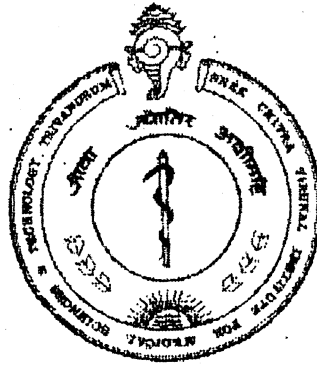


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PROJECT REPORT



Name : *MOHD. IRFAN SIDDIQUI*
Programme : *M.Ch. NEUROSURGERY*
Month and Year of Submission : *NOVEMBER - 2000*

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PROJECT REPORT

TITLE OF THE PROJECT:

COMPLICATIONS OF TEMPORAL LOBE EPILEPSY SURGERY

Name : *MOHD. IRFAN SIDDIQUI*
Programme : *M.Ch. NEUROSURGERY*
Month and Year of Submission : *NOVEMBER - 2000*

CERTIFICATE

I, Dr. Mohd. Irfan Siddiqui hereby declare that I have actually performed all the procedures listed/carried out the project under report.




Signature:

Place: Thiruvananthapuram

Date : 1st November -2000

Name in capital letters:
(MOHD. IRFAN SIDDIQUI)

Forwarded. He has carried out the minimum requirement of procedures / etc.



3.11.2000
Signature

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MOHD. IRFAN SIDDIQUI

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PREFACE

PREFACE

Surgery for intractable epilepsy is making resurgence. Recent trends indicate a marked shift from the earlier concepts. Indeed the requirement for intractability too is being questioned. The present trend is to offer surgery if the patient has a surgically correctable lesion. With this increasing popularity and frequency of surgery the need for evolving a strict protocol for surgery cannot be overemphasized. As a premier national institute Sree Chitra Tirunal Institute has shown the way with the establishment of a comprehensive epilepsy program. We have one of the largest series of surgery for intractable epilepsy majority being temporal lobe epilepsy surgery. An attempt is therefore made to study the incidence of complications and the relative safety of temporal lobe surgery. This study is the fruit of this endeavor.

INTRODUCTION

INTRODUCTION

Epilepsy is a chronic condition characterized by recurrent unprovoked seizures. It is a common disorder affecting 5–10 per 1000 persons (1,2). Complex partial seizures (CPS) constitute almost 53 % of seizures in adults and approximately 80% of CPS are of temporal lobe origin. As many as 70–80% persons with epilepsy achieve remission with antiepileptic drugs, whereas remaining 20-30 % will continue to have recurrent seizures despite treatment. Surgical treatment of epilepsy is indicated in this 20–30% uncontrolled epilepsy (2).

During the past decades the interest in surgical treatment for medically intractable epilepsy has increased. However epilepsy surgery displays some peculiarities that are uncommon to other neurosurgical procedures (3,4,5). Highly invasive procedures are applied for diagnostic purposes and surgery does not always result in the offer of a cure. A unique feature of epilepsy surgery is that removal (resective surgery) of functional brain regions is often essential elements of the operative strategy. This requirement for resection or disconnection of functional brain areas may endanger postoperative complications including neurological, neuropsychological, psychosocial and psychiatric impairments (6,7).

These possible complications are highly dependent on the appropriate selection of surgery candidates. Only a few articles provide exact data on the complications that are immediately related to the surgical intervention and may cause unexpected transient or permanent morbidity (8,9). A consideration of complications of epilepsy surgery must embrace complications attributable to inadequacies during the phase of preoperative evaluation, as well as complications attributable to the definite surgical intervention. Surgical and neurological complications of a consecutive series of 232 procedures performed for medically intractable temporal lobe epilepsy were analyzed with special regards to transient and permanent morbidity. Seizure outcome is not discussed as it directly reflects the selection strategy and the extent of resection and cannot be regarded as a complication.

AIMS OF STUDY

AIMS OF STUDY

This study was undertaken with the following aims and objectives:

1. The incidence of surgical complications in temporal lobe epilepsy surgery and to evolve guidelines to reduce the risk of complications.
2. Introduce a fresh protocol with regards to preoperative surgical preparation, patient positioning, skin incision, extent of craniotomy, and the surgical steps.
3. The incidence of neurological complications including visual deficits and to suggest measures to reduce them.
4. The incidence and prevalence of psychosocial complications following temporal lobe epilepsy surgery.

MATERIALS

&

METHODS

MATERIALS & METHODS

Two hundred and thirty two patients with intractable temporal lobe epilepsy were operated at **Sree Chitra Tirunal Institute for Medical Sciences & Technology, TRIVANDRUM**, under the Comprehensive Epilepsy Program between 20-03-1995 to December 1999. A retrospective analysis of these patients clinical data was done to assess the incidence of complications and to suggest modifications.

The study group include **131** males and **101** females ranging from 2 years to 57 years of age with a mean age of 26.88 years. The case records of one hundred and sixty three patients operated between 1995&1998 were analysed retrospectively whereas the remaining 69 cases were analysed prospectively under close supervision.

Patient selection & Preoperative Preparation:

All patients subjected to a routine protocol of evaluation preoperatively for localization of seizure focus and routine investigations for fitness for general anesthesia This included, routine hematological and biochemical investigations, MRI of brain with a special protocol for mesial temporal structures, scalp EEG, Video EEG, visual field charting, neuropsychological, psychosocial assessment and WADA test in cases of left side disease.

In this series no patient underwent pre/per-operative electrode implantation or cortical mapping due to the nonavailability of these resources.

Surgical steps:

All patients underwent whole head shaving on the morning of surgery. All patients received routine perioperative prophylactic antibiotic, which includes one dose, the day prior to surgery, three to four doses on the day of surgery and one dose on the first postop. day. In early part of study patients received six doses of Cefotaxime and four doses of Amikacin but in later part of study the antibiotic regime was switched over to Chloramphenicol and Gentamicin based on the current sensitivity pattern.

All operations were performed with the patients under general anesthesia and surgical microscope was used in all cases. The patient is positioned supine with head fixed on a three pin Mayfield skull clamp. The head is rotated 45 degrees to the contralateral side and the neck is sufficiently extended. A question mark shaped incision is made on the temporal bone joining three landmarks. The first inferior point is chosen 1 cm in front of the tragus avoiding the superficial temporal artery branch. The second superior point is chosen 1 cm below the superior temporal line and the third anterior point is chosen just behind the hairline. The temporalis muscle is incised leaving sufficient margin for adequate tight closure.

A small craniotomy is performed and the sphenoid wing is nibbled sufficiently to expose as much of the temporal pole as possible. Dura is opened based on the sphenoid bone. On dural opening the cortex visualized includes, part of the inferior frontal gyrus, the sylvian fissure, the superior, middle and the inferior temporal gyrus. Anterior temporal lobectomy is performed sparing 2mm of the superior temporal gyrus. The extent of resection is 5cm on the dominant side and 6cm of the nondominant side measured along the middle temporal gyrus. The remaining part of the superior temporal gyrus is removed by subpial resection. The temporal horns are then opened to visualize the hippocampus. The extent of hippocampal resection is often guided by the MR visualization of the extent of hippocampal sclerosis. But on an average the anterior two thirds of the hippocampus is excised. The landmarks to measure anterior two thirds are as follows:

- The anterior 3.0 – 3.5 cm of the hippocampus measured from the pole as the hippocampus is approximately 4.0 – 4.5 cms long.
- Resection until the beginning of the tail of hippocampus as evidenced by the medial turn and the tapering of the body.
- Upto the first cortical branch of the posterior cerebral artery.

