Mechanism of Stroke Progression

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Gift of Healing
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In an era where technology is becoming increasingly dominant, the approach of physicians appears to be changing. The availability of very sophisticated imaging techniques, laboratory tests and genetic tests had made diagnosis very precise. Newer designer drugs with more specific actions are now available to target each disease. Robotic surgery and other new less invasive interventions have made surgical procedures very precise reducing blood loss and complications during surgery. All in all the new medical technology available for patient care is really impressive and effective.

However, there is still no substitute for a careful history and a detailed physical examination by the physician to elicit symptoms and signs which will lead to a diagnosis. The scans and investigations should only be used to compliment the physician's diagnosis. Even in the matter of providing treatment, the compassion and healing touch of the physician, though now greatly undervalued, is far superior to any drug or therapy that we can conjure up. Many patients feel that the mere presence of the physician lifts their mood and reassures them. A firm and kind “don't worry, we will get you better” will work wonders if the physician is genuinely compassionate. Unfortunately many young doctors nowadays are slaves of technology to the point where they will see the patient only after a battery of tests have been done. How one can order an Echocardiogram or MRI brain or CT chest even without seeing the patient, let alone examining him, is beyond comprehension. But unfortunately such an approach to practising medicine is on the increase.

We must be patient-centric in our approach. First and foremost we must form a bond with the patients through proper communication and examination and only then must we unleash all the sophisticated technology at our disposal and that must be done judiciously to better the health of our patients.
Broaden Your Vision

As physicians we must be kind and compassionate to our patients. Since this caring attitude is a part of our job, it should be easy for us to extend this compassion to all other people with whom we interact. Indeed, we should extend this attitude of love and compassion to all creatures around us and to all of Nature. But very often we get caught up in our own private world and then we only have concern for our own needs and may be the needs of our family. This makes our thinking and outlook very restricted. We may be nice people, but yet we often tend to narrow down and zone in an only ourselves and hence miss the larger picture.

The following parable narrated by Amma is a simple example of this.

One day a lady was waiting for her flight at an airport. She sat down on a bench and began to read a book. She had a packet of biscuits in her handbag and was thinking of having a few biscuits, but she got immersed in reading her book. She noticed that a pleasant young man sat down on the same bench. The lady then saw that the young man was helping himself from her packet of biscuits which was lying on the bench beside her. She looked out of the corner of her eyes and saw the young man help himself to another biscuit. She was irritated that he was helping himself to her biscuits without her permission or invitation.

She kept glancing out of the corner of her eye to see what he was up to, and she became more and more agitated each time the young man took another biscuit. Her peace of mind was gone. She was unable to concentrate on her book. Suddenly she saw that the young man had picked up the biscuit packet and held it up to her and asked with a smile, “Would you like to have one?”

The lady was furious. “He has coolly helped himself to my biscuits and now he has the cheek to ask me if I want one” she thought. She didn’t reply to his enquiry, but snorted in disgust and gave him a dirty look and got up and went away, thinking, “This fellow has no manners. Let the greedy pig have the rest of my biscuits as well.”

Later on, after she had calmed down and boarded her flight, she opened her handbag and found her packet of biscuits inside the bag—unopened. Only then did she realise that all along the young man was eating his own biscuits and she needlessly got agitated thinking that they were her biscuits. She felt ashamed at her behaviour, especially when she recollected how the young man had offered her his biscuits and she got up rudely and went away without replying. “Wouldn’t it have been a much more pleasant experience if I had shared the biscuits with him, without worrying about whom they belonged to?” she thought regretfully. After all they were only biscuits.

This is how our attachment to objects and people that we think belongs to us results in unnecessary and endless stress and problems. We should always concentrate on giving, instead of accumulating.
An Insight into Mechanism of Stroke Progression

ABSTRACT

Early neurological deterioration following stroke is quiet common and is associated with significant mortality and morbidity. Etiology of stroke is very well understood, whereas that of neurological worsening is different and not as clear. Vascular occlusion, reocclusion of recanalised artery, rapid rise in intracranial pressure, hemorrhagic transformation are the various mechanisms for stroke progression whereas good recruitment of collaterals is associated with recovery from an ischemic stroke. Earlier, clot progression was attributed to neurological worsening but with the advent of MRI, it is now understood that failure of collaterals is responsible for stroke progression.

Keywords: Stroke Progression, Early Neurological Deterioration, Mechanism of stroke progression.

INTRODUCTION

It is estimated that, annually, 15 million people worldwide suffer a stroke. Of these, 5 million deaths occur and another 5 million are left permanently disabled. Various studies have shown that early neurological worsening in acute ischemic stroke is common; ranging from 20 – 40%. Various risk factors for stroke have been well established. These include high blood pressure, disorders of heart rhythm, smoking, high blood cholesterol, physical inactivity, diabetes mellitus, end stage renal disease & chronic kidney disease.

Early neurological deterioration following stroke is quiet common and is associated with significant mortality and morbidity. Etiology for stroke is very well understood, whereas etiology behind neurological worsening is not clear and is different.

MECHANISM OF STROKE PROGRESSION

Several mechanisms have been proposed for progression of stroke. Various factors include failure of collaterals, occlusion of large arteries, raised intracranial pressure, seizures and hemorrhagic transformation and inflammation.

Failure of collaterals

Occlusion of a major blood vessel is one of the most important independent predictors of early neurological deterioration. Vascular occlusion leads to hypoperfusion of the affected region, unless effective collateral circulation develops. Collaterals are native blood vessels connecting different arterial territories. Initial clinical worsening is due to synaptic dysfunction with preserved cell membrane integrity and is potentially reversible with vessel recanalisation. Good recruitment of collaterals helps in the rapid recovery.

Collateral status at baseline is an independent determinant of clinical outcome amongst patients with acute ischemic stroke. Studies have shown that good collaterals at baseline have small baseline infarcts when compared with patients with intermediate and poor collaterals. The rate of infarct growth is also quicker in patients with intermediate collaterals and outcome is improved in patients achieving recanalization following thrombolyis.

Diabetic microangiopathy and chronic hypertension impair microvascular function, reducing the potential for collateral development. Insufficient collaterals leads to reduced oxygen delivery and metabolic disturbance, aggravates cellular damage by enhancing brain edema and free radical injury.

Cerebral oedema

Davalos et al demonstrated that brain edema is an independent factor for early neurological worsening. Raised ICP accounts for 19% of cases of early deterioration in ischemic stroke. It is usually a complication of large intracranial artery occlusion and large multilobar infarction. Brain edema spreads in concentric fashion and progressively reduces clinical function without extension of the original area of infarction.

Life-threatening middle cerebral artery infarction occurs in upto 10% of all stroke patients. Werner et al demonstrated that complete middle cerebral artery territory stroke leads to rapid development of space occupying mass effect and most of these patients developed hemiation. Derk et al & Scott et al also demonstrated that patients with ≥ 50% of middle cerebral artery territory stroke are at a high risk for developing fatal brain swelling.

Hemorrhagic transformation

Hemorrhagic transformation in ischemic stroke is common and ranges from small asymptomatic petechiae to a large hematoma with pressure effects. Large parenchymal hematoma is considered to be associated with adverse effects. As the ischemia prolongs, there will be uncoupling of the astrocyte foot process from the endothelium and blood brain barrier becomes porous. Hence, the duration of ischemia is a crucial factor in hemorrhagic transformation of infarcts.

Vincent et al demonstrated that the risk of hemorrhagic transformation is
related to extent of cerebral ischemia. They found that patients with hypotension in >33% of the middle cerebral artery territory on baseline CT scan had higher risk for hemorrhagic transformation. Vincent et al also analyzed the relationship of hemorrhagic transformation and cardio-embolic stroke, and found that congestive heart failure was associated with increased hemorrhagic transformation, whereas atrial fibrillation and myocardial infarction were not. Lodder et al demonstrated that confluent hemorrhages where more common in patients with cardio-embolic stroke.

Vincent et al also demonstrated that risk for hemorrhagic transformation is higher in older patients following rtPA. There is higher incidence of hemorrhagic transformation in rtPA treated patients who had aspirin before stroke. Re-occlusion of re-canalized artery

Early re-occlusion accounts for two thirds of deterioration following improvement in patients treated with tPA. Alexandrov demonstrated that occlusion occurs in up to 34% of tPA treated patients with any initial re-canalisation. He also found that re-occlusion occurs more often in patients with earlier and partial re-canalization, leading to neurologic deterioration and high in-hospital mortality. However, he also observed that patients with re-occlusion have better outcomes than patient without any re-canalization. A single cohort study of acute tPA given in stroke patients showed an early recurrent ischemia of 6%. Most of these patients were having atrial fibrillation.

Marta, et al demonstrated that clinical worsening occurs in up to 12% of middle cerebral artery stroke treated with tPA. They demonstrated that stroke severity at the time of admission and presence of extracranial carotid artery disease represent independent predictors of early arterial re-occlusion after tPA induced re-canalization. They also observed that stroke severity represents the clinical surrogate of clot burden.

Experimental studies have demonstrated that effective delivery and distribution of tPA into the clot accelerates fibrinolysis and that the fibrinolysis rate is dependent on the pressure gradient to which the clot is exposed. Presence of an extracranial severe carotid stenosis or occlusion leads to a regional decrease of cerebral perfusion pressure, which may not only hamper MCA clot dissolution but also favor blood stasis, increasing the likelihood of rethrombosis after incomplete re-canalization. Furthermore, in vitro and animal models had demonstrated that clots formed under variety of biochemical and physical conditions exhibit a differential susceptibility to lysis. This could be one of the possible mechanisms for re-occlusion following re-canalisation with tPA.

Clots formed in arterial bifurcations had usually been considered as platelet rich clots. The latter are resistant to lysis and more prone for rethrombosis. It is known that the tPA itself promotes thrombosis by stimulating the plasmin production, which activates platelets and transforms prothrombin to its active form. Thrombin has also been demonstrated to mediate platelet activation and to convert fibrinogen to fibrin. The activated platelets secrete native plasminogen inhibitor 1, which opposes the intrinsic fibrinolytic cascade and administrated tPA. The presence of a platelet-rich clot probably enhances this mechanism as demonstrated in patients with acute MI in whom an augmented platelet aggregation was a powerful predictor of re-occlusion after thrombolysis. This could be another probable reason for re-occlusion.

Seizures

Seizures account for neurological deterioration in 3% of patients with ischemic stroke with large cortical infarct. They lead to transient neurological worsening, though prolonged partial seizures can lead to persistent worsening.

Inflammation

The cause for early neurological deterioration in patients with lacunar infarct is still unclear. Study done by M. Castellanos, et al in a large series of patients with lacunar infarction demonstrated that high levels of inflammation is an independent risk factor for early neurological deterioration and poor outcome. Plasma levels of inflammatory mediators interleukin-1, Tumor necrosis alpha and Intercellular adhesion molecule-1 have been observed to increase after experimental brain ischemia.

