

However, in the specific instrument IHD-NS, we verified meaningful improvement in the total score (Table 2) and in the communication, physical condition, independence and the Psychological Condition dimensions when comparing the before and after twelve months from surgical intervention evaluations. A tendency for improvement was observed after the meningioma removal only in Social Isolation and Autonomic Nervous System Function domains (Table 4). This study displayed different results from those reported by Mohsenipour et al. (2001) that evidence was restricted to severe damage in Physical Condition domain.

Conclusion

The present study allowed us to conclude that patients who undergo surgical intervention for the resection of meningiomas presented meaningful improvement in their QOL. It is also noticed that the QOL improvement, that is, symptom reduction, takes place more intensively up to three months after surgery, between three and six months the situation tends to settle and a new reduction takes place up to twelve months.

The stabilized situation at six months seems to be linked to emotional and effective aspects, as well as to symptoms that arise in the Emotional Reaction domain, making it relevant to consider a psychotherapeutic intervention. Hypothesis after three months from surgery, aim to prevent emotional and affective changes, and regular evaluation of these symptoms, if necessary, to undergo medical treatment. After twelve months from the meningioma removal the patients meaningfully improved in the Pain, Emotional Reactions, Sleepiness, Physical Abilities, Communication, Physical Condition, Independence and Psychological Condition dimensions. In the remaining dimensions (Autonomic Nervous System, Function, Energy Level, Isolation and Social Interaction) we observe a tendency, thought not significant, to reduce symptoms (QOL improvement).

Studies that specifically look at the emotional aspect

with prospective evaluations could better elaborate this question – as well as conducting evaluations both pre and post psychotherapeutic and/or drug therapy to verify the importance of a specific treatment over a period of time to improve the QOL of patients during their recovery.

This study featured were limited due to the size of the sample, this made it difficult for a more specific analysis concerning factors such as age, level of school education, size of tumor, grade of edema, resection grade and meningiomas location. Even so, it was possible to observe that patients who had meningiomas in the left hemisphere show higher symptomatology, but those were also the ones who have shown significant reduction of the symptoms after the surgical intervention.

The presence of co-morbidities possibly interfered in the results obtained in this work, since the QOL instruments do not allow the distinction from existing diseases.

REFERENCES

- Arienta C, Caroli M, Balbi S (1992). Intracranial meningiomas in patients over 70 years old. Follow-up in operated and inoperable cases. *Aging (Milano)*, 4: 29-33.
- Black PM (1993). Meningiomas. *Neurosurgery*, 32: 643-657.
- Botega NJ, Bio MR, Zomignani MA, Garcia C Jr, Pereira WAB (1995). Mood disorders in hospital and the validation of the measurement of the (HAD) scale, anxiety and depression. *Rev. Saúde Pública*, 29(5): 355-363.
- Chan RC, Thompson GB (1984). Morbidity, mortality, and the QOL following surgery for intracranial meningiomas. A retrospective study in 257 cases. *J. Neurosurg.*, 60: 52-60.
- Chibnall JR, Tait RC (1990). The quality of life scale: A preliminary study with chronic pain patients. *Psychol. Health*, 4: 283-292.
- Figueiredo EG, Aguiar PH, Córdoba BF (1998). Meningiomas supratentoriais: diagnosis, surgical results and complications. *Arq Neuro-Psiquiatr.*, 56: 429-35.
- Gotay CC, Moore TD (1992). Assessing QOL in head and neck cancer. *Qual. Life Res.*, 1: 5-17.
- Guiteras AF, Bayés R (1993). Desarrollo de un instrumento para la medida de calidad de vida en enfermedades crónicas. In: Forns M, Anguera MT, organizadores. *Aportaciones recientes a la evaluación psicológica*. Barcelona: Universitat, pp. 175-195.
- Hernández EG, Rodríguez MR (2004). Meningiomas Intercranial evolution in patients treated in INNN. *Av. Med. Cuba*, 11(40): 10-11.
- Kalkanis SN, Quiñones-Hinojosa A, Buzney E, Ribaud HJ, Black PM (2000). Quality of life following surgery for intracranial meningiomas at Brigham and Women's Hospital: a study of 164 patients using a modification of the functional assessment of cancer therapy-brain questionnaire. *J. Neurooncol.*, 48: 233-241.
- Karnofsky DA, Abelmann WH, Craver LF, Burchenall JF (1948). The use of nitrogen mustard in the palliative treatment of cancer with particular reference to bronchogenic carcinoma. *Cancer*, 1: 634-656.
- Kozler P, Benes V, Netuka D, Kramár F, Charvat F (2007). Preoperative neuro-image findings as a predictor of postoperative neurological deficit in intracranial meningiomas. *Zentralbl Neurochir.*, 68(4): 190-194.
- McDonough EM, Varvares MA, Dunphy FR, Dunleavy T, Dunphy CH, Boyd JH (1996). Changes in quality of life resulted in a population of patients treated for squamous cell carcinoma of the head and neck. *Head Neck*, 18: 487-493.
- Miao Y, Lu X, Qiu Y, Lin Y (2010). A multivariate analysis of prognostic factors for health-related quality of life in patients with surgically