The lateral two thirds of the amygdala is resected which approximately corresponds to the area in front of the entry of the anterior choroidal artery into the choroidal fissure. The dura is closed watertight, the bone replaced and the muscle, fascia, subcutaneous tissue and the skin closed in separate layers. Postoperative investigations include scalp EEG, visual field charting & neuropsychological assessment for memory & speech. 8th/9th day of surgery patients are discharged unless any complication arises.

Follow up and assessment:

Complications were classified as SURGICAL such as wound infection, operative site hematomas, subgaleal collection, subdural hygroma, brain abscess, brain swelling, pneumocephalus, meningitis, deep vein thrombosis, pulmonary embolism & vascular injury etc., MEDICAL such as hyponatremia, bronchopneumonia, upper respiratory tract infection, UTI, I V Cannula site infection, pyrexia of unknown origin or NEUROLOGICAL such as hemiparesis, hemiplegia, diplopia, hydrocephalus, mutism, cranial nerve palsies, visual field defects, disconnection syndrome or early post operative seizures .During follow up patients were assessed regarding late surgical complications also such as T M J dysfunction, osteomyelitis of bone flap, late hydrocephalus, porencephalic cyst, arachnoid cyst ,etc. All patients were followed up at 3 months, 6 months, 12 months and then yearly intervals.

REVIEW OF LITERATURE

Epilepsy is a chronic condition characterized by recurrent unprovoked seizures. It is a common disorder affecting 5–10 per 1000 persons (1,2). Partial epilepsy is the most common seizure disorder encountered. Partial seizures may be simple, complex partial seizures or secondarily generalized tonic clonic seizures. Complex partial seizure (CPS) constitutes almost 53 % of seizures in adults and approximately 80% of CPS are of temporal lobe origin. Extra temporal CPS most frequently emanate from the frontal lobes. As many as 70–80% persons with epilepsy achieve remission with antiepileptic drugs whereas remaining 20–30 % will continue to have recurrent seizures despite treatment. Surgical treatment of epilepsy is indicated in this 20–30 % uncontrolled epilepsy (2,3,4).

During the past decades the interest in surgical treatment for medically intractable epilepsy has increased. However epilepsy surgery displays some peculiarities, which are uncommon to other neurosurgical procedures. Epilepsy surgery is always elective. Highly invasive procedures are applied for diagnostic purposes and surgery does not always result in the offer of a cure. A unique feature of epilepsy surgery among the neurosurgical procedures is that removal (resective surgery) of functional brain regions is often essential elements of the operative strategy. This

requirement for resection or disconnection of functional brain areas may endanger postoperative complications including neurological, neuropsychological, psychosocial and psychiatric impairments (6,7). These possible complications are highly dependent on the appropriate selection of surgery candidates. Only a few articles provide exact data on the complications that are immediately related to the surgical intervention and may cause unexpected transient or permanent morbidity (8,9). A consideration of complications of epilepsy surgery must embrace complications attributable to inadequacies during the phase of preoperative evaluation, as well as complications attributable to the definite surgical intervention. Surgical and neurological complications of a consecutive series of 232 procedures performed for medically intractable temporal lobe epilepsy is presented regarding transient and permanent morbidity. Seizure outcome is not discussed as it directly reflects the selection strategy and the extent of resection and cannot be regarded as a complication.

We consider a complication to be that which we do not expect to occur during a normal postoperative course. Reversible postoperative complications are common with surgery of eloquent brain areas and do not affect the patient's condition at longer terms. These postoperative neurological disturbances were classified as acceptable side effects but not as complications, if they resolved completely within two weeks. A slight

dysnomia after a temporal lobectomy on the dominant side lasting for a couple of days is a typical example of an acceptable side effect.

Complications of epilepsy surgery:

The complications of epilepsy surgery may be broadly classified as follows:

I. Surgical complications

- Infection
- Hematoma
- Vascular compromise
- Brain swelling
- Hydrocephalus
- Injury to essential brain
- Death

II. Neurological impairment

- Hemiparesis
- Hemiplegia
- Visual field deficit
- Aphasia

III. Neuropsychological impairment

- Cognitive
- Memory
- Language
- Attention & concentration

IV. Psychosocial impairment

- Family/interpersonal impairment

Complications of the preoperative evaluation including diagnostic procedures

Elements of the preoperative evaluation include the comprehensive neuropsychological assessment and the intracarotid Amytal procedure, as well as ictal monitoring methods designed to characterize electrographic features of seizures in each patient. The failure to accurately identify the epileptogenic zone or the potential for a postoperative neuropsychological deficit may lead to postoperative complication or the failure to control seizures. Such complications are ultimately attributable to inadequacies in the preoperative evaluation.

Complications pertinent to inadequacies in the neuropsychological evaluation, especially in temporal lobe resection candidates, encompass global and material specific memory deficits, cognitive losses following resective surgery as well as complications of the WADA test. (3,4,5).

Neuropsychological Assessment

Intracarotid Amytal Procedure:

The IAP or Wada test is widely used in the preoperative evaluation. This assessment is felt to provide a measure of the risk to memory and language following resective or disconnection surgery and may provide evidence of lateralised memory dysfunction, which assists in the identification of the epileptogenic zone.

Vocational/educational

Feeling of not being healthier

V. Psychiatric impairment

VI. Failure to control seizures

The accurate identification and safe removal of the epileptogenic zone constitute essential elements of all resective operations for intractable epilepsy. At the last Palm desert conference (4) at least four alternative approaches to temporal lobe resections were presented.

- Enbloc temporal resection.
- Awake tailored resection
- Amygdalo-hippocampectomy
- Radical hippocampectomy.

It is unlikely that a unitary operative approach will suffice as a convenient therapy for all patients with this disorder. As our methods of preoperative evaluation become more sophisticated it is likely that most centers will employ a variety of surgical approaches each tailored to the appropriate patient population. The available information regarding complications has been derived from the previous accumulated experience with a more standard temporal lobe resection. (3,5,7).

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Some centers may defer surgery altogether in this setting while others variably alter the medial or lateral extent of resection in temporal lobe cases. Complications associated with transfemoral carotid angiography include thromboembolism and stroke (0.5–1%), contrast hypersensitivity and local complications of femoral puncture (10,11,12). Individual mortalities during an IAP have been reported associated with the accidental injection of hypertonic saline and other associated with the angiogram itself. Anecdotal reports of allergic reactions to amobarbital associated with neurological deficits and other neurologic complication have not been accurately documented in the literature. Application of super selective catheterization and balloon techniques are used in an effort to more accurately assess hippocampal performance. Errors in the interpretation of the IAP including false negative and false positive assessments may result in postoperative amnesia following ipsilateral lobectomy or denial of surgery in appropriate candidates.

Global Memory deficits:

The syndrome of profound anterograde memory loss with preservation of cognitive performance, personality, early memory and technical skills constitutes a rare but disabling functional complication of resective surgery in the temporal lobe. Initial reports described global amnesia following unilateral temporal lobectomy in either the dominant or the non-dominant hemisphere (13,14,15).

In one patient undergoing a staged temporal lobe resection profound memory loss occurred following the mesial resection. Global memory loss has also been recorded following selective unilateral amygdalo-hippocampectomy. The damage to mesial structures must be bilateral to produce this syndrome. In contemporary practice disabling postoperative memory deficits occur with a frequency of 1–4% in series from Montreal, UCLA, Duke and the medical colleges of Georgia. (16,17).

Material specific memory deficits:

Material specific memory deficits include deterioration of verbal memory performance following dominant and visuo-spatial memory following non-dominant lobe resection. Although less striking than global amnesia these deficits may be quite troubling for affected patients especially in the context of dominant temporal lobe resections. Unfortunately neither the IAP nor the comprehensive neuropsychological evaluation has been established as an accurate predictor of material specific deficits that appear postoperatively. The relative contribution of the lateral and mesial resections to postoperative material specific deficits is the subject of continuing debate and controversy. One body of evidence emphasizes the contribution of the medial or hippocampal excision and certain material specific deficits are reported to appear only in patients undergoing more extensive hippocampal excision (7,13,14).

