
Surgery

Associate Editor: Mark Sadler

Chairpersons: M. Jones, M. Sadler

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PATIENTS' MENTAL PREPARATION

Dr. F. Maroun: Dr. Woodhurst, in the situation when the patient is awake in the operating room, could you comment on the relationship of the various operating team members?

Dr. W.B. Woodhurst: It is clear that the situation must be business-like. Specifically the situation must be very clear as to who is going to be in charge. We often use the anesthetists as the "intraoperative friend", and the surgeon as the "commander".

Dr. J. Girvin: In the preoperative preparation for the patient, a very useful instrument is a video tape that we have prepared. The video tape shows the operative procedure and the patient can view this multiple times which will help him/her understand what to expect. In contrast to the past, we find that patients nowadays are much more inquiring and often like to have as much information as possible before their surgery.

Dr. W. Blume: In previous discussions, Dr. Manchanda discussed various personality types that can lead to difficulties. There appears to be at least two types of individuals that the surgical team may have difficulty in dealing with: (1) the paranoid personality that is inherently distrustful and (2) the obsessive patient. Could Dr. Girvin or Dr. Woodhurst comment on how to deal with these individuals?

Dr. W.B. Woodhurst: I do not have any special techniques for dealing with the patient with the paranoid personality. For the obsessive patient I am prepared to sit and talk as long as it takes to ensure that the necessary information is given. I try to resist giving "hard numbers" for complication rates and success rates.

Dr. J. Girvin: The patients that I worry most about are those who do not want to have any information and just want to "get on with it". Some of these patients have not come to the realization that this is a procedure that has definite risks and the procedure may not achieve the expected positive outcome. I always make sure that I speak to one of the family members or other members of the patient's support group to make sure that at least one person close to the patient understands the potential risks and potential benefits.

Dr. F. Andermann: I agree with Dr. Woodhurst's and Dr.

Girvin's comments. When patients come to talk about surgery, I always ask "why do you want to have surgery?" The young patients invariably answer that they "want to drive" but I always make the effort to take extra time to inquire what are the other problems and issues that they have other than just driving. I agree with Dr. Girvin that other family members must be involved in the discussion.

I would like to emphasize that it is important that all the different members of the team, including the neurosurgeon, neurologist, and neuropsychologist have a uniform view of the potential risks and benefits. Each of these individuals may give a different perspective on the problem but it is important for the patient and their family to receive the same general message from all the surgical team members.

Dr. G. Savard: I would like to ask the surgeon if they have ever had the experience of the patients changing their mind in the operating room about having the surgery done? Do they often panic?

Dr. W.B. Woodhurst: I have never had the experience of a patient changing his/her mind in the operating room.

Dr. A. Olivier: I also have not had a patient change his/her mind during the procedure. However, there have been a few instances of patients beginning to panic during the operation but it is at this point that the anesthetist is so important in getting the patient settled down.

Dr. A. Parrent: I would like to make an additional comment about the mental preparation of the patient. It is extremely important to give the patient the opportunity and time to voice their fears. Frequently the physicians have a preconceived idea of what the risks and benefits of epilepsy surgery are, but the patient's fears may be of sustaining a complication that is entirely unrealistic or have virtually no chance of happening. For example, a tremendous, but unrealistic fear for some patients is that they will become totally amnesic.

ANESTHESIA

Dr. D. MacDonald: I would like to comment on our experience with electrocorticography (ECoG) in patients undergoing temporal lobe surgery with propofol anesthesia. We have recorded some patients during the phase from their state of anesthesia through the

transition state to awakening. We have noticed on occasion that the epileptiform spikes gradually increase in frequency as the propofol effect wears off.

I would like to issue a word of caution concerning anesthetic agents that have been reported to increase spikes. When we give medications that activate spikes we are getting further away from the patient's "natural state" and it begs the question of the relevance of these spikes to the patient's true epileptogenic zone.

Dr. I. Herrick: I agree that this has been one of the controversies of the different anesthetic agents and the ECoG.

Dr. W.B. Woodhurst: Dr. Sahjpaal, I was surprised to hear that you are doing intraoperative monopolar stimulation without ECoG monitoring. I do not think that this technique is valid because if you have a prolonged afterdischarge at the site of stimulation, the validity of that site as a true positive for language mapping is in doubt as the afterdischarge can precipitate a subclinical seizure that may spread and be unrecognized. I think it is mandatory to do ECoG recording intraoperatively if you are doing monopolar stimulation.

Dr. A. Lozano: I would like to ask the representatives of the surgical centers in Canada what is their method of anesthesia for most temporal surgical cases. I am getting the impression that different centers are using different techniques.

Dr. R. Sahjpaal: We do almost 100% of the temporal cases under local anesthesia.

