Quality of Life after Successful Epilepsy Surgery: Evaluation by Occupational Achievement and Income Acquisition

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Objectives: *A comprehensive epilepsy surgery program has been developed at Chulalongkorn University Hospital, Thailand to reach an international standard level, rendering patients good surgical outcomes comparable to developed countries. After successful operation, seizure free patients have become independent, self earning or employed. However, quality of life (QOL) in terms of occupational achievement and income acquisition after epilepsy surgery has never been studied. These indicators reflect the ultimate QOL in the aspects of actual independency, intact brain functions, mental health and psycho-social interactions. The authors therefore conduct the study on improvement of QOL after successful epilepsy surgery using these parameters.*

Material and Method: *One hundred and eleven intractable epilepsy who have become seizure free to worthwhile improved (Engel class I to III) after standard presurgical evaluation and epilepsy surgery from January 2002 to December 2004 were evaluated. The patients were followed up for 3 years. The occupational status and incomes were categorized according to the ranking of the patients' functioning levels. The pre and post surgery work abilities, employment and incomes were interviewed and compared. Mc Nemar test and paired t-test were used for statistical analyses.*

Results: *The average age of the 111 adults (54 males and 57 females) was 33.7± 9.2 years. Eighty two percent of the patients had temporal lobe epilepsy (TLE) with mesial temporal sclerosis (MTS) and underwent standard anterior temporal lobectomy. The rest had tumors, cortical dysplasia or scar and received lesionectomy or cortical resection assisted by intra-operative or intra-cranial EEG. The overall seizure free rate is 83.8 %. The occupational status of the subjects was shown to improve significantly after surgery from unemployed to higher categories of professional achievement ($p < 0.001$). The number of unemployed and no income individuals decreased from 66 to 25 cases (62.1 % reduction rate) after surgery ($p < 0.001$). Reciprocally, the number of persons who achieved professional jobs with regular incomes or salaries increase from 30 to 53 cases (43.4 % increasing rate) ($p < 0.001$). The patients who have not acquired any income increment showed improvement in working ability after epilepsy surgery. The average annual incomes per capita shows the increasing rate of 45.08 %, from 55,657.85 Baht (approximately US$ 1,390) to 80,748.15 Baht (approximately US$ 2,018), with strong statistical significance ($p < 0.001$). The improvement is best seen in seizure free than in non-seizure free subjects.*

Conclusion: *The present study, to the authors' knowledge, is the first to use work abilities, professional achievement and income acquisition to assess the ultimate QOL after epilepsy surgery. Most subjects have been shown to significantly improve their postoperative lives in terms of occupational accomplishment and income increment, especially in seizure free individuals. The need for expansion of epilepsy surgery is emphasized.*

Keywords: *QOL, Epilepsy surgery, Occupation, Income, MTLE*

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In Thailand, the epilepsy surgery program was first established as a comprehensive tertiary center at Chulalongkorn University Hospital in 1994. Advanced diagnostic and therapeutic facilities have been developed to reach international standard level so that the surgical outcomes are comparable to the global result [1]. After the surgery, seizure free and significantly improved patients have become independent. Among these are adults who have shown their abilities in working and earning not different to healthy people. However, quality of life after epilepsy surgery in these particular aspects has never been documented. The present study, therefore, aimed to determine the improvement of quality of life after successful surgery using occupational achievement and income acquisition.

Material and Method

One hundred and eleven patients who have become seizure free (Engel class I), almost seizure free (Engel class II) or worthwhile improvement (Engel class III) [2] after standard presurgical evaluation and epilepsy surgery at Chulalongkorn University Hospital from January 2002 to December 2004 were evaluated. There were 11, 26 and 74 cases of such successful operations in 2002, 2003 and 2004 respectively. All patients have been followed up for at least 6 months to the maximum of 3 years. The patients were interviewed regarding their pre and post surgery work abilities, occupation achievement and income acquisition in addition to their postoperative seizure reduction and neurological decline.

Statistical Analysis

The patients' earning status is categorized in Table 1. These occupational categories are classified according to the patients' real life situation observed post operatively. The categories are coded in the order of the functioning levels. The lower the alphabetical order of the category; the lower status of job and revenue accomplishment, and vice versa.