Another view suggests that incremental deficits in immediate and delayed recall performance do not result in patients undergoing radical as compared to standard hippocampectomy (15,16). Postoperative deficits correlate most with the extent of the lateral rather than the mesial resection. Although the IAP may not predict material specific deficits in the setting of failed or equivocal IAP, operations which spare neocortical or hippocampal memory site are favoured. Some centers will defer surgery entirely. Operative approaches, which may reduce postoperative deficits in this setting, include intraoperative memory mapping and a tailoring of the cortical excision. More commonly the focus is upon the volume of mesial tissues resected. Notably global memory loss will occur even with selective medial excisions confirming the importance of mesial structure in the memory performance. Finally material specific memory deficits following dominant temporal resections are more likely when verbal memory is unimpaired preoperatively.

Surgical and Neurological complications

Permanent hemiparesis:

Permanent hemiparesis as a complication of epilepsy surgery was reported by Van Buren (7) to occur in 0.7% after temporal lobectomy, in 0.9% after extra temporal resection, in 0.8% after corpus callosotomy and in 0% after hemispherectomy (18).

Polkey (6) reported a less than 2 % rate of permanent hemiparesis after temporal lobectomy since 1993. Pilcher (4) et al reported 2% permanent hemiparesis after anterior temporal lobectomy. Elga Behrens (3) series reports hemiparesis after temporal resection to be less than 1%, after extra temporal resection to be 1.2%, after callosotomy as 0%, and after hemispherectomy to be 2.8%. In his series however hemiparesis gradually improved over time in all instances and all of his patients were eventually able to walk with little or no assistance. Hemiparesis was seen in 3% and dysphasias either temporary or mild in 5.5% of patients (11.6% of dominant resections) (4,7,17).

Hemiparesis occurs rarely following anterior temporal lobe resections and is usually transitory. An ischemic mechanism most likely in the territory of the anterior choroidal artery is believed to be responsible. Since Penfield's (18) original report of transitory hemiparesis in 5% of patients following temporal lobe surgery this complication continues to be widely reported with varying incidences. The more disabling syndrome of permanent hemiparesis or hemiplegia occurs less frequently. Penfield reported a 2.5 % hemiplegia rate in his early series. In Penfield's (18) original description of disabling hemiplegia following temporal lobectomy he attributed this complication to the sequelae of excessive manipulation of branches of the middle cerebral artery during the trans-sylvian resection of insular cortex.

Alternate explanations include direct capsular injury with insular resection, as well as comprise of lenticulo-striate vessels and the anterior choroidal artery (3,4,5). In seven of eight hemiplegic patients in his series the operative resection across the sylvian fissure required him to work between insular vessels. Penfield subsequently abandoned the procedure of trans-sylvian insular cortex resection and in the subsequent series of 550 patients in whom the sylvian pia was not violated, no patients exhibited postoperative hemiparesis. With the current emphasis upon protection of distal MCA vessels and avoidance of insular resection hemiplegia due to MCA comprise is probably uncommon. However with current focus on extensive mesial resections other hypotheses may be advanced to explain disabling postoperative hemiplegia (14,16). These include surgical manipulation or injury to mesial vessels including the anterior choroidal artery or posterior cerebral artery or even the posterior choroidal artery. These vessels are located within the choroidal fissure abutting the hippocampal sulcus and may be inadvertently damage d during the process of uncus or hippocampal removal. Vascular injury may engender distal ischemia and diencephalic infarction with hemiparesis or hemiplegia as well as visual field defects and aphasia are prominent sequelae.

Visual complications:

Asymptomatic visual field defects are by far the most common neurologic consequence of anterior temporal lobe resections seen in 54.2% to 70% of patients (19,20,21). An upper homonymous quadrantanopia due to the sectioning of Meyers loop is typically seen. More severe visual field cuts and homonymous hemianopia are rare and usually associated anterior choroidal artery infarcts and hemiparesis. Superior sub quadrantic visual field deficits occur following temporal lobe resection in approximately 50% of operated patients (4,6,20). Such minor field defects are rarely noticed by the patient or referring physician without formal testing and do not represent functionally disabling complication. These deficits are often incongruous or worse in the ipsilateral eye reflecting the anterolateral location of ipsilateral fibers overlying the rostral temporal horn and do not significantly affect measures of acuity. Symptomatic field cuts considered troublesome or disabling by patients occurs less frequently and was reported in 8% of operated patients in a Cleveland series 9%. In Elga Behrens (3) series persistent complete, or near complete hemianopia occurred in three patients. The literature reviews a 2 to 4% range of full quadrantic or hemianopic visual field defects after anterior temporal lobectomy. (4,6,14). Hemianopic or full quadrantic defects appeared in 2-4 % of operated patients. These larger defects may disappear slightly with delayed testing.

The majority of visual field defects are thought to result from disruption of Meyers loop -optic radiation fibers which course in the roof of the temporal horn of the lateral ventricle. Most likely this occurs during the process of ventricular entry and hippocampal exposure that requires an incision in the white matter at the lateral most aspect of the ventricular roof. The interpersonality variability in the distribution of optic radiation is reflected in the fact that the extent of the postoperative field defect cannot be predicted on the basis of resection size alone for resections less than 7.5cms. It is well known that because of the variable course of the optic radiation the extent of postoperative visual field defects after temporal lobe resection cannot be predicted on the basis of resection size alone, with resections of less than 7.5 cms from the temporal pole. Rasmussen suggested that limiting the extent of the superolateral ventricular opening to 1cm quadrantic field defects could be avoided. Increasing defects are noted with more extensive ventricular openings. Unexpected visual field defects may also result from vascular injury, during the mesial resection resulting in a distal ischemic insult to the optic tract, lateral geniculate bodies or posterior temporal lobe white matter. Alternatively direct surgical injury to the optic tracts or the lateral geniculate nucleus during the course of an extensive postero mesial resection may account for such defects.

Cranial nerve palsy:

Cranial nerve palsies occur occasionally after surgery. Peripheral facial nerve palsies are uncommon but third nerve palsies have been described following anterior temporal lobectomy. Third nerve palsy was uncommon and never was complete or persistent in Elga's series (3) although they used enbloc resection of the temporo-mesial structures. Other authors using the same technique have reported similar figures for postoperative transient third nerve palsy whereas groups using piece meal resections observed none (6,7,16). Transitory third nerve palsy has been reported in a small minority of patients presumably due to transpial manipulation of the oculomotor nerve during the mesial resection. Jacobson observed that trochlear nerve palsy may be more frequent than oculomotor palsy but under recognized. Thus third and fourth nerve palsies must be considered in the diagnosis of postoperative diplopia: both usually resolve within few weeks. Transitory delayed facial nerve palsy constitute another uncommon complication occurring in 3 % of patients in a recent Cleveland clinic series presumably due to transdural injury to the geniculate ganglion or VII nerve during the inferior temporal lobe resection.(7,13).

Fatal complications:

Mortalities occur with a frequency of approximately 1% following temporal lobectomy and are variably attributed to postoperative hemorrhage, infarction, pulmonary complications and the phenomenon of sudden death

(8,9) Earlier large series include Jensen's world wide survey of 2282 operations and Rasmussen MNI series of 1300 operations in which 0.8% and 1.2 % mortality rates were defined. The trend towards decreasing mortality is seen in the MNI report in which no deaths occurred in the most recent 526 cases operated. Van Buren (7) reported mortality rates as follows:- anterior temporal lobectomy < 0.5%; extra temporal resections 0%, corpus callosum section 2% and hemispherectomy 4%. The following figures for postoperative deaths were reported by Polkey (6): temporal lobe resection 0.7%, other resections 0.9% and hemispherectomy 3.3%. Pilcher et al reported a less than 1% mortality rate in anterior temporal lobectomy. In a series of 200 consecutive temporal lobectomies, Popvic et al noted no fatalities. In general, mortality after temporal lobectomy has been estimated at 0.8%.