Dr. J-M. Saint-Hilaire: At our institution we do not do ECoG recording for interictal spikes. Our cases are generally done with general anesthesia and we awaken the patient for evaluation of the speech zone if required.

Dr. W.B. Woodhurst: Almost every case is done under general anesthetic; we awaken the patient for the ECoG as Dr. MacDonald indicated. We use local anesthesia for dominant hemisphere neocortical resections that are close to the expected speech zone.

Dr. N. Pillay: We do almost all cases with general anesthesia.

Dr. A. Olivier: For standard temporal lobe resection we use virtually 100% general anesthesia for the standard anterior temporal epilepsy resections. We have a very stereotyped procedure and historically have done most with ECoG recording, but we are doing an increasing number without ECoG. I would like to emphasize that I am not referring to resections in the posterior temporal region.

Dr. F. Maroun: We shifted about 10 years ago from doing all cases under local anesthesia to a light general anesthesia with ECoG recording. We also use local anesthesia only when working close to the speech zone.

Dr. J-M. Saint-Hilaire: Dr. Olivier, what is your main use of ECoG?

Dr. A. Olivier: For recording of spontaneous electrical activity.

Dr. A. Lozano: In Toronto, we do approximately 90% of temporal lobe resections under general anesthesia; we have done only a small number with local anesthesia, and in those it is because of concern with respect to the speech area.

Dr. M. Lee: Almost 100% of the temporal resections in Calgary are done under local anesthesia.

Dr. P. Hwang: In the pediatric cases in Toronto we use a general anesthetic for children under the age of 5 years; for those greater than 6 years we use neuroleptic anesthesia with the nitrous oxide turned off during the time that we do the ECoG.

Dr. M. Sadler: In Halifax, we almost always use propofol anesthesia and awake the patient for an ECoG and stimulation studies if required in the dominant hemisphere.

Dr. A. Lozano: It is very interesting to hear the differences from one center to another in Canada. I think that this is an area in which it would be difficult to obtain a consensus; all of these techniques probably have equal efficacy.

Dr. J. Girvin: I would like to make a few comments, as we are one of the two centers in Canada that appears to do all cases under local anesthesia. I would like to say that we do not use local anesthesia because we think it is more effective. We have, over the years, learned a great deal from stimulation studies as a result of doing the patients under local anesthesia. What this has allowed us to do is to have an entire team with several anesthetists very comfortable with this procedure such that when we use the local anesthetic technique for a case that we consider it to be mandatory (such as surgery in eloquent cortex) there is no discomfort among the team members using this technique.

Dr. A. Lozano: In Toronto, we have an increasing number of cases done under local anesthesia for extratemporal resections and our number of temporal lobe cases performed with local anesthesia is falling. We feel that the patients done under local anesthesia have a shortened hospital stay.

Dr. A. Gelb: I would like to comment on the use of narcotic based anaesthetics. Narcotic based anaesthetics are not inert in terms of provoking spikes. The St. Louis group have found that fentanyl is totally nonspecific in where it provokes spikes.

SURGICAL TECHNIQUE AND ANATOMY; SURGICAL PITFALLS; STEREOTACTIC SURGERY

Dr. D. MacDonald: I would like to comment on Dr. Olivier's presentation. In the literature, the selective procedure discussed by Dr. Olivier is usually referred to as a "selective amygdalohippocampectomy"; strictly

speaking, the technique that Dr. Olivier presented should be called a “selective amygdala-hippocampus-para-hippocampal resection” because of the removal of the parahippocampal gyrus. We have observed with ECoG how often the parahippocampal gyrus has large numbers of spikes.

Dr. J.-M. Saint-Hilaire: Dr. Girvin, could you comment on the mechanism of injury to the IIIrd nerve?

Dr. J. Girvin: I think it is an infarct of the nerve. Further, with respect to the so called “manipulation hemiplegia” I do not think that this is the correct term; I think it is because during the surgical procedure one of the feeder vessels to the internal capsule has been compromised.

Dr. J.-M. Saint-Hilaire: I agree with your comment on the mechanism of injury to the IIIrd nerve. We had two cases about 15 years ago that may be instructive. When the neurosurgeon was coagulating, the EEG technologist was watching the eye of the patient and each time the coagulation instrument was turned on the pupil dilated ipsilateral to the side of the surgery. I should add that this was with a monopolar instrument. Subsequently we have used only a bipolar coagulator and we have not observed any further difficulties.

Dr. J. Girvin: The only case of a hemiplegia I have had, occurred with bipolar coagulation.

Dr. W.B. Woodhurst: I have had the experience of several IVth palsies. They are transient and I believe occurred because of manipulation of the IVth nerve at the tentorial edge. I believe the reason I have had this experience is because my technique is a subpial “dissection” (as opposed to a subpial “resection”) – and this technique sometimes leads to a bit of excessive traction on the IVth nerve.