Categories A to C represent patients who have no income earn. Categories D to H represent those with income acquisition ranging from irregular earnings to salaries. Category I represent Buddhist monks who live regardless of money. The Buddhist monks are in a privileged social situation in Thai society and their living depend totally from Buddhist laity respectful alms. This special category is therefore exceptional in ranking with others. Pre and post surgical occupational status in each category is also compared using Mc Nemar test. Improvement of average income (Baht per capita per year; approximately 40 Baht = 1 US dollars) are calculated and paired t-test is used herewith for testing the statistical significance. A p-value of less than 0.05 was considered significant

Table 1. Categories of ability to work, occupation and earning status

Category	Occupation	Income Acquisition
A	No work	No income
B	Studying	No income
C	Domestic assistance	No income
D	Household, farmer	Irregular incomes
E	Employee	Irregular incomes
F	Business	Irregular incomes
G	Professional job	Regular incomes or salaries
H	Government service	Salaries
I	Buddhist monk	Regardless of income

Results

The demographic data of the 111 subjects is shown in Table 2. There were totally 54 male and 57 female adults, age range from 16 to 55 years (mean 33.7± 9.2 years). All patients suffered from medically intractable localization related (focal) epilepsies comprised of complex partial seizures with or without secondarily generalized tonic clonic seizures or auras. The average age of onset and duration of epilepsy were 12±7.8 years and 20.5±9.7 years respectively.

Ninety five percent of the subjects had intractable temporal lobe epilepsy (TLE). Mesial temporal sclerosis (MTS) was the pathologically proven etiology in 91 cases (82 %). The rest had tumors (10.8 %), focal cortical dysplasia (FCD) (3.6%) or scar tissue (1.8%). Dual pathology comprised of MTS and FCD or tumor was found in 1.8%. Ninety out of 111 cases (81%) underwent standard anterior temporal lobectomy for intractable TLE with MTS (MTLE). One patient underwent selective amygdalo-hippocampectomy.

Lesionectomy or cortical resection under electrocorticogram or invasive EEG monitoring were the surgical procedures for the rest. The surgical outcomes were seizure free in 93 cases (83.8 %), almost seizure free in 12 cases (10.8 %) and worthwhile improvement in 6 cases (5.4 %). All continued to take antiepileptic drugs after surgery; the medications were gradually tapered off at least 2 years post operatively [3].

Eighty percent of the subjects had educational level above high school, 32.4 % finished college or graduate levels and 3.6 % post graduate level. Pre-

Table 2. Demographic data and surgical outcomes of 111 patients studied

Patients' characteristics	Number
Age: range (mean) (years)	16-55 (33.7±9.2)
Gender (male:female)	54:57
Age of epilepsy onset (years)	0.2-34 (12.0±7.8)
Duration of epilepsy (years)	2-53 (20.5±9.7)
Epileptic syndromes (cases):	
TLE	106 (95.4%)
ETE	5 (4.6%)
Etiology of epilepsy (cases):	
MTS	91 (82.0%)
Tumor	12 (10.8%)
Cortical dysplasia	4 (3.6%)
Scar	2 (1.8%)
Dual pathology	2 (1.8%)
Mentality (cases):	
Normal	111 (100%)
Mental retard	0
Highest education (cases):	
No education	8 (7.2%)
Elementary school	14 (12.6%)
High school	49 (44.2%)
College and graduate	36 (32.4%)
Post graduate	4 (3.6%)
Surgical outcome (cases):	
Seizure free (Engel class I)	93 (83.8%)
Almost seizure free (Engel class II)	12 (10.8%)
Worthwhile improvement (Engel class III)	6 (5.4%)
No worthwhile improvement (Engel class IV)	0
Total	111

operative annual income per capita below 100,000 Baht was found in the majority (80%) of the subjects.

The changes in occupational status after surgery are shown in Fig. 1. The job situation increased from lower to higher categories with statistical significance ($p < 0.001$). The patients without work production (category A) decreased from 49 to 5 cases (89.8% reduction rate) after epilepsy surgery ($p < 0.001$). The group of patients who formerly had no income (category A to C) also decreased from 66 cases to 25 cases (62.1 % reduction rate) after surgery ($p < 0.001$).