They observed higher levels of inflammatory molecules in patients with lacunar infarcts located in basal ganglia and brainstem than in those with white matter infarctions, so it was hypothesized that excitotoxicity and inflammation might represent sequential and interacting processes in the progression of lacunar stroke, particularly in areas in with high density of glutaminergic neurons. This theory is supported by an animal study done by Chaco, who demonstrated that exposure of human fetal neuronal cells to the excitatory aminoacid neurotransmitter, glutamate, for 6 days, resulted in a dose-dependent cell loss. Moreover they demonstrated that TNF-alpha potentiating glutamate toxicity was blocked by administering glutamate receptor antagonist.

Interleukin synthesis in the brain is stimulated by mechanical injury and it was demonstrated by Relton in animal studies that neuronal death resulting from focal ischemia is significantly inhibited in rats injected with a recombinant interleukin-1 receptor antagonist, indicating that endogenous IL-1 is a mediator of ischemia and excitotoxic brain.

Recently, studies have shown that patients on aspirin have less severe stroke. De Cristobal et al demonstrated that aspirin has neuroprotective effect also, apart from its antiplatelet activity.
from the antiplatelet effect in animal studies\textsuperscript{39}. The former effect is due to inhibition of glutamate. Later, they confirmed these findings in human studies. They studied the levels of glutamate in patients presenting with acute ischemic stroke and found that patients on aspirin had lesser levels of glutamate and also treatment with aspirin at stroke onset has 97\% risk reduction for early neurological deterioration\textsuperscript{39}.

**Recurrent Stroke**

Patients with acute ischemic stroke were associated with recurrent stroke during initial first week and were associated with early neurological worsening\textsuperscript{31,42}. Kang et al demonstrated that recurrent stroke was most frequently seen among patients with large artery atherosclerosis\textsuperscript{42}.

**Clot Progression**

Early neurological deterioration in acute ischemic stroke had been attributed to clot progression in the past\textsuperscript{44,15}. But studies of early MRI in acute stroke have shown large vessel occlusion and failure of collaterals rather than clot progression as the main mechanism of occlusion of early neurological deterioration\textsuperscript{41,48}.

**Cortical Spreading Depression**

These are small depolarization waves at the peri-infarct and injury areas which continue for a varying period of time and causes progressive damage\textsuperscript{45}. It is very common in massive hemispheric infarcts. Further research is ongoing to tap the potential therapeutic option in this aspect.

**CONCLUSION**

Vascular occlusion, re-occlusion of a re-canalised artery, rapid rise in intracranial pressure, hemorrhagic transformation are all associated with stroke progression whereas good recruitment of collaterals is associated with recovery from an ischemic stroke. Further research is needed in this field to identify the factors responsible for stroke progression and to develop therapeutic options to prevent stroke progression.

**References**

SPECT & PET Imaging In Epilepsy – An Overview
S.Padma, P. Shanmuga Sundaram

ABSTRACT:
Epilepsy is one of the most prevalent neurological disorders worldwide. There are more than 10 million epileptic patients in India alone. Antiepileptic drugs are used to control seizures, but in about 30% of patients, they are refractory. These medically intractable patients are candidates for surgical treatment in order to achieve better seizure control. The single most important determinant of a successful surgical outcome is patient selection. This requires detailed pre-surgical evaluation to characterize seizure type, frequency, localization of seizure focus, psychosocial functioning and degree of disability in order to select the most appropriate treatment from a variety of surgical options. Molecular imaging with ictal and interictal single-photon emission computed tomography (SPECT) as well as positron emission tomography (PET) rank among the established functional imaging tests for the pre-surgical evaluation of patients especially with temporal lobe epilepsy (TLE). In TLE, the sensitivity of these methods is found to be excellent, in particular if a multimodality platform is used, which integrates the functional imaging with morphological information of magnetic resonance imaging (MRI), but is lower in extra-temporal lobe epilepsy. Functional imaging with SPECT and PET actually reflects the seizure-related changes of cerebral perfusion, glucose metabolism and neuroreceptor status.

Key words: Cerebral perfusion; SPECT; PET; Ictal; Interictal study.

INTRODUCTION
Patients unresponsive to anticonvulsant therapy may be candidates for surgical treatment. The pre-surgical evaluation of epilepsy patients is a multiphase process, involving noninvasive tests such as Electroencephalogram (EEG), neuropsychology assessments of verbal and non-verbal memory, MR, and ictal/interictal SPECT/PET.

Most partial complex seizures originate in the temporal lobe. Unfortunately scalp EEG often fails to accurately localize the seizure focus. Depth EEG is much more accurate, but it is invasive, requiring a craniotomy. Also, it suffers from regional under-sampling. Patients are said to be medically intractable when seizures remain uncontrolled despite an adequate trial with two of the first-line antiepileptics. This group consists of 0.1 to 0.5 % of the general population. Usually, refractory epilepsy is focal in origin, and mostly involve the temporal lobe. In fact, 50% of patients with TLE cannot be controlled completely with medication. Introduction of new imaging technologies like PET, SPECT and MRI in clinical practice has greatly reduced the need for invasive monitoring. They also help to avoid associated postoperative complications like hemorrhage and infection. Brain MRI demonstrates morphologic changes in approximately 80% of patients with epilepsy. However, structural lesions may not always correlate with clinical, EEG and pathologic localization of epileptogenic foci. Therefore, functional information provides a better road map to delineate the extent of epileptogenic zone.

SPECT provides information on neuronal uptake while PET displays the cerebral metabolism. Seizures are associated with pronounced changes in regional cerebral blood flow. SPECT imaging unfolds significant hyperperfusion at the site corresponding to ictal focus as there occurs a 300 percent increase in cerebral blood flow during an ictal episode. An interictal study should show a hypoperfusion on SPECT or a hypometabolism on PET in the epileptogenic zone (Fig 1). So the real power of SPECT lies in the opportunity of ictal examinations, with a sensitivity ranging from 90 to 97%. However, as interictal SPECT has shown low sensitivity (43% to 44%) nowadays it is largely replaced with 18F-FDG (18 Fluorine labeled Fluordeoxyglucose) PET. These images have higher spatial resolution (sharper images) and provide a direct measure of regional glucose metabolism. FDG PET interictal study cannot be performed as FDG injection has to be given within 30 sec of an ictal episode (FDG half life is 110 min) and the uptake of FDG into the cerebral tissue post injection is variable and occurs over a period of time which may not represent the actual site of ictal focus. FDG PET is typically positive in patients with hippocampal sclerosis on MRI. It also reveals hypometabolism in a majority of patients with nonlesional temporal lobe epilepsy, even in the absence of hippocampal atrophy.

The most common pathologic finding in patients with partial seizures is mesial temporal sclerosis which is thought to represent a gliotic scar. Excision of this focus can lead to elimination of the seizures or significantly improved pharmacologic control in 80% of patients. CT and MRI have low sensitivity for seizure foci detection, 17% and 34% respectively.
ABSTRACT:

Neuroreceptor status. tests for the pre-surgical evaluation of patients especially with temporal lobe epilepsy (TLE). In TLE, the sensitivity of these methods to determine the extent of epileptogenic tissue, ictal / interictal SPECT/PET. Cerebral perfusion; SPECT; PET; Ictal; interictal study.

INTRODUCTION

Cerebral perfusion imaging can be performed after stabilization of patient. Timing of the injection is very crucial as it reflects the cerebral activity at the time of injection. In a patient with temporal lobe epilepsy by continuous video EEG monitoring, the tracer would be injected within 30 seconds of an ictal episode (as patient will be under video EEG coverage). The acquisition can then wait until the patient has recovered and imaging can be performed after stabilization of patient. The mechanism of uptake using both HMPAO or ECD tracers are similar; subtle variations exist as far as brain uptake and stability of compound are concerned.

FDG interictal PET - Hypometabolism in Rt temporal lobe corresponding to ictal site.(arrow)

After intravenous injection of HMPAO, it distributes in brain substantially on first pass. Once inside the neuron, it is converted into a hydrophilic compound, which is trapped inside the cell membrane. Therefore, the distribution of the compound and radiotracer remains stable for many hours after injection. Effectively, this means that an image acquisition carried out at some time after the injection will show the pattern of perfusion that existed at the time of the injection. All that requires to be done at the time of the seizure is to give the injection within 30 seconds of an ictal episode (as patient will be under video EEG coverage). The acquisition can then wait until the patient has recovered and imaging can be performed after stabilization of patient. The mechanism of uptake using both HMPAO or ECD tracers are similar; subtle variations exist as far as brain uptake and stability of compound are concerned.

In pre PET era, the interictal ECD imaging was followed by an ictal ECD SPECT. Usually, the interictal scan is done first. While the patient is on antiepileptics which is then followed by tapering of antiepileptic drugs to elicit seizure. And once patient has documented epilepsy by continuous video EEG monitoring, the tracer would be injected within 30 seconds of a documented seizure episode. Timing of the injection is very crucial as it reflects the cerebral activity at the time of injection. In a patient with temporal lobe epilepsy during the seizure, the ictal focus will show hyperperfusion. This hyperperfusion persists until the seizure discharge stops, and probably for a short time after, if the discharge is of short duration. If timing of injection is delayed and given at the early postictal phase, the hyperperfused ictal zone loses its intensity and may become variable.

After ictal SPECT has high sensitivity and specificity in temporal lobe seizures, both parameters diminish with time into the postictal period. Hence for a successful identification of an ictal focus, timing of...
SPECT images are no matter 60 min post injection or whenever patient gets stabilized in their next 3 hours. Images are acquired using a variable angle dual or triple head Gamma Camera with ultra high resolution/fan beam collimators. Image reconstruction is done to obtain Transaxial, Sagittal and coronal slices. SPECT/PET images can be coregistrated with MRI using a vendor provided fusion software. Both ictal and interictal scans are essentially compared to localize the ictal focus accurately.

**FINDINGS**

SPECT/PET scans are helpful in patients with normal MRI or in patients with abnormal MRI findings and a nonlocalizing EEG. Since seizures are associated with increased glucose metabolism (metabolism is closely coupled to cerebral blood flow), ictal SPECT scans show increased perfusion in the region of seizure onset. However, obtaining a true ictal injection is important as has been mentioned earlier, particularly for extra-temporal lobe seizures, since with late injections, the areas of increased perfusion may represent seizure spread rather than seizure onset.

In patients with temporal lobe epilepsy, during ictal phase thus is increased perfusion in both the medial and the lateral temporal lobes. While in the immediate postictal period (60 seconds), hyperperfusion of the medial temporal lobe with hypoperfusion of the lateral temporal lobe are noted. When injected is the late postictal period (up to 20 minutes postictally), perfusion in both the medial and lateral temporal lobes may be decreased.