I accept this as a complication of a manipulation of an *en bloc* mesial specimen. I have had the complication of a partial IIIrd nerve palsy as a result of a subdural EEG recording strip that was inserted too far.

Dr. A. Olivier: The only IIIrd nerve problem we have had was in a case of a selective amygdalohippocampectomy in a patient with a ganglioma. I recall the circumstances very well and I think the IIIrd nerve injury was certainly related to manipulation. I was not too worried about recovery at the time, as I could see that the nerve was intact, and we recognized that we had been manipulating it when the partial paresis occurred. I think there is an increased risk of complications with an *en bloc* resection and I do not do that procedure.

Dr. R. Sahjpal: From the discussion, it appears that the major intraoperative complications of surgery are related to vascular injury or resection of eloquent cortex. Obviously the latter can be minimized with neuroleptic anesthesia.

Dr. Parrent, could you comment on your approach for the stereotactic procedure?

Dr. A. Parrent: I do an entry through T2 and therefore I am below the insula and above the hippocampal sulcus.

Dr. R. Sahjpal: Could you target the parahippocampal gyrus?

Dr. A. Parrent: In that situation, I would have to transgress the collateral sulcus. Dr. Blume and I have talked about this but then the procedure becomes much larger and therefore it would probably be more reasonable to do a selective amygdalohippocampectomy.

The most feared complication of the stereotactic procedure is hemorrhage and this is a function of crossing pial boundaries. With the procedure that I have described, the only pial boundary that I cross is in the lateral temporal neocortex.

Dr. W. Blume: I would like to comment on the relationship of spikes to seizures. These two phenomena do not have the same physiology. When we have been recording intraoperatively with Dr. Parrent during stereotactic procedures, we have a recording electrode in the ventricle. With progressive lesioning of the amygdala and then the anterior and mid portion of the hippocampus, we have not seen a change in spike frequency. When we started this procedure we wondered if we could use the ventricular electrode and spike frequency as a guide as to how far to go with the lesioning. We considered whether the entire complex could be viewed as a “series” circuit such that lesioning one part of the “circuit” would destroy epileptogenesis.

Dr. A. Parrent: I agree with Dr. Woodhurst that we should define the minimal lesion. We are at the stage now in our stereotactic procedure where we have a “standard” technique. The next step would be to conduct a proper prospective trial.

I would like to add a few comments to the earlier statements of Dr. Blume. We have had the opportunity on one occasion to have recording EEG electrodes in the ventricle as well as depth electrodes in the amygdala, hippocampus, and parahippocampal gyrus. We have recorded electrographic seizures from the intraventricular electrode, when there does not appear to be anything happening in the amygdala and hippocampus; we have recorded seizures in the amygdala and nothing obvious in the intraventricular electrode or the parahippocampal electrodes. We are clearly seeing different things with different recording techniques. We do not know the significance of this yet.

Dr. R. McLachlan: I think an important aspect of a discussion of operative and complications of temporal lobe surgery will depend on who is asking the questions. When surgeons ask the question, they have the lowest complication rate; when the neurologists ask the questions, we have an intermediate figure, but when the nurses ask the questions, we have the highest complication rates. For example, intractable

postcraniotomy headache is an entity that I am sure most neurologists believe in; I am not sure what the surgeons think about this.

Dr. A. Parrent: I think we must be careful not to confuse the issues of “surgical technique” and “volume of tissue resected”. For example, some of the discussion has been on whether we should go around the parahippocampal gyrus with a subpial resection technique or aspirate this tissue with an ultrasonic aspirator; with both techniques the volume of tissue resected is exactly the same. With one technique we have a very nice specimen to be able to present to the pathologist and with the other we do not.

Dr. R. McLachlan: I would like to bring up the issue of a lesionectomy. Suppose you have a patient with limbic seizures but also an anterior neocortical ganglioglioma and the MRI scan does not show mesial temporal sclerosis. What would you do?

Dr. A. Parrent: There is a body of literature that would suggest, in the absence of dual pathology, that lesionectomy alone should be effective. However, one could make a case for doing a standard anterior temporal resection including the mesial structures.

Dr. A. Olivier: These are always difficult cases in which the decisions must be individualized. For example, if we have a small cortical cavernous angioma I would resect only that lesion and the surrounding gliotic tissue. If the lesion was not involving the mesial structures I would leave them alone, at least initially. In the case of a ganglioglioma, they are frequently large and may be very close to the amygdala; in those situations I would tend to remove the amygdala and the anterior hippocampus as well. I think that in the situation when we have a tumor immediately adjacent or impinging on the amygdala, we should remove that structure as well because I do not think that the seizure control will be as satisfactory if only the lesion is resected. We must remember that the objective of the surgery is to make the patient seizure-free, as opposed to only reducing the number of seizures. I think that the chance of having the patient seizure-free is higher if a more extensive resection is done.