The concept of the patient's well being must be considered as well as the risks of having no surgery. The most common long-term effects of chronic illness are a loss of autonomy and increasing dependence. The question of whether successful surgery lowers the mortality rates in-patients with epilepsy to those of the general population has not yet been answered. There is only one study comparing the mortality of surgically treated patients with that of nonsurgically treated patients.

Jensen in a follow up study of 829 patients treated from 1928 through 1973 with temporal lobe resections reported late mortality rates of 4.76% in those who survived the operation whereas the mortality in the Danish epilepsy material was 5.94 %. She thus considered that temporal lobe resection might reduce the estimated preoperative mortality rate.

Language:

An acquired disturbance of language function is potentially a major complication of epilepsy surgery especially involving the speech dominant hemisphere, which in most centers is identified through presurgical intracarotid amobarbital testing. In order to avoid unnecessary language deficits surgeons may either limit the resection to less than 3 cm of the superior and middle temporal gyri of the language dominant hemisphere or tailor the resection on the basis of cortical mapping of language areas using subdural electrode grids or intraoperative corticography. With adequate presurgical assessment frank disturbances of language functions are relatively rare even following dominant temporal resections. Nonetheless subtle changes from baseline level on formal measures of naming and other language skills have been associated with epilepsy surgery but typically only during the immediate postoperative period.

The test retest paradigm has been especially valuable in assessing postoperative language changes because most patients with dominant temporal lobe seizure foci have more impaired language skills preoperatively than do those with non-dominant temporal foci. Formal evaluation of language skills during the first month after surgery routinely shows, a modest exacerbation of baseline naming deficits following dominant, but not nondominant resection with relative sparing of verbal fluency. The decrements in confrontation naming appear to resolve over time, as they have not been noted in 6 month or 1 year follow up. Although group outcome data suggest that frank aphasia or major language dysfunction is relatively rare following temporal lobectomy considerable individual variation has been noted. Stafinak and coworkers proposed age of first risk for seizures as a marker for some of this variability (14,15). Patients with early risk factors for seizures who subsequently underwent dominant temporal lobectomy were less likely to show decrements in naming during the first postoperative month than were those without early seizure onsets. The authors suggested that individuals who incur brain insults at a young age may develop atypical patterns of cerebral representation for naming that protract them somewhat from the acute effects of focal dominant temporal resection.

In a subsequent study Saykin and associates replicated the role of early risk factors in mediating differences in confrontation naming but failed to find any relationship between them and post surgical changes in other language functions (7,15,17).

Transitory aphasia:

The syndrome of progressive anomia or dysphasia is not uncommon following dominant temporal lobectomy. These aphasias are usually maximal at 1-3 days postoperatively and largely resolve within 1 week. Transitory dysphasia are reported in upto 30% of operated patients even in the setting of awake surgery with intraoperative language mapping or following extra operative language mapping with grids. In Elga 's series there was no permanent loss of speech function and three case of temporary dysphasia. The number of postoperative speech disturbances would be more if formal postoperative testing was applied. Occasionally a subtle word finding difficulty or stuttering will persist for weeks or months and gradually resolve. Removal of anterior temporal gyrus or inferior temporal (Parahippocampal or fusiform gyri) language sites may account for this phenomenon. Other explanations for transitory anomia include resection of cortex within 1-2 cms of essential areas identified by language mapping, brain retraction, postoperative neuromuscular edema and disruption of white matter pathways connecting language association areas.

Persistent aphasia:

Persistent aphasia has been reported in 6% to 20% patients in various series. Using intraoperative mapping no lasting aphasia were identified postoperatively in the NIH and MNI series. Ischemic insults in the distribution of the MCA or anterior choroidal artery constitute uncommon causes of persistent dysphasia. Patients with postoperative anomias exhibit considerable improvement by 1 year follow up providing that seizure control is achieved. Standard resections incorporating anatomical strategies designed to avoid language deficits has gained popularity in recent years. Spencers current standard anteromedial resection spares the superior gyrus entirely and limits the middle gyrus resection to 3.5 cms. Falconer's original standard resection incorporated 4.5 cm of middle gyrus resection and a minimal superior gyrus excision. The tailored resection is designed to use language mapping techniques to identify and protect neocortical language sites that exhibit interpersonal variability in location and may extend into areas considered safe by anatomic criteria. In the only comparison available of standard versus tailored operations performed by the same surgeon a slight increase in postoperative dysnomia in multilanguage aphasia battery was identified at 6 months postoperatively following a standard resection. The absence of early risk factors for epilepsy may be associated with an increase risk of postoperative anomia in patients undergoing a standard resection without language mapping.

With the trend towards generally smaller neocortical excisions and the evidence that most language deficits are not functionally significant and are resolved by 1 year postoperatively, the tailored operation with intraoperative or extra operative language mapping is employed more selectively today than in the past. In circumscribed resections close to the language sites that require individual tailoring subdural grids for extra-operative speech localization helps. Engel used a very similar anatomically guided technique of enbloc anterior temporal lobectomy without any instances of permanent postoperative aphasia.

Miscellaneous:

Significant cases of postoperative infection occurred in large series with a frequency of less than 0.5% (22,23). In Oliver's series of 560 patients, one case of meningitis, two cases of subdural abscess and five cases of scalp infection were reported (24). Aseptic meningitis, most prevalent after large cortical resections was described by Penfield as syndrome of headache, nuchal rigidity and fever which usually resolved in 10–20 days. This was felt to occur as result of blood entering in to the ventricular system or subdural space. This has come down with use of steroid and so has the incidence of hydrocephalus earlier reported to be about 1%.

Neurobehavioral complications

Memory deficits: is a major complication of temporal lobectomy. Bilateral surgical resection of the anterior temporal lobes and their mesial structures has long been known to cause a profound and lasting anterograde amnesia. Unilateral temporal lobectomy does not result in comparable memory loss unless the contralateral temporal lobe is also damaged but later produces mild material specific deficits. Reports of decrements in the acquisition and retention of new verbal information following dominant temporal lobectomy are ubiquitous in the literature affecting as many as 45% of patients. Comparable deficits in learning and memory for complex nonverbal visual spatial material after non-dominant temporal lobectomy have been reported less consistently. Memory deficits are most evident during the first postoperative month and resolve to near baseline levels by 1 year. However significant deficits were apparent at extended follow up periods among patients who underwent dominant hemisphere temporal lobectomy. Thus a significant impairment of verbal memory is a major complication of dominant temporal lobectomy, especially for individuals with average or above average function prior to surgery. Patients who achieve seizure control continue to have milder deficits than those who continue to have frequent seizures after surgery.

A release of function or an improvement in material specific memory capacity also has been reported in the hemisphere contralateral to surgery. That is non-verbal memory may improve from baseline after dominant temporal lobectomy, whereas verbal memory may improve after non-dominant hemisphere resection. Patients with seizure onset at or before 5 years of age and who underwent dominant temporal lobe resection showed little or no change in acquisition and retention of verbal memory but had marked decrements in non verbal memory. Patients with later seizure onset who underwent dominant hemisphere lobectomy manifested the typical pattern of decrements with slight increase in non-verbal memory. Patients who had non-dominant temporal resection showed generalized improvements on measures of both verbal and non verbal memory regardless of age of onset. The nature and extent of temporal lobe resection also may affect the pattern of changes in material specific memory capacity. Contrary to earlier findings a prospective randomized surgical trial failed to find a relationship between extent of hippocampal resection or neocortical resection and changes in memory after either dominant or non-dominant temporal lobe resection. Strong convergent data from measure of both function and structure suggest that post surgical memory deficits depend largely on the functional adequacy of the tissue resected. Those who were higher functioning were also at greater risk for decrements than those whose capacities prior to surgery were more limited.