Reciprocally, the number of patients in the group having incomes (category D to H) increased significantly in their post operative lives. The most outstanding subgroup was seen in persons who achieved professional jobs with regular incomes or salaries (category G) showing an increment from 20 to 43 cases or 53.5 % ($p < 0.001$).

The increase in the numbers of household assistant patients in category C from 3 to 10 cases, (70% increment) did not effect direct income rising but showed the improved work ability after surgery. Changes in the numbers of government services and Buddhist monk (category H & I) were scarcely seen. Table 3 shows the changes in numbers of the patients in each occupational category between pre and post operative periods.

The patients' revenue changes after successful surgery are shown in Table 4. The average annual income per capita (in Baht) increased significantly from 55,657.85 to 80,748.15 which accounted for 45.08 % raising ($p < 0.001$). After adjusting for an estimated 3% annual inflation rate, the changes still showed statistical significance. The increment of post operative income was markedly seen in Engel class I (seizure free) patients, modestly in class II but none in class III.

Discussion

Employment rates of people with epilepsy have been shown to be poorer than the general population [4]. The research showed that being employed is an important ingredient of the quality of life of people with epilepsy. The World Health Organization also stresses the importance of employment as a part of social well being, and therefore, improving the quality of life [5].

Evaluation of quality of life in epilepsy has evolved from generic measures of cognitive, behavioral and psychosocial functions under traditional clinical evaluation to the development of epilepsy-specific

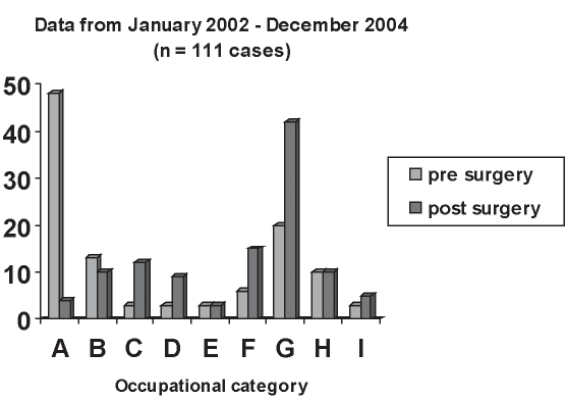

Fig. 1 Changes in occupational status of total 111 patients after epilepsy surgery

Legend (A = No work, B = Studying, C = Domestic assistance, D = Household, farmer, E = Employee, F = Business, G = Professional job, H = Government service, I = Buddhist monk)

Table 3. Changes in occupation and income category before and after surgery of 111 subjects

Occupational categories	Number of patients		% change	Statistical significance (p)*
	pre	post		
A	49	5	-89.8	<0.001
B	14	10	-28.6	NS
C	3	10	+70.0	NS
D	3	11	+72.7	<0.05
E	3	3	0	NS
F	6	15	+60.0	<0.05
G	20	43	+53.5	<0.001
H	10	10	0	NS
I	3	4	+25.0	NS
No income group (A to C)	66	25	-62.1	<0.001
Regular incomes /salaries group (G & H)	30	53	+43.4	<0.001

* Mc Nemar test
NS = Not Significant

Table 4. Changes between pre and post surgery annual income per capita of 111 patients

Total n = 111	Average annual income per capita (in Baht)				% change	Statistical significance(p)*
	minimum	maximum	mean	SD		
Pre surgery	0	540,000	55,657.85	103,316.80	+45.08	<0.001
Post surgery	0	564,000	80,748.15	107,934.38		

* paired t-test

measures, e.g. Washington Psychosocial Seizure Inventory WPSI and recently health-related quality of life (HRQOL), e.g. QOLIE-89 [6]. However the assessment of QOL after epilepsy surgery using occupational achievement and incomes acquisition has never been studied before.