Ictal SPECT is not helpful in localizing seizures in patients with bilaterally independent temporal lobe seizures, since the procedure samples only one seizure at a time. Moreover, false lateralization with ictal SPECT may occur if the seizure ceases in the temporal lobe of origin while continuing in the contralateral temporal lobe at the time of tracer injection. For extratemporal lobe seizure, such as frontal and parietal lobe seizures, ictal SPECT has sensitivity as high as 90% in localizing seizures if ictal injection occurs shortly after ictal onset (i.e., within 20 seconds).

PET scans use $^{15}$F tracers tagged to FDG (Fluoro deoxyglucose) or $^{18}$N ammonia for imaging the brain. It is useful for demonstrating hypoperfusion and hypometabolism involving the temporal lobe, which contains the seizure focus. While the degree of hypometabolism can vary greatly from person to person, the condition is present in the affected lobe in more than 80% of patients with refractory TLE. A 10% or greater relative reduction in metabolism in the left temporal lobe on preoperative FDG-PET is associated with a lower risk of postsurgical, verbal memory impairment. In addition, for TLE patients with normal MR results, PET scans will reveal temporal lobe hypometabolism in 60% of the cases.

**DISCUSSION**

Surgically correctable epilepsies are temporal and extratemporal but with localized focus.

**Temporal lobe epilepsy**

The syndrome of medial TLE is associated with hippocampal sclerosis. Approximately 40-67% of these patients have a history of a complicated febrile convulsion (a febrile seizure lasting >30 min). These patients typically present with seizures in late childhood, at which time seizures are well controlled with drugs. As the child enters adolescence and early adulthood, the seizures recur and become refractory to multiple medication trials.

**Extratemporal lobe epilepsy**

Extratemporal lobe epilepsy also may be treated effectively with epilepsy surgery, particularly when a clearly defined lesion is present on high-resolution MRI. In fact, surgical outcome improves from 20% seizure free in patients without a lesion to 70% seizure free in patients with a lesion. Extratemporal seizures may have variable seizure semiologies that represent seizure propagation patterns rather than the region of onset; however, these regions usually have selected pathways of propagation that may help to narrowly define the potential epileptogenic region.

Nuclear medicine techniques help by demonstrating good correlation of the regional cerebral blood flow exemplified by the uptake of HMPAO and ECD/FDG PET tracers.

Quantitation software, like SISCOM i.e Subtraction ictal SPECT co-registered to MRI, increase the sensitivity and specificity of ictal SPECT significantly. In this, the ictal and interictal images are subtracted and the subtracted image which actually highlights the ictal focus site is then superimposed on high resolution MRI. Surgical outcomes in patients whose seizure focus is localized with this quantitative technique are well established. The other method that has been tried as a localization tool for identifying epileptogenic focus is using postictal subtraction SPECT co-registered to MRI.

Surgical management is based on anatomical and functional imaging modalities. Anterior temporal lobectomy provides seizure freedom in 70% or more of patients with intractable TLE. Resection elsewhere in the brain is less successful and more risky while resection of the extratemporal foci, renders only 40-50% of patients free of seizures.

Advances in neurosciences are foreseen with the availability of $^{11}$C Flumazenil PET (Carbon labeled FMZ positron emission tomography) to study the status in epilepsy benzodiazepine receptor. Unlike the hypometabolic changes seen on FDG-PET studies, FMZ-PET reveals reduced tracer binding in the mesial temporal lobe, which may make it a more sensitive test for patients with TLE arising from the amygdala/hippocampal regions.
CONCLUSION

In TLE, ictal SPECT has 90% sensitivity in localizing seizures, with good inter-observer reliability. In medial temporal lobe epilepsy, the reported sensitivity of $^{18}$F-FDG PET for localizing the seizure focus is 85%–90%, with false lateralization being extremely rare. Thus an ictal SPECT interictal FDG can accurately localize an ictal focus.

There are studies on PET/SPECT procedures in ascertaining the usefulness in frontal lobe epilepsies and neocortical seizures also.

References

A Prospective Study to Determine the Efficacy of CIMT in Infants with Erb's Palsy


ABSTRACT

Objective: To test the efficacy of Constraint Induced Movement Therapy (CIMT) in patients with Erb’s Palsy.

Method: In this study we followed the effects of mCIMT (modified CIMT) on infants up to their first year. We measured active Range of motion in the affected limb and Compound Motor Action Potentials, to see if there is a difference in the rate of recovery/improvement in these parameters.

Result: We found that patients who received mCIMT improved faster than the group that did not both in clinical parameters and electrophysiological parameters.

Conclusion: mCIMT may be of benefit in helping infants with Erb’s palsy recover faster.

Keywords: OBPI, Erb’s palsy, CIMT, Botulinum toxin, LMN lesion.

INTRODUCTION

Obstetric lesions of the brachial plexus are not uncommon. The effects range from temporary functional impairment to a lifelong total paralysis of one arm. Though this has been studied in depth by many clinicians over time acceptable comprehensive treatment plans have not emerged. Some prefer early surgical intervention whereas others are more conservative and reserve surgery for infants in whom spontaneous repair is deemed insufficient after a certain period. Unfortunately that certain period is not fully agreed upon either.

Part of this uncertainty is due to a lack of appropriately designed outcome studies. Another major difficulty is the lack of reliable indicators of prognosis. Nerve Conduction Studies (NCS) would seem an ideal tool for this purpose, but it has been seen that even with normal NCS deformities and impaired function exist.

With respect to non-surgical interventions the treatment plan is even less clear. The majority of clinicians will refer the patient to Physical Therapy, but what is done from there is highly variable. Some therapists promote only passive range of motion, whereas others may supplement the same with electric stimulation. As the majority of therapies are not directly aimed at functional goals this results in developmental disuse. Attempts to make the developing brain aware of the affected limb, and its potential is critical to good outcomes.

Taub introduced the therapeutic intervention called Constraint Induced Movement Therapy (CIMT) which was later applied to children with cerebral palsy. Significant improvements have been seen when used in patients with Upper Motor Neuron problems. While it can be argued that the prior patients have a relatively intact peripheral nervous system, and brachial plexus injury infants do not we felt it warranted testing.

In this study we follow the effects of mCIMT(modified CIMT) on infants up to their first year. We will measure active Range of motion in the affected limb and Compound Motor Action Potentials, and see if there is a difference in the rate of recovery/improvement in these parameters.

MATERIALS AND METHODS

Study Design: Prospective Study.

Sample size: Since no prior study has been done comparing the effects of Home Exercise Program (HEP) with Home exercise combined with Constraint Induced Movement Therapy(CIMT) a pilot study was done to calculate sample size. Based on the results using 99% Confidence Intervals and 90% Power a sample size of less than 10 was calculated for each group.

Total no. of Infants: 52
Group A– (HEP +/- Botulinum toxin) - 30
Group B–(HEP with mCIMT +/- Botulinum toxin) - 22

Study Period: 18 months

Study Setting: Amrita Insitute of Medical Sciences.

Patient selection criteria
Definition of OBPI
Trauma to the Brachial plexus in the perinatal period as per the Louisiana State University (LSU) classification of OBPI.

- Erb’s Palsy- C5, 6, root with or without upper trunk involvement.
- Erb’s Plus- same with C7 root involvement.
- Klumpke- C8, T1 root with or without Lower trunk involvement.
- Erb-Klumpke- all involved.

Inclusion criteria
- Patients with unilateral Erb’s palsy.
- Palsy per the Louisiana State University Classification.
- Infants up to 2 months age.
Exclusion criteria
- Other Neurological disorders in the perinatal period.
- Birth related and subsequent bony trauma to infant skeletal system.
- Bilateral Obstetric Brachial Plexus Injury.
- Traumatic Brachial Plexus Injury.
- Malnutrition.
- Con-comitant UMN injury.
- Parents not willing for study, follow up or not giving written consent.

MEASURES
1. Electrodiagnostic variable NCS/ EMG machine.
   Axonal Viability index. This is a measure used to determine the rate of recovery in injured nerves by comparing the Compound Motor Action Potential (CMAP) amplitude of the affected side to that of the normal side. The patient must have only one limb affected. This is used in children as acceptable range for CMAP amplitude varies. After obtaining bilateral CMAPs we divide the CMAP of the affected side by that of the normal side. This gives the value in percentage.

   $AVI = \frac{CMAP\ abnormal\ limb}{CMAP\ normal\ limb}$

Nerves for comparison
- Axillary Nerve studied on Deltoid
- Musculocutaneous studied on Biceps
- Suprascapular studied on Infraspinatus

2. Qualitative Upper Extremity Skills Test (QUEST Score)
   The QUEST score (Qualitative Upper Extremity Skills Test) is a scale validated for neurological conditions in children. Considering that our patients do not have proper proximal power it was not possible to scale them using all the measurements this includes. We focused on using the Dissociative Movements sub-scale only. The value it provides is a total for the limb and is a single composite value. This made it easier to monitor the progress patients were making.

3. Goniometric measurement of Range of Motion

4. Botulinum toxin
   Botulinum toxin is injected into the co-contracting muscle groups to prevent contracture. Co-contracting muscles are antagonist muscle groups that contract when the agonist attempts to contract. It is found by palpating both groups simultaneously as we monitor for the agonist activity. For example, if we are checking for Triceps co-contraction, during elbow flexion by biceps we monitor Triceps activity also. Normally contraction would not be expected in Triceps, but it will get tensed if it is co-contracting. This increases the chance of contracture formation. There are a few expected co-contracting muscle group patterns that are looked for in OBPI.

   - Triceps with Biceps induced elbow flexion
   - Lattisimus and Pectoralis Major with Deltoid/Supraspinatus induced shoulder abduction.

The patients in this study were assessed for co-contracting muscles at every appointment. This was found in the 6th month usually and the overactive muscles were injected. As they were all nearly the same weight the same number of units were administered to them. Then they were instructed to continue along their treatment plan.

5. Arm gator
   This was used as a constraint in the study. This is a soft lined leather sheet that can be rolled into a cylinder and can be closed with 3 velcro straps. A fourth strap would encircle the waist and keep the limb fixed to the trunk.

METHODOLOGY

All infants satisfying the inclusion and exclusion criteria were included in the study after getting written informed consent from their parents. Each infant then underwent a baseline Electrodiagnostic study and Axonal Viability Index (AVI) was assessed. A baseline Dissociated movements Subscore of QUEST was also done. The parents were then given training on Home Exercise Program at entry.

Home Exercise Program (HEP). This consists of a simple program that the parents can carry out on the child. The exercises stretch the affected arm in the shoulder abduction and external rotation, elbow flexion, forearm supination, with wrist and finger extension.

At 3 months of age, the infants were reassessed again. QUEST score was done. Degree of contractures was then assessed. Contractures in shoulder adduction, internal rotation, elbow extension, forearm pronation, and wrist flexion were noted and scaled accordingly:

0 = no contracture
1 = < 25% contracture
2 = 26 - 50% contracture
3 = 51 - 75% contracture
4 = 76 - 100% contracture

Matching was done for children who showed development of co-contraction. These subsets were given additional treatment with Botulinum toxin for the co-contracting muscle.