Patients who demonstrated relatively intact memory in the surgical hemisphere following contralateral injection of amobarbital showed greater decrements in memory than those with either poor amobarbital memory or with memory function favoring the non surgical hemisphere. Baseline memory performance on neuropsychological tests and from the intra carotid amobarbital procedure has been shown to be positively related to degree of neuronal cell loss in the hippocampal; structures of the speech dominant hemisphere. Conversely memory loss appears to be inversely related to the histologic evidence of hippocampal pathology with those patients demonstrating the largest amount of neuronal loss having the greatest decrements in memory following surgery. Patients with the greater degree of hippocampal adequacy prior to surgery are most at risk for subsequent memory loss if surgery involves the language dominant temporal lobe. Larger resection of severely sclerotic tissue makes no more impact on subsequent memory than smaller resections (4,6).

Cognitive deficits:

Significant impairment of intellectual performance following temporal lobe resections occurs uncommonly. When seizure control is achieved elevations of performance IQ following left temporal lobectomy have been reported suggesting improvements in contralateral functions (7,15).

Improvements are most striking following non-dominant resections. In patients rendered seizure free and tested 5 – 20 years postoperatively there was a significant improvement in Weschler full scale IQ regardless of the side of surgery. In a recent investigation, most cognitive domains (intelligence, academic achievement , language function problem solving skills, sensorimotor ability, auditory perceptual function and complex attention skills) were either unaffected by surgery or improved with only the area of memory/ learning showing more cognitive loss than gains.

Evaluation of intelligence within 1 to 2 months following resection of either dominant or non-dominant temporal lobe generally demonstrates mild decrements in performance from base lines. Slightly larger initial defects typically follow dominant than non-dominant temporal lobectomy, but these resolve with time. Small improvements in full scale IQ scores may be observed with time on long term follow up. Improvements are reported more frequently following non-dominant temporal lobe resections than dominant temporal lobectomy. An interaction between side of performance and selective changes in verbal and Performance IQ scores has also been reported. Performance IQ scores are almost invariably improved compared to baseline regardless of the side of surgery. In contrast, non-dominant temporal lobe was associated with larger positive gains in Verbal IQ, compared with baseline than as dominant temporal lobectomy.

Among patients in the latter group Verbal IQ was invariably reported as persistently depressed at follow up or slightly improved. Patients with good postoperative control are likely to experience improvement in Full scale IQ at follow up regardless of the side of surgery whereas those with poorly controlled seizures have either little change or mild losses. Whether the slight improvement in general intelligence following epilepsy surgery actually reflects true enhancement in cognitive capacity or merely the effects of practice is questionable.

Psychiatric deterioration:

The risk for psychiatric manifestation are elevated in patients with preexisting psychiatric disease mandating a thorough psychiatric evaluation and perioperative intervention in this group. Post operative psychosis has been reported in as many as 10–12% of operated patients in some series (4,15,17). Many of these patients may have suffered from psychiatric illness however. A transitory postoperative depressive illness is not infrequent after temporal lobectomy even when seizures are eliminated. These depressive episodes may be quite profound and may require antidepressant therapy. There is little evidence however that psychiatric deterioration is any more frequent following resective surgery than after any other major operation, or for that matter any more frequent after resective surgery than in patients with complex partial seizures undergoing successful medical treatment.

Invasive monitoring methods

An increasing diverse array of invasive monitoring methods has been developed over the years. At the same time we have witnessed a trend towards greater agreement between centers with regard to the invasive monitoring approaches utilized in various situations. Available techniques now include depth and subdural strip electrodes as well as subdural grid electrode arrays that facilitate both electrographic assessment and extra operative brain mapping procedures. More recently foramen ovale and epidural peg electrodes have provided alternative methods of acquiring semi invasive recordings.

Subdural strip and intracerebral depth electrodes:

The issues of relative efficacy and safety of strip and depth electrodes have sparked considerable debate between proponents of each technique. Several comparative investigations have suggested that depth electrodes may be more sensitive to localized discharges emanating from deeper structures (3,4,17) with a possible improvement in diagnostic accuracy. However there is no clear evidence to suggest that surgical decisions based on depth electrode investigation lead to an improvement in long term seizure outcome. The strip electrode monitoring may be associated with a slightly lower risk.

The principle complications associated with depth electrode placement include hemorrhage and infection (23,24). Centers employing hippocampal placements have reported a 2–3% incidence of hematoma requiring reoperation or associated with neurological deficits. In a series of 163 patients two deaths resulted from vascular injury involving the posterior cerebral artery and a parasagittal bridging vein while two additional hematomas required surgical evacuation. In a smaller series of thirty patients two cases of permanent hemiparesis were reported, a morbidity rate higher than that associated with temporal lobectomy. A serious complications caused by depth electrode implantation has been reported in literature by Engel who reported two deaths from intracerebral hemorrhage and three instances of bleeding from the superficial cortex that needed surgical decompression. Van Buren reported 24 hemorrhages with either transient or permanent sequelae from 879 depth electrodes implantation corresponding to a 2.7% rate of hemorrhage. Pilcher et al in a literature reviews reported 2.5% rate of hemorrhage in 1582 patients who were assessed using depth electrodes Direct cortical visualization through a small craniectomy prior to electrode placement has been recommended as a method to reduce the incidence of vascular injury and hemorrhage. Tapering of valproic acid preoperatively to reverse a presumed associated coagulopathy is recommended in most centers. In grid electrode implantation the incidence of subdural hematoma was 8%.

Smaller grids, central tack up sutures and minimization of hyperventilation and CSF leakage to reduce ICP helps to avoid this complication. Recent reports suggest that subdural depth electrodes insertion may be somewhat more safer than depth electrode placement.(4,6). Localized infections occur at a slightly lower frequency than depth electrodes and usually respond to antibiotic therapy. Depth electrode placement is routinely associated with two, frequently one and sometimes even more separate incisions, depending on the epileptologists needs to evaluate the individual patient. The electrodes remain implanted during an average period of 12 days. The surprisingly low incidence of frank purulent infections may be because all patients receive antibiotic covering during the whole period. Intracranial infection rates of 1-5 % inclusive of meningitis and less commonly brain abscess have been reported with depth electrodes, most of which resolved with antibiotic therapy. The report of two deaths from Cruetzfeldt Jacob disease acquired from reused depth electrodes has stimulated most centers to employ disposable electrodes only.

Key issues relating to depth electrode placement and associated complications include

- The relative safety of lateral, parasaggital and tangential methods of insertion.
- The relative safety of flexible versus rigid electrodes

- The role of computer assisted work stations in the improvement of stereo tactic accuracy and the reduction of vessel injury and the
- The effect upon infection complications of length of monitoring, antibiotic prophylaxis, tunneling of electrode leads and methods of electrode removal.

Foramen ovale and peg electrodes:

The recent introduction of these semi invasive electrodes provides a theoretically less morbid method of acquiring electrographic recordings. Associated morbidity is low. The reported complications include infection, transient pain with mouth opening and persistent perioral numbness /dysesthesia, subarachnoid hemorrhage, transient upper pontine syndrome. Notably seizure outcome was no different in-patients monitored with FO electrodes as compared to those monitored with depth electrodes.