The desires beyond seizure freedom after epilepsy surgery were assessed by Taylor, et al. Among 69 patients or care-givers, the five most outstanding needs were found to be desire for work, driving of motor vehicles, independence, socializing, and freedom from drugs [7]. Therefore the study measuring the achievement in occupation and incomes after surgery is considered mandatory.

So far, there have been 2 studies evaluating psychosocial status after anterior temporal resection. Jones, et al studied 84 adults with intractable epilepsy on employment, education, driving status, financial assistance and independency up to 9 years [8]. Sixty eight percent of individuals who underwent surgery exhibited improved psychosocial status compared with 5% of the medical treatment group. Another study assessed heath-related quality of life (HRQOL) using Quality of Life in Epilepsy-89 (QOLIE-89) in 53 patients who underwent anterior temporal lobectomy. The overall score and 10 of 17 scales namely, emotional well-being, attention/concentration, language, social isolation, health perception, role limitations-physical, work/drive/social, health discouragement, and seizure worry showed significant improvement compared to 37 non surgical controls [8].

To the best of the authors' awareness, the present study is the first to use occupational achievement and income acquisition as indicators for QOL improvement after epilepsy surgery. These parameters measure altogether intact brain function including psychomotor skill, mentality and psychosocial interactions of the subjects. The state of the mind and moral can also be reflected by such socially active behavior. This output is the ultimate evaluation of the ability to cope and to survive after having successful operation. The assessment of earnings and job accomplishment provide the actual quality of individual patient in the real life situation. Practically, it seems to be more sensible and realistic than the scoring output. This can imply how well each patient can become an effective social member post operatively. It may also reflect semi-quantitatively how much burden of the society has been relieved by increasing a substantial numbers of financially productive persons.

Our study demonstrated the obvious occupational status improvement and revenue increment after surgery, both of which reach robust statistical significances ($p < 0.001$). As a consequence of dramatic seizure reduction by surgery, unemployed individuals are reduced substantially. The effect was seen as early as 6 months post operation and was not seemed to correlate with the time after surgery or the concomitant medications. The changes from unemployment to professional achievement in higher categories represent a strong positive impact toward patients' post operative lives. The maximum change is demonstrated in the professional work (category G). Most are cases that never achieved jobs after finishing their education or otherwise had lost their job previously due to their seizures. Among the professions acquired after surgery in this category are engineer, teacher, lawyer, nurse aid, designer, cashier, garage mechanic, post office worker, as well as mobile phone and business employees. When correlated with the surgical outcomes, marked improvement is observed in the seizure free subjects while less change is seen in patients who are almost seizure free. No one with worthwhile improvement has income increment. Our findings are agreeable to the study by Markand, et al [9] which demonstrated that only complete seizure free patients achieved the better improvement in QOL after surgery, compared to those who were not.

The mixture of the patient's goals of life after surgery makes up the numbers in category B (studying group). Overall decrease in numbers of this group is due to two reasons. Some patients eventually finished their education and subsequently have found their jobs while many who have become seizure free seek for further education later. All of the patients in this group demonstrate the positive direction toward better life achievement regarding their education.

The higher numbers on the domestic assistance group (category C), although did not directly effect rising in individual's earnings, demonstrate the improvement in work abilities after becoming seizure free or having marked seizure reduction.

There was no change in the number of patients under government services (category H) after surgery. These patients are under government welfare coverage for their medical expenses and are able to maintain their job situations despite their epilepsies. Although a handful of patients in this subgroup can not reflect all the whole patients under government services, since many of them not shown in the present study may have given up or been dropped off because of their seizures, it seems to reflect more or less the stability in the occupational status as a government employee, a traditional way of Thai culture. The same is particularly true for Buddhist monks who, in Thai society, live in a privileged and respectable status under the Buddhist laity support.

There has been underutilization of epilepsy surgery worldwide, especially in developing countries [10]. The reasons are the inadequate awareness of the medical personnel on advances and advantages of epilepsy surgery as well as the lack of budget to access necessary presurgical diagnostic facilities. There are approximately 600,000 epilepsy cases in Thailand, 20 percents of which are intractable to all medications. More than two-thirds of these 120,000 pharmacore-sistant patients are indeed a good surgical candidate who can be rendered seizure free [11]. A recent prospective study on cost effectiveness of different epilepsy therapeutic modalities demonstrated that daily treatment of patients who underwent resective surgery costs significantly less than ongoing conservative medical treatment [12]. Another study on economical concern has concluded that anterior temporal lobectomy for treatment of intractable TLE is a cost-effective use of medical resources [13].