They were separated into groups as follows:
Group A – HEP with or without Botulinum toxin
Group B – HEP and CIMT with or without Botulinum toxin

Group A was taken as the control group and Group B was taken as the Study group.
Constraint Induced Movement Therapy

The protocol was as follows:

Introduction of CIMT at age 3 months to those in the appropriate groups. CIMT was given in addition to the ongoing HEP. Parents were given the arm gator and told to apply it for 5 minutes daily for the first 2 days and in that time keep the infant engaged in play. At the start, the parents were expected to show colorful and noise-making toys to distract the infant. On the third day they were to increase it to 5 minutes twice daily, then thrice daily by day 5. By the beginning of the next week they had to make the first session 10 minutes and the reminder 5, and then by day ten make it 10 minutes twice daily. By day 13, they would be doing 10 minutes thrice daily. Thus on a weekly basis they would increase the duration up to a maximum of 1 hour thrice daily with play. In that interval the infant would be expected to be developing reaching and start grasping such that the CIMT would be ensuring they use the affected limb daily. By 4 months, the parents were educated on how to produce voluntary movements to strengthen selected muscle groups. As the child would already be reaching by this point of time the parents were told to keep the toys near the head on the affected side inducing shoulder abduction, then to keep it alongside the trunk at arm level to induce external rotation, and just above the arm to induce elbow flexion. At 6 months follow-up, the child would be manipulating objects to some degree and the parents were told to offer things to the child so as to keep the forearm in supination. Aside from teaching the parents, live videos of the sessions were made on their mobile phones for their reference. They were asked to make a video of their therapeutic play sessions at home for follow-up. The control group was managed in the same way with the exception of not following the CIMT protocol. The infants were then assessed periodically at ages 6 months and 12 months with QUEST scores and AVI. Any contractures present were also noted.

STATISTICAL ANALYSIS

The data collected was entered in MS excel and then analysed using SPSS software. The statistical significance of the differences in mean change of parameters between the different treatment groups was done using One way Non-parametric Analysis of Variance. We had planned for Parametric studies, but due to attrition from non-compliance with CIMT we had to option for Non-Parametric studies. Significance of pairs of the groups was identified by multiple comparison test. Statistical significance of the mean change in study parameters after treatment in different groups was tested by applying Wilcoxon’s signed rank test.

OBSERVATIONS

The study consisted of total of 52 infants with OBPI, of which 30 were included in Group 1 (Controls) and 22 in Group 2 (CIMT group). 8 patients from the CIMT group failed to comply with protocols and were excluded prior to statistical testing. Out of the total 52, 29 were males and 23 females. The present study showed a slightly more prevalence in males which is slightly contrary to the literature which suggests a prevalence of OBPI in female gender. Most of the infants were recruited into the study in first month of age (group A 70%, group B 86%). Right sided brachial plexus injury was more compared to left (group A 70%, group B 68%). The test group had more apparent Pre-ganglionic lesions at baseline (group A 56%, group B 90%). Though the difference was significant we ignored the baseline data as studies in this age may not be reliable. The majority of patients who needed Bo-Tox were in group A (group A 47%, group B 32%). Though there was a difference between the groups it was not significant (p-value 0.077). A statistically significant difference was found in this at 12 months. With respect to the QUEST score there was a significant difference between the groups at 6 and 12 months. For the AVI-MCN a statistically significant difference were found between the 2 groups at 12 months. At the start the test group had slightly worse scores, but began improving faster by 6 months. The test group had an overall better outcome. For the AVI-MCN the mean change was significant. For the Axillary AVI the difference was significant at 12 months. The Mean change was also significant. For the SSN AVI the difference was significant at 12 months, and with the mean change at that time. (Ref table 1 for all p values).

Table 1: Primary variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1 (30)</th>
<th>Group 2 (22)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUEST 0 months</td>
<td>0.75 ± 0</td>
<td>0.75 ± 0</td>
<td>1</td>
</tr>
<tr>
<td>3 months</td>
<td>0.7883 ± 0.02417</td>
<td>0.7736 ± 0.0173</td>
<td>0.24</td>
</tr>
<tr>
<td>6 months</td>
<td>0.8403 ± 0.0452</td>
<td>0.8789 ± 0.0375</td>
<td>0.002</td>
</tr>
<tr>
<td>12 months</td>
<td>0.906 ± 0.0662</td>
<td>0.963 ± 0.0196</td>
<td>0.003</td>
</tr>
<tr>
<td>MCN 0 months</td>
<td>0.3613 ± 0.2839</td>
<td>0.2073 ± 0.2292</td>
<td>0.02</td>
</tr>
<tr>
<td>6 months</td>
<td>0.6610 ± 0.2162</td>
<td>0.5864 ± 0.2250</td>
<td>0.349</td>
</tr>
<tr>
<td>12 months</td>
<td>0.9713 ± 0.0658</td>
<td>1.00 ± 0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Axillary 0 months</td>
<td>0.4010 ± 0.3417</td>
<td>0.2877 ± 0.2526</td>
<td>0.307</td>
</tr>
<tr>
<td>6 months</td>
<td>0.7067 ± 0.2481</td>
<td>0.6535 ± 0.1603</td>
<td>0.262</td>
</tr>
<tr>
<td>12 months</td>
<td>0.9530 ± 0.1001</td>
<td>0.9991 ± 0.0029</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SSN 0 months</td>
<td>0.4577 ± 0.3025</td>
<td>0.2759 ± 0.2111</td>
<td>0.38</td>
</tr>
<tr>
<td>6 months</td>
<td>0.6907 ± 0.2283</td>
<td>0.6991 ± 0.1423</td>
<td>0.993</td>
</tr>
<tr>
<td>12 months</td>
<td>0.9750 ± 0.0383</td>
<td>1.0 ± 0</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Shoulder adduction contractures were present in both groups more in group 1 than group 2 at 3 months of age but this was not statistically significant. After the initiation of CIMT, shoulder adduction contractures were significantly less in the CIMT group (Group B) at both 6 months and 12 months. Shoulder internal
were also noted. With QUEST scores and AVI. Any contractures present assessed periodically at ages 6 months and 12 months following the CIMT protocol. The infants were then sessions at home for follow-up. The control group was

significance of the mean change in study parameters made on their mobile phones for their reference. They was identified by multiple comparison test. Statistical Parametric studies. Significance of pairs of the groups non-compliance with CIMT we had to option for Non-

One way Non-parametric Analysis of Variance. We had degree and the parents were told to offer things to the arm to induce elbow flexion. At 6 months follow-up, at arm level to induce external rotation, and just above shoulder abduction, then to keep it alongside the trunk toys near the head on the affected side inducing by this point of time the parents were told to keep the muscle groups. As the child would already be reaching and grasp but they are critical to use of the limb later. As the limb is not used in such a fashion developmental disuse/learned non-use develops. The cortical centers for producing these effects may not mature.

While changes happen in the PNS during recovery, there are also changes in the CNS simultaneously. The developing brain has never made an effort to include the affected limb in the developing stages of ‘executive function’. In an infant these functions are as basic as reaching and grasp but they are critical to use of the limb later. The limb is not used in such a fashion developmental disuse/learned non-use develops. The cortical centers for producing these effects may not mature.

Though 80-90% of patients with OBPI have a favorable prognosis, this does not directly translate into normal function for the involved limb though. There are three reasons for this: The first reason is assessing the functional end stage. The second is due to immature motor control. Lastly, co-contraction has been shown to affect the functional end stage.

Co-contraction refers to activation of antagonistic muscles or muscles not normally involved in the intended movement, along with contraction of an agonist. Recurring patterns of cocontraction in obstetric plexopathy include: activation of the triceps when elbow flexion is intended; activation of shoulder adductors when abduction is intended. Recent therapeutic interventions aim to abolish this counter-productive effect of nerve regeneration with botulinum toxin or muscle transposition. All these factors suggest that a functional end stage in obstetric plexopathy can only be assessed reliably in children of about 4 years or older.

Constraint-Induced Movement Therapy (CIMT) aims to reverse the behavioral suppression of movement in the affected upper limb by constraining the use of nonaffected limb and providing massed practice of activities with the affected limb with specific functional goals as outcomes. The concept of constraining the normal limb to improve the activities of the affected upper limb was first put forward by Taub. Very few studies have been done with CIMT in Obstetric Brachial Plexus palsies. Promoting early use can enhance motor development.

Taub required the children to don the restraint for 24 hours per day. Despite the emerging popularity of CIMT, a review identified a significant treatment effect in only a single trial which adopted a less intensive modified form of CIMT. The modified CIMT (mCIMT) involved the application of a restraint on the unaffected upper limb and less than three hours per day of therapy provided to the affected limb. While a positive trend was found favoring CIMT no significant treatment effect was demonstrated for these interventions when compared with traditional services.
Concerns have been mentioned with respect to CIMT in younger children (0–18 months) with hemiplegia. There are relatively few accounts of adverse events that have been reported in pediatric CIMT literature that support these concerns\(^{26}\). The mCIMT protocol incorporates the two fundamental components of CIMT as described by Taub et al; the use of a restraint device and the provision of massed practice but limited to 3 hours of therapy\(^{25}\).

CIMT effects change by making a situation where the patient receives positive reinforcement for use of the weaker arm, and negative reinforcement for efforts to use the constrained stronger arm\(^{26}\). At the same time, it increases use of the more impaired arm and induces cortical reorganization\(^{27,28}\). Slowly the patient reaches a "critical mass" of intensity and the impaired limb will regain cortical space to maintain its use\(^{29,30}\). Sunderland and Tuke label this as "compensatory learning\(^{31}\)."

A pilot study of CIMT on two children with OBPI has shown a certain degree of improvements for both patients. A functional improvement observed by the parents and the participant was reported, which was in accordance to improvements of motor functions observed in neurological assessment\(^{12}\).

Overall the test group was worse than the control group at baseline for the primary NCS variables. The test group showed rapid improvement once the intervention was added. The recovery speed was evident in the QUEST score, Musculocutaneous, Axillary, and Suprascapular nerve AVIs at 12 months. Contractions were noted as more prominent in the control group and overall this did not improve as well compared to the test group. There were statistically significant differences noted for Shoulder Adduction contractures at 6 and 12 months, Shoulder Internal Rotation contractures at 6 months, and Forearm pronation contractures at 12 months.

With the addition of mCIMT the baby was more likely to move the affected limb more frequently. Once mCIMT was started volitional tendency to use the limb would start earlier. This likely prevented developmental disuse from occurring, compared to the control group which only got passive stretching.

The 2 groups were not comparable at baseline for the AVI. This is explainable in that NCS at that time is not accurate. Regardless the QUEST score was comparable hence overall the groups were similar.

Many parents were concerned that constraint would damage the normal limb. Despite alloying their fears we still had 8 patients fail to comply with the treatment protocol. Follow-up was done per protocol using home recordings of therapy sessions made in smartphones, as many of the children who came were uncooperative on arrival.