Complications of anterior temporal lobectomy (Pilcher and Ojemann)

Mortality	<1%
Hemiparesis	2-4%
Visual field deficit	
Mild	>50%
Severe	2-4%
Infections	<5%
Epidural hematoma	<5%
Third nerve palsy	<1%
Transitory anomia	20%
Persistent dysphasia	1%
Global memory deficits	1%
Transitory psychosis/depression	2-20%

Selective amygdalo-hippocampectomy

Although there is a general perception that amygdalo-hippocampectomy may be an operation associated with a higher morbidity the utilization of this operation is not yet wide spread for conclusions to be drawn. A trend towards superior postoperative neuropsychological performance in AHE patients when compared with classical anterior two-thirds temporal lobectomy has been suggested. It has been suggested that sparing of lateral cortex and sub cortical white matter may contribute to the reduction of postoperative material specific memory and visual field deficits. Despite this suggestion of superior neuropsychological outcome with AHE postoperative global memory lass has been reported with this technique. In Weissers series of 286 patients there was one case of persistent hemiparesis due to intraoperative injury of the anterior choroidal artery, one case of osteomyelitis and two cases of subdural hematoma.

RESULTS

RESULTS

Two hundred and thirty two patients with intractable temporal lobe epilepsy were operated at **Sree Chitra Tirunal Institute for Medical Sciences & Technology, TRIVANDRUM**, under the Comprehensive Epilepsy Program between 20.03.1995 to December 1999. A retrospective analysis of these patients clinical data was done to assess the incidence of complications and to suggest modifications.

The study group includes **131** males and **101** females ranging from 2 years to 57 years of age with a mean age of 26.88 years. There were equal number of patients of right and left side temporal lobe epilepsy 116 cases each.. The case records of one hundred and sixty three patients operated between 1995 & 1998 were analyzed retrospectively whereas the remaining 69 cases were analyzed prospectively under close supervision. The mean follow up was 9.93 months with a range from 3 months to 5 years.

Age group:

The study group included patients with age ranging from 2yrs to 57 years with a mean age of 26.88 yrs. (table 1). Age was not found to be significant prognosticator for complications with no definite preponderance for complications noted in any age group.

TABLE - 1: Complications according to Age distribution

Age Group	No. of Patients	Surgical Complications	Neurological complications	Medical Complications	Late Complications	Resurgery	Fatal Complications
01-10	8	2 (25%)	3 (37.5%)	--	--	--	--
11-20	52	19 (36.5%)	26 (50%)	3 (6%)	--	--	--
21-30	89	15 (16.8%)	40 (45%)	3 (3.8%)	2 (2.2%)	4 (4.5%)	--
31-40	68	20 (29.4%)	35 (51%)	7 (11%)	--	--	2 (3%)
41-50	13	3 (2.3%)	8 (62%)	2(15.4%)	--	--	--
51-60	2	--	--	--	--	--	--
TOTAL	232	59 (25.4%)	113 (48.7%)	15 (6.5%)	2 (0.8%)	4 (1.4%)	2 (0.8 %)

Sex group :

The study included 131 males and 101 females. The incidence of complication was not found to have any relation with either sex groups.

(Table 2)

TABLE - 2: Complications according to Sex distribution

Sex	No. of Patients	Surgical Complications	Neurological complications	Medical Complications	Late Complications	Resurgery	Fatal Complications
Male	131	30 (23%)	64(48.9%)	5(3.8%)	1(0.8%)	2(1.5%)	1 (0.8%)
Female	101	29 (28.7%)	49(48.5%)	10(9.9%)	1(0.99%)	2(1.9%)	1 (0.99%)

Side of surgery:

It was evenly matched with 116 patients having left side surgery and 116 having right side surgery. Although surgery was relatively easier on the right side for a right handed surgeon the complication rates were found to be the same (Table- 3). Similarly although the extent of resection was more on the right side the complication rate was not similarly different.

TABLE - 3: Complication according to Side of surgery

Side of Surgery	No. of Patients	Surgical Complications	Neurological complications	Medical Complications	Late Complications	Resurgery	Fatal Complications
Right	116	38 (32.7%)	56(48.3%)	8(6.8%)	1(0.8%)	3(2.6%)	1(0.8%)
Left	116	21(18%)	57(49%)	7(6.0%)	1(0.8%)	1(0.8%)	1(0.8%)

Procedure related:

All operations were performed with the patients under general anesthesia and surgical microscope was used in all cases. Temporal lobectomy was performed in two hundred thirty patients as a standardized resection, which included 4.5 cm & 5.5 cm from pole on dominant & nondominant side respectively and anterior 2/3 rd of hippocampus & lateral 2/3 rd of amygdala were taken out en bloc. The surgical steps were along the same protocol mentioned earlier. However with the increasing experience of the surgeon the steps underwent serial modifications with emphasis on reducing the scalp incision and the extent of bone work. This was reflected in the outcome as well, with the patients operated earlier in the series showing higher incidence of wound related complications.

Three consultant neurosurgeons were involved in the program and all the patients were operated by either one of them. No comparison was made between the complication rates in relation to the surgeon as the surgical steps involves were essentially the same by all of them.

Majority of the patients had evidence of mesial temporal sclerosis. However eleven patients having a lesion in temporal lobe underwent lesionectomy along with standard resection. Two patients having temporal lobe lesions underwent only lesionectomy with a 1.0-1.5 cm margin, sparing the temporal lobe a mesial temporal structures (table-4).

The incidence of complication in relation to the underlying pathology and the extent of resection is show in Table 4.

TABLE - 4: Complications according to Type of procedure

Procedure	No, of patients	Surgical Complications	Neurological complications	Medical Complications	Late Complications	Resurgery	Fatal Complications
ATL+AH	215	49 (22.8%)	102 (47.4%)	14 (6.5%)	2 (0.9%)	3 (1.4%)	2 (0.9%)
ATL+AH+L	15	8 (53%)	11 (73%)	1 (0.7%)	--	1 (0.7%)	--
L	2	--	--	--	--	--	--

SURGICAL COMPLICATIONS :

The list of complications with their relative incidence is shown in table 5&6.

Wound infection:

Among these 232 temporal lobectomy cases only 6 (2.5 %) patients developed mild to moderate superficial wound infection that was controlled with antibiotic therapy. No patient developed osteomyelitis or brain abscess requiring a second stage surgery. Meningitis developed in 2 (0.86 %) cases, which too responded to appropriate antibiotics.

Subgaleal collection:

Subgaleal collection was the commonest surgical complication in this series, which occurred in 42 (18 %) patients which required multiple aspirations. This complication was more frequent in the earlier operated patients when the incision and the craniotomy limits were more than the present protocol.

Hematomas:

Three (1.29 %) patients developed operative site hematomas. One patient developed a large extradural hematoma in the immediate post-operative period, which was evacuated, and patient recovered fully without any deficit. Two patients developed small hematomas in cavity, which were treated conservatively.

No patient developed DVT, pulmonary infection or pulmonary embolism.

TABLE -5 : Surgical complications according to age of the patients

Complication	01-10	11-20	21-30	31-40	41-50	51-60	Total
No: of pts	8	52	89	68	13	2	232
Wound infection	0	3	1	2	0	0	6
Subgaleal collection	2	11	12	14	3	0	42
Hematoma	0	2	0	1	0	0	3
Meningitis	0	0	1	1	0	0	2
Pulmonary complications	0	1	0	1	0	0	2
Vascular injury	0	1	0	0	0	0	1
Brain swelling	0	1	1	1	0	0	3

TABLE-6 :Surgical complications according to Sex , Side of procedure & Type of procedure

Complications	SEX		SIDE		Procedure		
	F	M	L	R	ATL+A	ATL+AH +L	L
Wound Infection	4	2	3	3	6	0	0
Subgaleal collection	19	23	16	26	37	5	0
Hematoma	0	3	0	3	2	1	0
Meningitis	1	1	1	1	2	0	0
Pulmonary complications	1	1	1	1	2	0	0
Vascular injury	1	0	0	1	0	1	0
Brain swelling	3	0	0	3	2	1	0

NEUROLOGICAL COMPLICATIONS:

The neurological complications encountered are listed in table 7&8.