Regular TLE surgery at our center, which includes all necessary advanced diagnostic tests (average of 7-day long-term video/EEG monitoring, high resolution-MRI, ictal and inter-ictal SPECT, Wada test, neuropsychological tests and surgery) cost not exceed 150,000 Baht (approximately 3,750 US dollars) per patient. The present study clearly demonstrated that after successful epilepsy surgery, majority of TLE patients can achieve satisfactory QOL in terms of job finding and income increment. Balancing this one-time high cost payment to the benefit of becoming a seizure free, independent, subsequent self earning and financially productive person and against the suffering from continuous burden of having intractable seizures despite all medications and hospitalized costs, the policy to do surgery in the surgical remediable syndromes is obviously a high-yield investment.

Particular subsets of adult surgically amenable epilepsies in the present report may not be able to be extrapolated to all types of intractable epilepsies, especially of childhood onset. The presented population is mainly adults with MTLE who have average intellectual functions and whose seizure freedom has been accomplished in more than 90% [1]. The result of epilepsy surgery in MTLE is usually excellent [14]. Patients in this group usually have normal intellectual

functions although memory and some non specific psychiatric illness are sometimes associated. Due to the fact that MTLE is the most common form of human epilepsy, contributing two-thirds of all epileptic disorders and intractable MTLE comprised of more than 60% of all medically refractory epilepsy [15], the improvement of quality of life after surgery in this common syndrome would considerably be of great benefit to the patients, their families and the society as a whole [14].

Each aspect of psychosocial status in HRQOL is not included in the present study. For assessing such details, epilepsy-specific measures such as QOLIE, WPSI or qualitative analysis were used and reported separately. In conclusion, the present study has shown that the role of surgery has a clear impact on the ultimate post operative performance regarding occupational aspects and earnings, and thus, provides a vision for the need of urgent expansion of epilepsy surgery, especially in MTLE patients.

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คุณภาพชีวิตผู้ป่วยโรคลมชัก หลังผ่าตัดหาย - ประเมินด้วยการมีอาชีพและรายได้

ชัยชน โลว์เจริญกูล, บุรณี กาญจนถวัลย์, กฤษณพันธ์ บุณยะรัตเวช, ธีรเดช ศรีกิจวิไลกุล, ทายาท ดีสุดจิต, สุภัทรพร เทพมงคล, สุกัลยา เลิศล้ำ, ลาวัณย์ ตู้จินดา, ชนพ ช่วงโชติ, ประดิษฐ์ อุ่นภักดิ์

วัตถุประสงค์: *การผ่าตัดโรคลมชักโดยการประเมินแบบครบวงจรตามมาตรฐานสากล (Comprehensive epilepsy program) ได้รับการพัฒนาขึ้นในประเทศไทย จนมีระดับความสามารถและผลการผ่าตัดเท่าเทียมประเทศที่พัฒนา หลังผ่าตัด ผู้ป่วยที่หายชักแต่ละราย สามารถดำเนินชีวิตได้ด้วยตนเอง และมีประสิทธิภาพในการทำงานมากขึ้น รวมทั้งมีอาชีพ และรายได้เพิ่มขึ้นกว่าก่อนผ่าตัด การมีอาชีพและรายได้ สามารถสะท้อนถึง สุขภาพทางกายที่ปรกติ และโรคลมชักที่หายหลังการผ่าตัดโดยปราศจากผลแทรกซ้อนที่สำคัญ การพึ่งพาตนเองได้ มีความสามารถ มีความคิดสร้างสรรค์ มีจิตใจใฝ่ดี รวมทั้งการมีปฏิสัมพันธ์กับสังคม จึงเป็นตัววัดสรุปรวบยอดที่สะท้อนถึงคุณภาพชีวิต ของผู้ป่วยในสถานการณ์จริง แต่คุณภาพชีวิตผู้ป่วยโรคลมชักหลังผ่าตัด ในแง่มุมดังกล่าวนี้ ยังไม่เคยมีรายงาน ที่ใดมาก่อน การวิจัยนี้ จึงประเมินคุณภาพชีวิต ในแง่การมีอาชีพและรายได้ที่เพิ่มขึ้น หลังการผ่าตัดโรคลมชัก*