**CONCLUSION**

mCIMT added to the rehabilitation plan allows for:

- Better recovery of volitional motor activity in the affected limb.
- Better electrophysiological recovery in Musculocutaneous, Axillary, and Suprascapular nerves.
- Less contractures.

Considering the data gathered we can conclude that those patients who did not receive mCIMT:

- Did not improve as well as those who did.
- Had more co-contracting muscles that required Botox injections.
- Despite Botox still did not improve as well overall as the group with mCIMT.

We cannot clearly say if Bo-Tox had a role in the outcomes we found.

This study is unique as no other study has looked this in depth into the conservative treatment of Erb’s palsy using a multi-modal approach.

**Limitations:**

- High attrition rate
- Due to attrition we had to use non-parametric studies for statistics
- Inability to intensely monitor therapy
- No control on stimulating devices used by parents

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Mid-term follow up and Functional outcome after Surgical fixation of Displaced Acetabular Fractures – An Institutional experience

Melvin J George, Druvan.S.P, K.K.Chandr babu, V.K.Bhaskaran

ABSTRACT

Incidence of acetabular fractures are on the rise now due to increased high velocity injuries. Management of these complex fractures needs accurate knowledge of anatomy, approach and the potential complications. We studied patients with displaced acetabular fractures treated surgically over a period of 10 years with minimum follow up of 3 years to evaluate the functional outcome. Fractures were classified according to Letournel and Judet classification. Radiographic imaging was done to assess the reduction and clinical scoring was done with Modified Merle D’Aubigne Score and Harris Hip Score. Out of the 54 patients whom we identified, 20 turned up for follow up studies. 75 to 82.5% of patients had excellent – good scores. Poor function was obtained in 3 patients. Two of them had rather simple fractures and had achieved perfect anatomical reduction in the follow up radiograph. Also some patients with comminuted associated fractures have shown excellent scores in spite of near anatomical reduction in radiographs. This points to the fact apart from the reduction, severity of articular cartilage injury, labral and soft tissue injuries also need to be assessed and addressed to obtain optimal functional outcome.

INTRODUCTION

Acetabular fractures usually occur in younger age group due to high velocity injury. These injuries are most often associated with other serious injuries or polytrauma. But over recent years, the incidence of acetabular fractures has increased, especially in elderly population due to increased longevity of life, as also an increase in their involvement in high velocity injuries. If left untreated, displaced acetabular fractures can lead to early onset osteoarthritis of the hip. Acetabular fractures are commonly classified by the “Letournel and Judet” system. It was in the late 1960s that Letournel and Judet proposed the importance of surgical fixation of acetabular fractures and congruent reduction for better functional outcome. But, initially, surgical fixation was a challenge to the orthopaedic surgeons due to difficult exposure, frequent complications, difficulty in obtaining anatomical reduction and joint congruency and ultimately poor functional outcome. The outcome is potentially dependent on personal characteristics of the patient and circumstances of the accident, type of fracture, displacement and comminution as well as concomitant diseases have been said to affect clinical outcome. The functional outcome is influenced by many factors, including fracture pattern, surgeon’s expertise, patient’s age, associated chondral damage and neurovascular injury and patient’s co-morbidities and functional expectations. With the advent of CT, expert surgical training and other intra operative radiographic facilities, and greater functional demands for the patients, surgical fixation has become the standard treatment in acetabular fractures. We present the mid term follow up and evaluation of functional outcome of 20 patients with acetabular fractures surgically fixed in our Institution between 2002 and 2012.

MATERIALS AND METHODS

Aims and Objectives
To evaluate and determine the functional outcome of patients with acetabular fractures surgically treated in our Institute.

Inclusion Criteriae
Those patients admitted with acetabular fractures and surgically treated in our Institute between 2002 to 2012 who have given valid informed consent to take part in the study.

Exclusion Criteriae
Those patients with open fracture, those lost to follow up and patients managed non surgically.

We identified 54 patients who had acetabular fractures and underwent Open Reduction and Internal Fixation in our Institute during the period 2002 to 2012. Of these, 20 patients turned up for functional evaluation and follow up studies. The relevant clinical and radiological findings, mechanism of injury, fracture pattern and classification were noted at the time of admission. Fracture classification was done according to Letournel and Judet Classification. We classified the data according to sex, age, fracture pattern and the associated complications. Operative indications for acetabular fractures are unstable or incongruence of the hip, posterior wall or anterior wall fractures with column displacement.

On admission, all the patients were evaluated with three radiological views – AP Pelvis and 45° oblique views of Judet and CT scan. The indications for surgery were instability of the hip, displacement of a fragment by > 2 mm, dislocation with a posterior wall fracture, and articular impaction or depression as seen on the pre-operative CT scan. All patients were operated using single approach (Kocher-Langenbeck, iliopinguinal, or extended iliopinguinal). Open reduction with
internal fixation was attempted to achieve anatomical reduction of the articular surface of the acetabulum. Suction drain was used routinely and was removed after 48 hours. Post-operatively skin traction was applied and no prophylaxis for heterotopic ossification and DVT was used in any patient. Immediate post operatively, ankle mobilization was started.

We retrieved the post operative images (AP Pelvis) of these patients and evaluated for reduction and comparison with the latest radiographs. In all cases, immediate post operative complications were noted. Mobilisation was done as early as possible with the aid of physiotherapist. Toe touch weight bearing was allowed till around 6 weeks, partial weight bearing for next 6 weeks and full weight bearing from thereafter. Clinical and radiological assessment was undertaken at six and 12 weeks, four, six and 12 months post-operatively and annually thereafter. For the purpose of the study, all these patients were called back for repeat radiological and clinical evaluation and scoring (Modified Merle D’Aubigne Score and Harris Hip Score). Heterotopic ossification, Avascular Necrosis and Osteoarthritis were diagnosed based on clinical and X ray findings.

**RESULTS**

Altogether we obtained 54 patients who underwent Acetabulumn ORIF during the study period. One patient had bilateral acetabuli fracture, one sustained open fracture injuring the rectum, 24 were lost to follow up and 8 patients died due to age related poor health. Overall, we had total cases of 20. Majority of them were males (78%). Age of the patients ranged from 14 years to 70 years. Mean age was 42.6. The follow up period ranged from 13 years to 3 years and the mean follow up period was 7.53 years. Right hip was involved in 15 cases and left hip in 5 cases. Clinically the subjects were graded according to Modified Merle D’Aubigne Scoring and Harris hip Scoring as Excellent, Good, Fair, and Poor.

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<td>Transverse fracture</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
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</table>

Table No:1 showing the frequency of each fracture classes in the study group.

The most common fracture noticed in our study group was posterior wall fracture (30%). Our study results with regard to the incidence of fracture types were comparable with that of Magu NK et al. and Letournel et al.'
Infection
Dislocation
Table No: 2 showing the various complications associated with each open book injujry to pelvis and post op image after ORIF.

Fig. No: 8, 9 - X ray image of bilateral acetabulum fracture with open book injury to pelvis and post op image after ORIF.

Table No: 2 showing the various complications associated with each fracture classes.

<table>
<thead>
<tr>
<th>Type of fracture</th>
<th>Complication</th>
<th></th>
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<td>Sciatic</td>
<td>AVN</td>
<td>Dislocation</td>
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<td>1</td>
<td>0</td>
</tr>
<tr>
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<td>Posterior wall and column</td>
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<tr>
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The most common complication we encountered among the patients in our study group was osteoarthritis (40%). Avascular necrosis occurred in 15% of patients. Most of these patients had a follow up period of more than 6 years. The incidence may rise with further follow up period. No specific fracture pattern was found to be associated with osteoarthritis and avascular necrosis. In our study group, heterotopic ossification was found in 15%, sciatic nerve palsy in 15% and 5 patients had dislocated their hip at the time of presentation. 60% of these patients developed AVN on follow up of at least 4 years. Infection was found in 2 patients (10%) in which extensile approach was used for fixation. The incidence of infection in our study is comparable to similar studies15,16. Three patients (15%) underwent THR 2, 5 and 7 years after the acetabular surgery due to post traumatic arthritis. The conversion rate to THR is comparable with similar studies17,18.

85% and 75% of patients made it into the Excellent - Good group according to the MMDA score and Harris Hip Score respectively. Fair - Poor function was obtained in 1 patient (MMDA) and 2 patients (HHS). Of these, one patient had an ipsilateral shaft of femur fracture, and the other had post operative infection requiring surgical debridement 3 times after the surgery. In the same group, two patients had perfect anatomical reduction, in the follow up radiograph. Clinical scoring not comparable with the radiological scoring can be due to multiple reasons of which the most likely is the severity of the cartilage, labral or other soft tissue injury at the time of insult or intra-operative.
As evidenced from the table, the most common mechanism of injury is bike accident. (45%). The relative number of elderly and younger generation using bicycles and the increased traffic may be the cause.

**DISCUSSION**

Fractures of acetabulum and pelvis constitute only 2% of all fractures but they are associated with significant morbidity and mortality due to associated injuries. Several studies report that accurate reduction and rigid internal fixation can decrease the incidence of post-traumatic arthritis and improve functional outcome. Clinical outcome after acetabular fracture surgery is difficult to predict. Poor bone stock in older patients, comminuted articular surface fractures and poly-trauma patients with multiple co-morbidities are adverse factors influencing outcome. Current trends in the treatment of these fractures include open reduction and internal fixation according to the principles that apply to all intra-articular injuries. Judet et al. in 1960s classified these fractures and established the principles of operative management. Elementary fractures are 1) Posterior column, 2) Posterior wall 3) Anterior column, 4) Anterior wall and 5) Transverse fracture. Associated fractures are 1) Both columns, 2) T shaped, 3) Transverse + Posterior wall, 4) Anterior column + posterior hemitransverse and 5) Posterior columns + posterior wall.

Incidence of acetabular fracture is on the rise in every part of the world. Road traffic accidents are the main cause of these injuries in young adult males between 20 to 40 years of age group. The outcome of open methods can be improved with more surgical experience in treating acetabular fractures which will enable us to minimise the complications with appropriate and innovative treatment methods. Finally, even if the prognosis for the restoration of normal joint function is not good, restoring normal anatomy will enable the patient to have a better quality of life and makes it easy for future reconstructive procedures.

Displaced fractures of the acetabulum are a diverse group of serious injuries which are difficult to treat. Success of the surgery and prognosis after high-energy trauma are based on the articular cartilage viability and anatomical reduction. The goal of the open reduction and internal fixation of acetabular fractures is to return the patient to pre fracture level of activities. This goal can be achieved by properly planned approaches. However, despite the appearance of an anatomical reduction on radiographs, there may still be imperfections on areas of the articular surface that are invisible on standard plain radiographs or are hidden by plates and screws. In some of our patients with anatomical reduction, functional scoring does not correlate. It must therefore be concluded that clinical results depend mostly on the severity of articular cartilage injury happened at the time of insult and the capability of the acetabulum in an adult to tolerate changes in the distribution of pressure and perhaps to reshape itself over time. Detailed study in this regard using cartilage mapping or arthroscopic evaluation may be warranted.