I think that Dr. Parrent’s work with the stereotactic procedure is extremely important. As we know, there is a movement towards making a radiosurgery lesion but we will not see the effects of this technique for nine months. Therefore, why not do the stereotactic procedure which will have its beneficial effects immediately?

However, I do have a problem with the stereotactic procedure in that it leaves a considerable amount of tissue behind. I think that the success of this procedure will depend on how much of the uncus and anterior hippocampus is destroyed and not only in the anterior-posterior direction; you must also consider the extent of

the lesion in a circumferential direction. I have concerns that this procedure will not produce results as good as with our conventional techniques. I would like to add that in Montreal, we do not necessarily do the selective amygdalo-hippocampectomy because we think it leads to a better seizure control than the other techniques, but rather because there is less manipulation of other structures intraoperatively and also, intellectually, if some tissue does not need to be removed, why remove it?

Dr. W. Blume: I would like to comment on the problem that Dr. McLachlan presented. I think the approach will depend on the state of the patient’s memory. For example, if the ganglioglioma is in the dominant hemisphere and the hippocampus is going to be resected, then that patient will lose some memory function. If the lesion is in the nondominant hemisphere then the memory issue is less problematic. I would add that insertion of a depth probe into the hippocampus during surgery will not necessarily solve the question as there has been some suggestion that the mere fact of inserting the electrode into the hippocampus will provoke spikes. An alternative might be to put some subdural electrodes on the parahippocampal gyrus at the time of surgery and see what is found. I would favor leaving the hippocampus alone on the dominant side if there is no abnormality of the hippocampus on neuroimaging and no memory deficit.

INTRAOPERATIVE EEG

Dr. W. Blume: Dr. MacDonald, could you tell us how you defined or distinguished discreet localized spikes from widely synchronous spikes?

Dr. D. MacDonald: The distinction was made purely on the appearance on the ECoG. Sometimes we see spikes arising from a single electrode location and at other times spikes involving multiple electrodes synchronously. Usually we find the distinction fairly straightforward.

Dr. W. Blume: To correlate with your work, Lieb in *Epilepsia* 1981, distinguished the number of independent spike patterns in depth recordings and found that the more independent spike patterns correlated with the most epileptogenic side.

An additional comment would be that the spikes noted immediately postresection often resemble “small sharp spikes” or “benign epileptiform transients of sleep” in terms of their morphology and widespread field.

Dr. R. Desbiens: Dr. MacDonald, do you think that some spikes become activated in areas of cortex that have had underlying white matter resected?

Dr. D. MacDonald: I think in some of these cases in which the mesial temporal structures have been resected that there is an element of postresection spike activation

that could be accounted for by a deafferentation process involving the lateral neocortex.

Dr. R. Desbiens: What do you do with the postexcision spikes? Do you do any further resection?

Dr. D. MacDonald: Absolutely not.

Dr. W.B. Woodhurst: I think that some of the spikes could be produced by the traction effects on underlying white matter. I think that our procedure produces traction damage and excisional damage at T3. The transcortical approaches can produce some deafferentation by cutting through the temporal stem.

Dr. M. Jones: I would like to ask the participants from the various centers whether they do or do not do an ECoG recording in cases of mesial temporal sclerosis.

Dr. S. Wiebe: From my perspective, I have not heard anything here that would conclusively support the use of ECoG. If we really would like to know the optimum extent of the resection, we should do the proper study.

Specifically, we should have a prospective comparative study in which different extents of resections are performed and the outcomes with respect to seizure control compared. This type of study has been

attempted on at least one occasion and was reported by Wyler and Hermann in 1995. They randomized patients to limited or more extensive resection of the mesial temporal structures. Unfortunately, the details of exactly how the trial was conducted were not contained in the publication. The overall result was that the patients with more extensive resections had better seizure control. It is tempting to speculate that an electrophysiologic parameter, such as spike location and spike frequency, will correlate with outcome but we will not know this until the proper study is done.

Dr. F. Andermann: Have any of those in attendance here been able to identify an inferior temporal language area?

Dr. D. MacDonald: We have no information on that at all.

I have some concerns about a prospective trial of the nature that Dr. Wiebe has suggested. One of the underlying concepts of "tailoring" the resection at least partly on the basis of ECoG is that we may not be dealing with an entirely homogeneous condition. Certainly many of these patients have certain factors in common but not all patients have the epileptogenic zone confined to the anterior hippocampus and amygdala. I think we should continue to use ECoG to help define the extent of the resection.