วัสดุและวิธีการ: *ผู้ป่วยผู้ใหญ่ทุกรายที่ได้รับการผ่าตัดโรคลมชัก หลังการประเมินก่อนผ่าตัดตามขั้นตอนมาตรฐาน ที่โรงพยาบาลจุฬาลงกรณ์ ตั้งแต่เดือนมกราคม พ.ศ. 2545 ถึงธันวาคม พ.ศ. 2547 ได้รับการศึกษาผลสัมฤทธิ์ หลังการผ่าตัด เกี่ยวกับคุณภาพชีวิตในแง่การมีอาชีพและรายได้ที่เพิ่มขึ้น โดยจัดกลุ่มตามระดับความสามารถ ในการทำงาน และการมีรายได้เปรียบเทียบกับก่อนผ่าตัด ระยะเวลาติดตามอย่างต่ำ 6 เดือน ถึงนานที่สุด 3 ปี ใช้ Mc Nemar test และ paired t-test เป็นวิธีการทดสอบทางสถิติ*

ผลการศึกษา: *มีผู้ป่วยผ่าตัดโรคลมชักทั้งสิ้น 111 ราย เป็นชาย 54 ราย หญิง 57 ราย อายุเฉลี่ย 33.7 $\pm$ 9.2 ปี ส่วนใหญ่ (82%) เป็นโรคลมชักที่ดื้อยา ชนิด temporal lobe epilepsy จาก mesial temporal sclerosis และได้รับการผ่าตัด standard anterior temporal lobectomy ที่เหลือเกิดจากเนื้องอก เซลล์สมองพิการโดยกำเนิด (cortical dysplasia) และแผลเป็น ซึ่งได้รับการผ่าตัด lesionectomy หรือ cortical resection ร่วมกับ electrocorticogram หรือ intracranial EEG โดยรวมมีผู้ป่วยหายขาดจากการชัก (Engel class I) 83.8%*

หลังผ่าตัด จำนวนผู้ป่วยเพิ่มจากกลุ่มที่ไม่มีอาชีพ เป็นกลุ่มที่มีอาชีพและรายได้ อย่างมีนัยสำคัญทางสถิติ ($p < 0.001$) จำนวนผู้ป่วยที่ไม่มีงานทำ ลดลง 62.1 % (จาก 66 ราย เป็น 25 ราย) ($p < 0.001$) ผู้ป่วยกลุ่มที่มีอาชีพ หรือมีเงินเดือนประจำ เพิ่มขึ้น 43.4 % (จาก 30 ราย เป็น 53 ราย) ($p < 0.001$) ส่วนผู้ป่วยที่ยังไม่มีรายได้ พบว่าสามารถ ช่วยทำงานได้มากขึ้น สำหรับรายได้เฉลี่ยต่อรายต่อปี พบว่าเพิ่มขึ้นจากก่อนผ่าตัด 45.08 % (จาก 55,657.85 บาท เป็น 80,748.15 บาท) ($p < 0.001$) โดยเห็นชัดเจนในรายที่หายขาดจากการชัก มากกว่ารายที่ยังเหลือ อาการชักอยู่บ้าง

สรุป: *การศึกษานี้ เป็นการศึกษาแรก ที่ประเมินคุณภาพชีวิตหลังผ่าตัดโรคลมชัก โดยวิเคราะห์จากการมีอาชีพ และรายได้ ผลการวิจัยพบว่า ผู้ป่วยที่หายชัก สามารถทำงาน มีอาชีพ และมีรายได้ เพิ่มขึ้นจากก่อนผ่าตัดอย่าง มีนัยสำคัญ และเน้นให้เห็นความสำคัญของการผ่าตัดโรคลมชัก*