The results of our treatment could be improved by more experience in the surgical group. Complications can occur from the injury per se or can be the result of surgical treatment. Early complications include thrombo-embolism (30% to 50%), neurologic injury (16 % to 30%), infection (3% to 9%), malreduction, loss of reduction, intra-articular hardware and vascular injury. Late complications include avascular necrosis (2% to 25%) heterotrophic ossification (1% to 60%), post traumatic arthritis (12% to 57%). Despite perfect reduction, osteoarthritic changes are expected to develop in the long term for which most common procedures done are hip arthrodesis or total hip replacement.

**CONCLUSION**

The acetabular fractures are seen in younger age group following high velocity injuries. Proper radiological assessment of fracture type is necessary to decide the proper line of management, which is mandatory for better outcome. The operating surgeon should have thorough knowledge of this region. An appropriate pre-operative planning, intra-operative execution and careful post-operative monitoring help to get good outcome in this set of fractures. An increase in the rate of anatomical reduction and decrease in the rate of operative complications should be the goal of surgeons who treat these fractures, even though set backs do occur due to associated injuries and inappropriate rehabilitation.

**Reference**

1. Narender Kumar Magu, Rajesh Rohlilla, Sanjay Arora; Conservatively treated acetabular fractures: A retrospective analysis; IJO; 2012; 46(1): 36-45.
Predicting Clinical Outcome In Acute Ischemic Stroke Based On TOAST Classification

Ajith Kumar J, *Vivek Nambiar, Gireesh Kumar, Sreekrishnan T. P., Ajith V, Naveen Mohan

INTRODUCTION

The classification of stroke was traditionally based on risk factors, clinical features and findings on brain imaging studies. The physician would usually determine subtypes of ischemic stroke based on clinical features and results of diagnostic studies. This non-standardized approach may be acceptable in clinical practice but not for studies.

TOAST (Trial of Org 10172 in Acute Stroke Treatment) classification of subtype of acute ischemic stroke was introduced to produce uniformity. The TOAST classification (Table 1) system is straightforward and follows a logical progression. There are only a few studies evaluating the usefulness of TOAST classification in predicting the clinical outcome following an acute ischemic stroke. Hence, we planned to evaluate its use in predicting clinical outcome, in this study.

Table 1

<table>
<thead>
<tr>
<th>TOAST CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Large artery atherosclerosis</td>
</tr>
<tr>
<td>2. Cardioembolism</td>
</tr>
<tr>
<td>3. Small artery occlusion</td>
</tr>
<tr>
<td>4. Stroke of other determined etiology</td>
</tr>
<tr>
<td>5. Stroke of undetermined etiology</td>
</tr>
</tbody>
</table>

METHOD OF STUDY

Patients presenting to Emergency Medicine Department of Amrita Institute of Medical Science during 2012–2013 with acute ischemic stroke were studied. Those presenting within 7 days of onset of stroke and age >18 years were included. Those patients with intracranial hemorrhages were excluded from the study.

Patients included in the study were evaluated and initial NIHSS Score was noted. All patients were subjected to CT/MRI to diagnose acute ischemic stroke. MRA/CTA was done to look for any large vessel disease. Patients were subjected to electrocardiogram, echocardiography and Holter monitoring for evaluation of any potential cardio-embolic focus for stroke.

Patients were reassessed for neurological worsening after 48 hrs and by the end of 5th day. This was defined as an increase in NIHSS score by 2 points from the baseline, as used in various other studies. This scoring system has been shown to have good reliability. Patients were then divided into two groups.

1) Neurological worsening group or Progressive group.
2) Stable group.

All patients were classified according to TOAST classification system. Statistical analysis was then done between the progressive and stable group.

STATISTICAL ANALYSIS

1. Percentage of stroke cases with neurological worsening was computed.
2. To compare categorical variables Chi square test was applied. The p-Value <0.05 was considered as statistically significant.

Statistical analysis was done using IBM SPSS Statistics 20.

RESULTS

Total study population was 66, composed of 52 males (78.8%) and 14 females (21.2%). Neurological worsening was seen in 16(24.2%) patients. The study population was categorized based on the TOAST classification system.

In our study population of 66 patients, we found that 22 patients had large vessel disease, 11 had cardio-embolic source, 9 had small vessel disease and etiology of 24 patients where unknown. 8 patients (36.3%) with large vessel disease, 5 (45.4%) patients with cardioembolic source, 2 (22.5%) patients with small vessel disease and 1 patient with unknown etiology had neurological worsening (Table 2). The p-value was 0.021, which is statistically significant.

DISCUSSION

In our prospective study, neurological deterioration was seen in 24.2% of total patients which is comparable to other studies.

Our study also showed that patients with large vessel disease (36.3%) and cardio-embolic source (45.4%) are at a great risk for early neurological deterioration when compared to stroke due to small vessel disease (22.5%) and unknown etiology (4.1%). The p-value of classification stroke subtypes based on TOAST classification was 0.021, which shows the statistical significance.

Our study clearly shows that patients with large vessel disease and cardio-embolic source are at a greater risk of neurological worsening warranting the need for intravenous thrombolysis or endovascular intervention. Intravenous fibrinolytic therapy for acute stroke is now widely accepted and approved.
Predicting Clinical Outcome In Acute Ischemic Stroke Based On TOAST Classification

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Large Vessel Disease</th>
<th>Cardioembolic</th>
<th>Small Vessel Disease</th>
<th>Unknown etiology</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Progressive Group</td>
<td>8 (36.3%)</td>
<td>5 (45.4%)</td>
<td>2 (22.5%)</td>
<td>1 (4.1%)</td>
<td>16 (24.2%)</td>
</tr>
<tr>
<td>Stable Group</td>
<td>14 (63.7%)</td>
<td>6 (54.6%)</td>
<td>7 (77.5%)</td>
<td>23 (95.9%)</td>
<td>50 (75.8%)</td>
</tr>
<tr>
<td>Study Population</td>
<td>22</td>
<td>11</td>
<td>9</td>
<td>24</td>
<td>66</td>
</tr>
<tr>
<td>p-Value</td>
<td>0.21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph 1: TOAST classification among progressive group

by US FDA\textsuperscript{2}. AHA Stroke Guidelines recommends to thrombolysse patients with only measurable neurological deficits; also to avoid thrombolysis in patients with minor stroke (NIHSS $\leq 4$)\textsuperscript{2}.

But patients with gait disturbance, isolated aphasia or isolated hemianopia may have potentially disabling symptoms although their NIHSS score is 2. Eric et al has shown that in patients with mild or improving stroke in whom IV tPA was not administrated was associated with poor outcome\textsuperscript{4}. Steven et al have demonstrated that the term RISS should be reserved for those who improve to mild deficit, specifically in whom it is perceived to be non-disabling\textsuperscript{9}. They have also shown that large artery occlusion on imaging, despite minor symptoms or clinical improvement, may identify patients at high risk of neurological deterioration\textsuperscript{7}.

Krasen et al in his study demonstrated that patients with persisting proximal vessel occlusion were 7 times more likely to have an unfavourable outcome at 3 months\textsuperscript{11}. He has also demonstrated that thrombolysis in a selected group of patients with mild or rapidly improving stroke is justified and has a favorable outcome\textsuperscript{11}. This warrants the need for early neurovascular (CTA/MRA) imaging in the emergency department itself and consideration of IV thrombolysis in all patients with large vessel disease even when the NIHSS score $\leq 4$ with disabling symptoms. Further studies are needed regarding the use of IV tPA in patients with minor stroke.

In our study, we demonstrated that patients with large vessel disease has greater chance of early neurological worsening, stressing the importance of thrombolysis in patients with large vessel disease even when they present with minor stroke (NIHSS $\leq 4$) with disabling symptoms. The actual percentage of patients developing neurological worsening is even higher than demonstrated by us, since our center is tertiary care where most of our patients are referred at a later stage. Further studies are required to understand the benefits of thrombolysis in minor stroke.

CONCLUSION

TOAST classification is a simple tool which classifies the stroke patient based on etiology. It is not only a useful classification system for studies, but also for predicting the prognosis of patients presenting with acute ischemic stroke. We found that patients with large vessel disease and cardio-embolic source tend to have early neurological deterioration. We suggest considering IV tPA even in patients with minor stroke with disabling symptoms.

LIMITATION

- The sample size of our study is small, even though we could demonstrate with statistical significance that TOAST classification is a simple classification based on etiology and can predict the prognosis based on the TOAST sub category.
- Those patients who worsened prior to presenting to our center were not excluded from the study, implying that the actual number of patients developing neurological worsening is even more.

ABBREVIATIONS

TOAST : Trial of Org 10172 in Acute Stroke Treatment
NIHSS : National Institute of Health Science Score
CT : Computerised Tomography
MRI : Magnetic Resonance Imaging
CTA : Computerised Tomography Angiography
MRA : Magnetic Resonance Angiography
ASA : American Stroke Association
tPA : Tissue Plasminogen Activator
RISS : Rapidly Improving Stroke Symptoms
ACKNOWLEDGEMENTS

1. All the staff of Department of Emergency Medicine and Critical Care, Amrita Institute of Medical Sciences, Kochi. Special Thanks to Dr. Elson.
2. Department of Biostatistics, Amrita Institute of Medical Sciences, Kochi.

References
A Study on Obstetric and Ultrasonographic Parameters in Patients with Early Miscarriage

Parvathy Ganesan, Deepthi Sharma, Sudha.S, Radhamany.K

ABSTRACT

Aim: To assess factors including yolk sac diameter and morphology associated with miscarriage.

Materials and Methods: This was an observational study carried out in the Department of Obstetrics and Gynaecology, Amrita Institute of Medical Sciences, Kochi from September 2013 to August 2014. A total of 50 subjects who had miscarriage were analyzed for factors associated with it including age, parity, duration of married life, co-existing medical disease, gestational age (assessed by last menstrual period, mean gestational sac diameter and crown-rump length), gestational sac (GS) morphology, yolk sac (YS) diameter and morphology.

Results: The mean age was 27.48 +/- 4.2 years and mean duration of married life was 4.3 +/- 3.4 years. Fetal pole was absent in 44%. GS and YS morphology was normal in 64% and 68% respectively. Echogenic YS was seen in 4%. YS diameter was <2mm in 2%, 2-6 mm in 58% and >6mm in 24%. Mean gestational age assessed by last menstrual period (LMP) and mean gestational sac diameter (MSD) was 8w 4d ± 1w4d and 7w3d ± 1w1d respectively.