Hemiparesis/hemiplegia:

Hemiparesis occurs rarely following anterior temporal lobe resections and is usually transitory. An ischemic mechanism most likely in the territory of the anterior choroidal artery is believed to be responsible. Since Penfield's (18) original report of transitory hemiparesis in 5% of patients following temporal lobe surgery this complication continues to be widely reported with varying incidences. The more disabling syndrome of permanent hemiparesis or hemiplegia occurs less frequently. Penfield reported a 2.5 % hemiplegia rate in his early series. In Penfield's (18) original description of disabling hemiplegia following temporal lobectomy he attributed this complication to the sequelae of excessive manipulation of branches of the middle cerebral artery during the trans-sylvian resection of insular cortex. Alternate explanations include direct capsular injury with insular resection, as well as compromise of lenticulostriate vessels and the anterior choroidal artery (3,4,5). In seven of eight hemiplegic patients in his series the operative resection across the sylvian fissure required him to work between insular vessels. Penfield subsequently abandoned the procedure of trans-sylvian insular cortex resection and in the subsequent series of 550 patients in whom the sylvian pia was not violated, no patients exhibited postoperative hemiparesis.

With the current emphasis upon protection of distal MCA vessels and avoidance of insular resection hemiplegia due to MCA compromise is probably uncommon. However with current focus on extensive mesial resections other hypotheses may be advanced to explain disabling postoperative hemiplegia (14,16). These include surgical manipulation or injury to mesial vessels including the anterior choroidal artery or posterior cerebral artery or even the posterior choroidal artery. These vessels are located within the choroidal fissure abutting the hippocampal sulcus and may be inadvertently damaged during the process of uncus or hippocampal removal. Vascular injury may engender distal ischemia and diencephalic infarction with hemiparesis or hemiplegia as well as visual field defects and aphasia are prominent sequelae.

Hemiparesis was observed in 6 (2.5 %) cases in post-operative period of which 4 cases had improvement but in 2 (0.86 %) cases it persisted. One patient had persistent hemiplegia following second surgery probably due to injury to the anterior choroidal artery. Temporary or partial spasm of the anterior choroidal artery could be the probable culprit in the other patients with hemiparesis.

Visual field deficit:

Post-operative asymptomatic visual field defect was the commonest finding on visual field charting, which was seen in our series.

Among 232 patients of temporal lobe epilepsy 62 (26.7 %) patients had asymptomatic contralateral superior quadrantenopia found on visual field charting on 8th post-operative day and out of these only 6 (2.5 %) continued to have symptomatic persistent visual field defect. Two patients developed contra lateral hemianopia and one patient having temporal lobe lesion improved in his visual field after surgery. The injury to the Meyers loop during temporal lobe resection is the implicated mechanism of visual field deficit. Injury to the optic tract is another possible complication, but fortunately was not encountered in this series.

Cranial nerve deficit:

Cranial nerve deficit was found in 14 (6 %) patients. Transient Third nerve paresis was observed in 5 (2.1 %), UMN 7th nerve paresis in 3 (1.29 %) and 6th nerve paresis in 1 (0.43 %). All these patients improved before discharge or on follow up. Third nerve palsy is the commonest cranial nerve deficit encountered other than optic nerve. The close proximity of the third nerve to the mesial temporal structure makes it susceptible to handling or retraction injury. These are however transient and improve in due course. The upper motor nerve seventh nerve paresis is possibly related to retraction injury of the internal capsule and the basal ganglia. This too improves with time.

Speech deficit:

An acquired disturbance of language function is potentially a major complication of epilepsy surgery especially involving the speech dominant hemisphere, which in most centers is identified through presurgical intracarotid amobarbital testing. In order to avoid unnecessary language deficits surgeons may either limit the resection to less than 3 cm of the superior and middle temporal gyri of the language dominant hemisphere or tailor the resection on the basis of cortical mapping of language areas using subdural electrode grids or intraoperative corticography. With adequate presurgical assessment frank disturbances of language functions are relatively rare even following dominant temporal resections. Nonetheless subtle changes from baseline level soon formal measures of naming and other language skills have been associated with epilepsy surgery but typically only during the immediate postoperative period. This was a very rare complication in our series and dysphasia developed in 1 (0.43 %) patient who underwent a left sided surgery. The speech deficit improved on follow up. No patient developed permanent loss of speech function.

Early Post op seizures:

Early post operatives seizures are not believed to carry any prognostic significance. The probable mechanism could be the handling of epileptogenic cortex and is usually transient phenomenon. However the only death in this series was following immediate postoperative seizure. Nineteen

(8.17 %) developed early post-operative seizures of which only 6 (2.58 %) were habitual seizures. Only 3 (1.29 %) developed status epilepticus, however one patient succumbed to that

TABLE-7: Neurological complications –AGE

Complication	01-10 (8)	11-20 (52)	21-30 (89)	31-40 (68)	41-50 (13)	51-60 (2)	Total (232)
Hemiparesis	0	3	2	1	0	0	6
Diplopia	0	1	0	1	0	0	2
Cranial nerves	1	6	3	4	1	0	15
Dysphasia	0	0	1	0	0	0	1
VF Symptomatic	0	3	2	1	0	0	6
VF Asymptomatic	1	9	21	24	6	1	62
Post-op seizures	1	4	11	2	1	0	19
Status epilepticus	0	1	0	2	0	0	3

TABLE-8: Neurological complications – SEX, SIDE, PROCEDURE

Complications	SEX		SIDE		PROCEDURE		
	F	M	L	R	ATL+AH	ATL+A H+L	L
Hemiparesis	3	3	1	5	5	1	0
Diplopia	1	1	2	0	2	0	0
Cranial nerves	7	7	7	7	10	4	0
Dysphasia	1	0	1	0	1	0	0
VF Symptomatic	1	5	2	4	5	1	0
VF Asymptomatic	24	38	32	30	58	4	0
Post-op seizures	10	9	11	8	18	1	0
Status epilepticus	2	1	1	2	3	0	0

LATE COMPLICATIONS

Arachnoid cyst/ hydrocephalus:

Resurgery for residual lesion was performed in 2 patients after 4 & 7 months respectively. One patient developed arachnoid cyst with recurrent seizures and underwent deroofting of the cyst following which she became asymptomatic. One patient who had an associated aqueduct stenosis developed worsening of his symptoms with recruitment of raised ICP signs. CT scan revealed marked hydrocephalus and he required ventriculo-peritoneal shunt after 2 months.

Mortality:

One patient died on the same post-operative day due to refractory status epilepticus. One patient after 45 months follow up developed large subdural hematoma due to a fall following recurrent seizure and expired.

TABLE -9: Late complications -AGE

Complications	01-10 08	11-20 52	21-30 89	31-40 68	41-50 13	51-60 02	Total 232
Hydrocephalus	0	0	1	0	0	0	1
Arachnoid cyst	0	0	1	0	0	0	1
Resurgery	0	0	4	0	0	0	4
Death	0	0	2	0	0	0	2

TABLE-10: Late complications - AGE, SEX, PROCEDURE

Complications	SEX		SIDE		Procedure		
	F	M	L	R	ATL+AH	ATL+AH+L	L
Hydrocephalus	0	1	1	0	1	0	0
Arachnoid cyst	1	0	0	1	1	0	0
Resurgery	2	2	1	3	3	1	0
Death	1	1	1	1	2	0	0

DISCUSSION

DISCUSSION

The discussion of the risks of epilepsy surgery profits from a subdivision into surgical versus neurological risks. The surgical risks of major neurosurgical intervention are well known from the literature. This study is done to evaluate the risks and complications of surgical treatment of temporal lobe epilepsy.