- managed meningioma. *J. Clin. Neurosci.*, 17(4): 446-449.
- Mirimanoff RO, Dosoretz DE, Linggood RM, Ojemann R, Martuza R (1985). Meningioma: Analysis of recurrence and progression following neurosurgical resection. *J. Neurosurg.*, 62: 18-24.
- Mohsenipour I, Deusch E, Gabl M, Hofer M, Twerdy K (2001). Quality of Life In Patients After Meningioma Resection. *Acta Neurochir. (Wien)*, 143: 547-553.
- Neil-Dwyer G, Lang DA, Davis A (2000). Outcome from complex neurosurgery: an evidence based approach. *Acta Neurochir (Wien)*, 142: 367-371.
- Rachlin JR, Roseblum ML (1991). Etiology and biology of meningiomas. In : Al-Mefty O (ed). *Meningiomas*. Nova York: Raven Press, pp. 22-37.
- Sachsenheimer W, Piotrowski W, Bimmler T (1992). Quality of life in patients with intracranial tumors on the basis of Karnofsky's performance status. *J. Neurooncol.*, 13: 177-181.
- Sachsenheimer W, Bimmler T (1992). Assessment of quality of survival in patients with surgically treated meningioma. *Neurochirurgia (Stuttg)*, 35: 133-136.
- Salo J, Niemelä A, Joukamaa M, Koivukangas J (2002). The effect of brain tumor laterality on patients' perceived quality of life. *J. Neurol. Neurosurg. Psychiat.*, 72(3): 373-377.
- Santana Jr PA, Marie SKN, Aguiar PHP (2002). Molecular Biology of meningiomas: Many unknown factors remain to be clarified. *J. Bras. Neurocirurg.*, 13: 81-86.
- Santos CB, Carvalho SCA, Silva MFG, Fuentes D, Santana PA, Furlan AB, Aguiar PHP (2008). Cross-cultural Adaptation of Innsbruck Health Dimensions Questionnaire for Neurosurgical Patients (IHD-NS). *Arq Neuropsiquiatr.*, 66(3-B): 698-701.
- Schiestel C, Ryan D (2009). Quality of life in patients with meningiomas: the true meaning of "benign". *Front Biosci. (Elite Ed)*, 1: 488-493.
- Simpson D (1957). The reoccurrence of intracranial meningiomas after surgical treatment. *J. Neurol. Neurosurg. Psychiat.*, 20: 22-39.
- Teixeira-Samela LF, Magalhães LC, Souza AC, Lima MC, Lima RCM, Goulart F (2004). Adaption of a health profile Nottingham: A simple instrument to evaluate the QOL. *Cad. Public Health*, 20: 905-914.
- Wertebroek AA, Kuiters RR, de Bruijn SF, van Woerkom TC (2006). A meningioma resulting in drastic changes in behavior and life course. *Ned Tijdschr Geneeskd*, 150(50): 2733-2738.
- WHO international histological classification of CNS tumors (1993). Springer, Berlin. Heidelberg. New York, Tokio.
- Yamashiro S, Nishi T, Koga K, Kaji M, Goto T, Muta D, Fujioka S, Kuratsu J (2007). A self assessment of quality of life in patients who underwent surgery for asymptomatic Meningiomas. *No Shinkei Geka*, 35(12): 1149-1155.