Conclusion: Abnormalities in diameter and morphology of YS and GS are seen to be associated more with miscarriages. Disparity between LMP GA, CRL GA and MSD GA may point towards a possible miscarriage. It may be stressed that routine assessment and documentation of YS and GS diameter and morphology in all early pregnancy scans might help in predicting chances of miscarriage.

Key words: Gestational age, Yolk sac, Gestational sac, Miscarriage

INTRODUCTION AND BACKGROUND

Accurate differentiation between normal pregnancy and pregnancy loss in early gestation remains a clinical challenge. Previous studies have described the association between embryonic well-being and the characteristics of gestational sac (GS), yolk sac (YS), amniotic cavity, and embryonic heart beat. Two dimensional USG remains a simple and convenient way to assess pregnancy status. There are discriminatory criteria in predicting spontaneous pregnancy loss. These include 8 mm mean sac diameter (MSD) without YS, 16-20 mm MSD without fetal cardiac activity etc. However, variations and exceptions exist in these. The transvagal probe has revolutionized the assessment of early pregnancy providing better spatial resolution and improved diagnostic accuracy.

The first definitive sonographic finding to suggest early pregnancy is the GS. First embryonic structure seen in a GS is the YS. It may be visible as early as 5th week when the MSD is around 5mm. During embryonic development, the yolk sac is the primary route of exchange between the embryo and the mother. Yolk sac supplies iron, calcium, cholesterol and folic acid and that is the reason why maternal nutrition and folic acid supplementation has a role in early organogenesis. During the process of neuralization, nutrients are absorbed by endocytosis in the endoderm derived cell layer of yolk sac. Aberrations in this is said to be one of the etiologic factors contributing to development of Neural Tube defects (NTDs). Therefore, the yolk sac is crucial in early embryonic life.

YS is always seen by 5.5 weeks of GA when the MSD is around 8mm. If not seen, pregnancy is not viable in most of the cases. Its diameter increases steadily between 5-10 weeks of gestation to a maximum of 5-6mm. By the end of first trimester, YS is no longer seen and it gets absorbed into the umbilical cord. Much debate has occurred regarding abnormalities of YS including abnormal size and shape, calcification, echogenic YS etc. Calcified YS is reported in dead embryo, echogenic YS is seen associated with poor prognosis. Abnormally large YS was found to be associated with trisomy 21, partial trisomy 18 and Turner’s syndrome.

As shown in Table 1, the observed diameter of the yolk sac with relation to gestational age was described by Faye et al.

Table 1 - Yolk sac diameter in various gestational ages

<table>
<thead>
<tr>
<th>Gestational Age (weeks)</th>
<th>Sonographic mean diameter of yolk sac (Mean ± Standard Deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>3.01 ± 0.75</td>
</tr>
<tr>
<td>7</td>
<td>3.99 ± 0.86</td>
</tr>
<tr>
<td>8</td>
<td>4.72 ± 0.64</td>
</tr>
<tr>
<td>9</td>
<td>5.22 ± 0.63</td>
</tr>
<tr>
<td>10</td>
<td>5.89 ± 0.56</td>
</tr>
</tbody>
</table>

YS diameter 2-6 mm is a favorable marker for viable pregnancy. The ongoing pregnancy rate when YS diameter ranged 2-6 mm was 85.3%. Only 20% had ongoing pregnancy when YS diameter was <2mm or >6mm. There is also an association between MSD and early pregnancy loss (EPL). Systematic review by Tom Bourne et al (2012) looked at the evidence...
AIM
To assess factors including yolk sac diameter and morphology associated with miscarriage.

MATERIALS AND METHODS
This was an observational study conducted on 50 subjects coming for early pregnancy scan and was diagnosed as having miscarriage. This was done in the Department of Obstetrics and Gynecology, Amrita Institute of Medical Sciences, Kochi from September 2013 to August 2014.

Approval from the institutional review board was obtained prior to the recruitment of subjects. The history and demographic data were obtained from the subjects. Ultrasonography was done for all subjects using transvaginal probe with frequency of 8MHz. The standard guidelines for obtaining the sonographic measurements and observations were strictly followed.

Yolk sac was visualized and the diameter was measured using electronic calipers taking inner to inner diameter and it was recorded as normal (< 6mm), large (> 6mm) or small (< 2mm). The morphology of the yolk sac was also assessed; whether its outline was normally rounded and regular or irregular. If irregular, its mean diameter and largest diameter were recorded. Any abnormal changes like echogenicity or calcifications were also noted.

The mean gestational sac diameter was calculated by measuring three orthogonal dimensions of the chorionic cavity (excluding the surrounding rim of echogenic tissue) and taking the mean. The morphology of the gestational sac was also noted.

The crown rump length (by Hadlock’s formula) and other essential sonographic features like chorionic reaction, presence and size of any subchorionic hematoma was also recorded.

The measurements were taken by operators trained in doing ultrasonography. All the measurements were recorded in the computer during the sonography. Majority of the recordings were done by or in the presence of the principal investigator. If done by a second person in the absence of the principal investigator, the findings recorded in computer were assessed by the principal investigator afterwards. This method helped in reducing the inter-observer variations. The measurements recorded were also randomly assessed by a second investigator and this helped in reducing the bias. All the data including the follow up were recorded against the patient’s identification number.

We took the sample size of fifty as this was the number of subjects available with miscarriage during the time period. We aimed to take all cases of miscarriage during the period, a method of convenient sampling.

All the data collection was done using Microsoft Office Excel spreadsheet and analysed for factors influencing miscarriage. Descriptive statistics like frequency and percentage was used whenever applicable. Mean and standard deviation was calculated under measures of central tendency for certain variables. Statistical software used was SPSS version 20.0

RESULTS
Majority of the patients were primi gravidas (62%). A total of 19 patients (38%) had associated medical co-morbidities. These included hypothyroidism (16%), PCOS (8%), epilepsy (2%), congenital heart disease (2%), overt diabetes (2%), hypertension (2%), APLA syndrome (2%), anaemia (2%) and Nephrotic syndrome (2%). (Table 2 & 3)

Table 2 - Parity and medical co-morbidities

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parity Primi</td>
<td>31</td>
<td>62</td>
</tr>
<tr>
<td>Multi</td>
<td>19</td>
<td>38</td>
</tr>
<tr>
<td>Medical Present</td>
<td>19</td>
<td>38</td>
</tr>
<tr>
<td>Co morbidities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>38</td>
<td>62</td>
</tr>
</tbody>
</table>

Table 3 - Details of Medical co-morbidities associated

<table>
<thead>
<tr>
<th>Disease</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothyroidism</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>PCOS</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Cong. Heart Disease</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Overt DM</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>APLA</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Anaemia</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Nephrotic Syndrome</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

The mean age of the patients in the group was 27.5 ± 4.2 years. The mean duration of married life was 4.3 ± 3.4 years. The mean gestational age (GA) as calculated from last menstrual period (LMP) was 8 weeks + 4 days and that calculated from mean sac diameter (MSD) was 7 weeks + 3 days. (Table 4)

Table 5 shows the GA distribution as calculated from LMP, MSD and crown rump length (CRL). Majority had GA between 8 and 9 weeks (34%) as calculated by LMP. However, when calculated by CRL and MSD showed that majority had GA between 6 and 7 weeks.
(30% and 42% respectively). There were 22 patients who didn’t have a visible fetal pole at diagnosis of miscarriage.

Table 4 - Age, Duration of Married Life and Gestational Age

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean (years)</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>27.5</td>
<td>4.2</td>
</tr>
<tr>
<td>Married Life</td>
<td>4.3</td>
<td>3.4</td>
</tr>
<tr>
<td>LMP GA</td>
<td>8w ± 4d</td>
<td>1w ± 4d</td>
</tr>
<tr>
<td>MSD GA</td>
<td>7w ± 3d</td>
<td>1w ± 1d</td>
</tr>
</tbody>
</table>

Table 5 - Comparison of GA assessed by different methods

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LMP GA</th>
<th>CRL GA</th>
<th>MSD GA</th>
<th>CRL GA</th>
<th>MSD GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6 wks</td>
<td>02</td>
<td>04</td>
<td>04</td>
<td>02</td>
<td>16</td>
</tr>
<tr>
<td>6w - 6w 6d</td>
<td>07</td>
<td>14</td>
<td>15</td>
<td>30</td>
<td>21</td>
</tr>
<tr>
<td>7w - 7w 6d</td>
<td>07</td>
<td>14</td>
<td>06</td>
<td>12</td>
<td>06</td>
</tr>
<tr>
<td>8w - 8w 6d</td>
<td>17</td>
<td>34</td>
<td>03</td>
<td>06</td>
<td>04</td>
</tr>
<tr>
<td>9w - 9w 6d</td>
<td>08</td>
<td>16</td>
<td>01</td>
<td>02</td>
<td>02</td>
</tr>
<tr>
<td>≥ 10 w</td>
<td>09</td>
<td>32</td>
<td>01</td>
<td>02</td>
<td>01</td>
</tr>
<tr>
<td>NA</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>8w 4d ± 1w 4d</td>
<td>-</td>
<td>7w 3d ± 1w 1d</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LMP - Last menstrual period, CRL - Crown rump length, MSD - mean sac diameter, GA - Gestational age, NA - Not applicable.

The data is demonstrated in figure 1.

Other sonographic parameters are shown in table 6.

Table 6 - Sonographic parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>GS morphology</td>
<td>Regular</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Irregular</td>
<td>18</td>
</tr>
<tr>
<td>YS diameter</td>
<td>&lt;2 mm</td>
<td>01</td>
</tr>
<tr>
<td></td>
<td>2-6 mm</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>&gt;6 mm</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>08</td>
</tr>
<tr>
<td>YS morphology</td>
<td>Regular</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Irregular</td>
<td>06</td>
</tr>
<tr>
<td></td>
<td>Echogenic</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>08</td>
</tr>
<tr>
<td>SCH</td>
<td>Present</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>Absent</td>
<td>47</td>
</tr>
<tr>
<td>CDR</td>
<td>Good</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>08</td>
</tr>
</tbody>
</table>

GS - Gestational Sac, YS - Yolk sac, SCH - Sub chorionic Hematoma, CDR - Chorio decidual reaction

DISCUSSION

During the first trimester of pregnancy, a unique and dramatic sequence of events occur defining the most critical and tenuous period of human development, the transformation of a single cell into a recognizable human being. Because of the complex events that accompany first trimester development, it is not unusual for complications to occur. Approximately 15% of clinically recognized pregnancies are miscarried. The loss rate is stipulated as 2-3 times higher with very early and clinically unrecognized pregnancy.

This was an observational study done in 50 patients with early pregnancy and was diagnosed as having miscarriage. Majority of the patients in the group were primigravidas (62%). Remaining 38% were multigravidas. The miscarriage rate was higher in primigravidas.

A total of 19 patients (38%) were having some coexisting medical illness. Majority had hypothyroidism (16%) and PCOS (8%). It may be prudent to give special attention in the preconceptional counselling of patients presenting with such medical illnesses.