SURGICAL COMPLICATIONS

Wound infection:

Incidence of post-operative wound infection after clean neurosurgical procedures is reported in literature in between 0.6 and 11.7 % (Dijindjian et al-1990, Mollman et al-1986, Shapiro et al-1986 , Young et al-1987) and commonly between 2.5 3.5 % (Behren et al -1997). In this series superficial wound infection occurred in 6 (2.5%) cases and no patient developed deep infection or osteomyelitis. This observation is comparative with the literature report.

Postoperative hematomas:

It is well known that trepanation or craniotomy alone is usually associated with a risk of post-operative haemorrhage of 1-2 % (Fukamachi et al-1986, Chan et al-1989, Palmer et al-1994, Taylor et al-1995). In this study, operated site hematoma developed in 3 (1.29%) cases, which is comparable with previous reports. One patient developed significantly large extradural hematoma in immediate post-operative period, which was evacuated, and patient recovered fully while two patients developed operated site small hematoma in cavity who were improved on conservative management.

Subgaleal collection:

Subgaleal collection of blood, serosanguinous fluid or cerebrospinal fluid was the commonest surgical complication (42-18 %) cases in this series. This parameter is not analysed in literature as complication of surgery.

Others

Other complications reported in literature are as follows. Meningitis between 0.34 and 2 % (Balch et al-1967, Buckwold et al-1977), Lower respiratory tract infection between 3.9 and 21 % (Dauch et al-1989), Deep vein thrombosis (DVT) between 2.3 and 43 % (Joffe et al-1975, Swann et al-1984, Black et al-1986, Frim et al-1992), Pulmonary embolism 1.8 % (Black et al-1986). Our incidence of meningitis too was low (0.86%) and we did not have any cases of deep vein thrombosis, pulmonary embolism etc.

NEUROLOGICAL COMPLICATIONS

Hemiparesis/hemiplegia:

Permanent hemiparesis as a complication of epilepsy surgery was reported by Van Buren et al (1987) to occur in 0.7 % after temporal lobectomy. Polky et al -1996 (6) reported less than 2 % rate of permanent hemiparesis after temporal lobectomy since 1993 in a summary taken from two Palm Desert Symposia. Pilcher et al-1993 (4) reported 2 % permanent hemiparesis after anterior temporal lobectomy. Behren et al (1997) reported 1 % permanent hemiparesis as a complication of epilepsy surgery for temporal lobe epilepsy in 279 temporal lobe resection. Incidence of permanent hemiparesis of 0.86 % (2 patients) in this series seems comparable with that reported in literature. Hemiparesis was observed in 6 (2.5 %) cases in post-operative period that improved in 4 cases but in 2 (0.86 %) cases it persisted. One patient had persistent hemiplegia following second surgery probably due to injury to the anterior choroidal artery. Temporary or partial spasm of the anterior choroidal artery could be the probable culprit in the other patients with hemiparesis.

Visual field deficit:

The majority of visual field defects are thought to result from disruption of Meyers loop -optic radiation fibers which course in the roof of the temporal horn of the lateral ventricle.

Most likely this occurs during the process of ventricular entry and hippocampal exposure, which requires an incision in the white matter at the lateral most aspect of the ventricular roof. The interpersonality variability in the distribution of optic radiation is reflected in the fact that the extent of the postoperative field defect cannot be predicted on the basis of resection size alone for resections less than 7.5cms It is well known that because of the variable course of the optic radiation the extent of postoperative visual field defects after temporal lobe resection cannot be predicted on the basis of resection size alone, with resections of less than 7.5 cm from the temporal pole. Rasmussen suggested that limiting the extent of the superolateral ventricular opening to 1cm quadrantic field defects could be avoided. Increasing defects are noted with more extensive ventricular openings. Unexpected visual field defects may also result from vascular injury during the mesial resection resulting in a distal ischemic insult to the optic tract, lateral geniculate bodies or posterior temporal lobe white matter. Alternatively direct surgical injury to the optic tracts or the lateral geniculate nucleus during the course of an extensive postero mesial resection may account for such defects

Persistent hemianopsia /quadratenopia reported in literature is between 2 and 4 % range after anterior temporal lobectomy (Van Buren-1987, Pilcher et al-1993, Polky-1996, Behren-1997). In this series persistent contralateral quadrantenopic or hemianopic visual field defect was in 6 (2.5 %) cases which is comparative to the reported incidence in literature. It is well known that because of the variable course of the optic radiation fibers, the extent of post-operative visual field defects after temporal lobectomy cannot be predicted on the basis of resection size alone, with resections of less than 7.5 cm from temporal pole (Falconer et al-1958).

Speech deficits:

There was no permanent loss of speech function and only transient dysphasia occurred in one (0.43 %) patient among 232 temporal lobectomies in this series based on pure clinical assessment. The number of post-operative speech disturbances would be much higher if formal post-operative testing was applied. With formal testing, the incidence of transitory post-operative language impairment is reported to reach upto 30 % even in awake temporal lobectomy with intraoperative speech mapping with grids (Van Buren-1987, Wyllie-1987). Permanent dysphasia after temporal lobectomy is reported in literature between 0 to 5.6 % (Van Buren-1987, Pilcher-1993).

In our experience, anatomic criteria alone was proven sufficient to avoid neocortical language site in temporal lobectomy which is corresponding to the results reported by Engel et al who used a very similar anatomically guided technique of enbloc anterior temporal lobectomy without any instances of permanent post-operative aphasia.

Cranial nerve palsy:

Cranial nerve palsies occur occasionally after surgery. Peripheral facial nerve palsies are uncommon but third nerve palsies have been described following anterior temporal lobectomy. Third nerve palsy was uncommon and never was complete or persistent in Elga's series (3) although they used enbloc resection of the temporomesial structures. Other authors using the same technique have reported similar figures for postoperative transient third nerve palsy whereas groups using piece meal resections observed none (6,7,16). Transitory third nerve palsy has been reported in a small minority of patients presumably due to transpial manipulation of the oculomotor nerve during the mesial resection. Jacobson observed that trochlear nerve palsy may be more frequent than oculomotor palsy but under recognized. Thus third and fourth nerve palsies must be considered in the diagnosis of postoperative diplopia, both of which usually resolve within weeks.

Transitory delayed facial nerve palsy constitute another uncommon complication occurring in 3 % of patients in a recent Cleveland clinic series presumably due to transdural injury to the geniculate ganglion or VII nerve during the inferior temporal lobe resection (7,13). Third nerve palsy was seen in 2.1 % cases and has never been complete or persistent in this series, although we always used en bloc resection of the temporomesial structures to obtain well-preserved specimens for the histopathological work-up. Other authors using the same technique have reported similar figures for post-operative transient third nerve palsy (Engel Jr. et al 1983), whereas none were observed by groups by using piecemeal resection (Van Buren-1997, Olivier et al 1988).

SUGGESTED MODIFICATIONS

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1. Small scalp incision with limited craniotomy. Limited craniotomy has the disadvantage of not visualizing the temporal pole after craniotomy. This makes enbloc temporal lobectomy little difficult but has the advantage of minimizing wound related complications.
2. Tight closure of the temporalis muscle layer and the temporalis fascia makes the incidence of subgaleal collection almost nil.
3. Selective amygdalo-hippocampectomy in clear cut appropriate cases can reduce the complications associated with anterior temporal lobe resection viz visual field cut.
4. Attempts to maintain the integrity of the pial layer during resection of the hippocampus can reduce the risk of injury to the anterior choroidal artery.

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