The mean age was 27.5 ± 4.2 years. The mean duration of married life was 4.3 ± 3.4 years. This shows that advanced age and prolonged duration of married life, even though might be contributing to miscarriage, were not found to be significantly associated in our group.

Gestational age (GA) was calculated from LMP, MSD and CRL. The GA was different when calculated from CRL and MSD as compared to that calculated from LMP. GA calculated from MSD was less than that from LMP in the group (7W 3d ± 1W 1d vs 8W 4d ± 1W 4d respectively). Fetal pole was absent in 44% and out of the
remaining 56% in whom CRL GA was obtained, it was consistently less than that calculated from LMP. However, the disparity was more pronounced between LMP GA and MSD GA than that between LMP GA and CRL GA. Hence, even if CRL GA is corresponding to LMP GA, small MSD may independently predict miscarriage. Similarly even if MSD is corresponding, small CRL might be indicative of miscarriage.

In 2011, the first systematic review of the evidence behind the diagnostic criteria for miscarriage was published. It states, “Findings were limited by the small number and poor quality of the studies,” and concluded that further studies were, “urgently required before setting future standards for the accurate diagnosis of early embryonic demise.” This implies that data used to define criteria to diagnose miscarriage are unreliable. The 2011 Irish Health Service executive review into miscarriage misdiagnosis highlighted this issue. So it is surprising how little evidence exists to support previous guidance.

Irregular GS morphology was seen in 32% of miscarriages. Remaining 68% had regular GS morphology. Even though the incidence of irregular GS was only 32%, its presence might be a marker to predict miscarriage. Irregular GS is sometimes associated with adenomyosis or leiomyoma or uterine abnormalities, the conditions which are usually attributed to cause increased incidence of miscarriage. Hence, it can be recommended that GS morphology need to be mentioned in all routine early pregnancy scans as it might be contributory in predicting or diagnosing miscarriage.

Yolk sacs with mainly wrinkled margins, indented walls, or both are usually identified as having an irregular shape. The clinical importance of an abnormal yolk sac shape is controversial and thus, still under debate. There are a number of clinical studies that have declared that the persistence of an irregular yolk sac shape may be used to indicate an adverse gestational outcome. There is one study reporting that an echogenic yolk sac can be associated with fetal death or abnormalities. However, an echogenic yolk sac is not associated with anomalies or a poor pregnancy outcome according to Sinan Tan et al. It has also been anecdotally emphasized that an echogenic yolk sac does not predict an embryonic anomaly or death.

In their review, Sinan Tan et al concluded that large-scale prospective studies are anticipated to clarify the prognostic importance of echogenic yolk sacs. We got irregular yolk sac in 12% of miscarriages. YS was absent in 16%, echogenic in 4% and with normal morphology in remaining 68%. Our findings don’t support a significant role of YS morphology in predicting miscarriage. However, presence of irregular or echogenic YS may warrant careful follow up with serial sonograms.

Although there is no clearly identified consensus, most authors accept either 5 or 6 mm as the upper limit for the size of a normal yolk sac in pregnancies with a gestational age from the 5th to the 10th weeks. In our series, YS was large (> 6 mm) in 24%, small (< 2 mm) in 2% and normal (2-6 mm) in 58%. YS was absent in remaining 16%. In those who had a yolk sac (42 patients), it was large in 12, small in one patient and normal in remaining 29. It may be concluded that large YS is a significant predictor of miscarriage and small yolk sac may not be having much clinical significance. However, a few authors have mentioned the existence of a very large yolk sac in a normal live pregnancy. Generally, it has been suggested that an abnormally large yolk sac may indicate a poor obstetric outcome; therefore, close follow-up with sonography is recommended for these pregnancies.

The presence of subchorionic hematoma was found in only 6% of the patients. The choriodecidual reaction was poor in only 16% of the cases with miscarriage. These were not having much predictive significance.

CONCLUSION

Abnormalities in diameter and morphology of yolk sac and gestational sac are seen to have more association with miscarriages. Routine assessment and documentation of yolk sac and gestational sac diameter and morphology in all early pregnancy scans might help to predict chances of miscarriage. With the advent of high resolution ultrasound, the conventional cutoffs of MSD and CRL in diagnosing miscarriage needs reappraisal.

Acknowledgement

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INTRODUCTION

Chronic pancreatitis (CP) is a progressive inflammatory disease of the pancreas characterized by irreversible morphological changes typically causing pain and/or permanent loss of function. Tropical pancreatitis was considered the dominant etiology in Kerala unlike Western countries and Japan where alcohol is the most common cause of CP. Tropical pancreatitis is characterized by abdominal pain, large intraductal calculi, diabetes mellitus, complicated by a high incidence of pancreatic cancer seen in young, non-alcoholic subjects. While the traditional risk factors implicated in TCP included malnutrition, dietary toxins and environmental agents, there is increasingly emerging evidence about the role of genetic factors. However, patients similar to those described as tropical pancreatitis comprised only 3.8% in a large multicentre study comprising 33 centres in India where AIMS, Kochi was the lead centre. There has been a rising trend in alcohol consumption in Kerala which has the highest per capita consumption of alcohol among Indian states. We report our experience in managing chronic pancreatitis over the last 15 years at the Pancreas clinic at Amrita Institute of Medical Sciences(AIMS), Kochi.

PATIENTS AND METHODS

The Pancreas clinic at AIMS, Kochi has been managing patients with pancreatic diseases including chronic pancreatitis from all over the state of Kerala. We have prospectively followed up the patients and maintained an electronic database. Chronic pancreatitis is diagnosed on basis of standard criteria in patients with typical clinical and imaging (US/CT/ERCP/MRCP/EUS). A detailed assessment of alcohol intake and smoking habits is performed using a standard pro-forma administered by a trained medical social worker. Alcoholic chronic pancreatitis (ACP) is diagnosed in CP patients who have been consuming >80 g alcohol/day for at least 5 years. Idiopathic chronic pancreatitis (ICP) is diagnosed if pre-existing conditions likely to cause CP (primary hyperparathyroidism, hypertriglyceridermia, hereditary pancreatitis, and other rare causes as well as excess alcohol consumption) were ruled out. Autoimmune pancreatitis is diagnosed as per previously reported criteria.

RESULTS

A total of 1157 patients (822 males, 335 females) with chronic pancreatitis were enrolled in our Pancreas clinic between 1999 and 2014. The mean age of diagnosis was 41.4 +/- 13.9 years.

The most common form of CP was ICP (720 patients) which comprised nearly 2/3 of patients with CP. ACP (412 patients) comprised nearly one-third of the patients and prevalence was seen to be increasing over the years. In recent years, there has been increased detection of rare causes of CP like hypercalcemia related CP (11 patients), hypertriglyceridermia related CP (2 patients), and autoimmune pancreatitis (3 patients). However, these entities comprised less than 2% of CP patients. Cases of CP where viral infections, drugs and medications possibly had a role were also noted in our series. Genetic factors were studied in some of our patients and common mutations which were detected included SPINK1, CFTR and CASR gene mutations. Familial aggregation was not uncommon in TCP.

The most common and predominant symptom was pain, seen in 1041 (89.9%) patients. Calcification was seen in 1040 (89.8%) patients. Diabetes was seen in 665 (57.4%) patients while steatorrhea, in 390 (33.7%) patients. Our findings corroborate the value of using fecal elastase1 estimation by polyclonal ELISA kit as a valuable method for testing for pancreatic exocrine insufficiency. The nutritional status was evaluated by anthropometric, biochemical, clinical assessment and a detailed dietary assessment was done. We found that severe malnutrition was less common than in previously reported series. Cassava was not found to be a significant dietary factor as was previously considered. Selective deficiencies in branched-chain amino acids were seen. Significantly, we noted deficiencies in micronutrients especially zinc and folic acid in both ACP and TCP patients.

Diabetes could be managed purely by dietary measures in a minority. Most needed use of OHAs or insulin. Pancreatic exocrine insufficiency (PEI) responded to pancreatic enzyme supplements (pancrelipase/pancreatin) and dietary measures. Use of minimicrosphere pancrelipase preparations was especially useful in cases of severe PEI (fecal elastase1 levels <100-mg/g stool) and following pancreatecto-duodenectomy. Pancreatic pain could be managed with medical management in the majority.
Common interventions for pain included endotherapy with ERCP, ESWL, and celiac plexus block (fluoroscopy or EUS guided).

Common local complications noted included pancreatic pseudocysts, pancreatic ascites, and benign biliary strictures. Endoscopic pseudocyst drainage (transgastric and transpapillary approaches) was successful in most patients with pseudocysts but needs proper case selection to identify cases likely to resolve without need for subsequent surgical drainage. However, endoscopic management was successful in most cases of pancreatic ascites corroborating use of endotherapy as a first line of management in this complication. Splenic and SMA pseudoaneurysms with GI bleed were most common vascular complications.

Pancreatic cancer complicating CP was seen in patients and was diagnosed late in most patients. Early diagnosis of pancreatic cancer in setting of CP and differentiation of benign and malignant mass in CP remain formidable clinical challenges despite medical advances. We found serum CA 19-9 was a valuable adjunct in diagnosis and management of pancreatic cancer and may possibly be used for screening. EUS was useful in evaluation of CP. However, the dense calculi burden in our CP patients, unlike in the West, appeared to reduce its value in differentiating a benign from malignant mass on a basis of sonographic morphology alone and in detecting very small lesions which are not seen on CT scan. EUS guided FNA was used in patients and was useful when a positive result was obtained. However, a negative FNA result could not conclusively exclude malignancy.

We have previously reported differences in drinking patterns between alcoholic liver cirrhosis (ALC) and alcoholic chronic pancreatitis (ACP). Older age of onset of disease, longer duration of drinking, and higher cumulative alcohol intake were seen in ALC. ALC patients were more often continuous drinkers and alcohol dependents whereas ACP patients were more often binge drinkers and tended to abstain more often. ACP patients were also more often smokers than ALC patients.

Regular 3-6 monthly counselling sessions in our clinic helped achieve significant reductions in cessation of alcohol and smoking.

**DISCUSSION**

TCP had been the dominant type of CP in Kerala and typically had a clinical presentation of “pain in childhood, diabetes in adolescence and death during prime of life”. A significant finding in our experience over the last 15 years has been a delay in age of onset of CP. Overall, the reasons behind this seem related to increase in prevalence in ACP (which is known to present later after several years of alcohol abuse); as well as change in the natural history of ICP patients who now appear to present later and have a seemingly milder course. The possible reasons for the latter include better socioeconomic conditions, improvements in health facilities, and diet of the people in Kerala. There is still lack of a definite understanding of the etiopathogenesis of TCP. It is likely that there is an interaction of multiple genetic and environmental factors. Oxidative stress and antioxidant depletion appear to be a common pathogenetic mechanism in chronic tissue inflammation and injury. Micronutrient deficiency could impact pancreatic function as some of these do appear to play a vital though often not well characterized role in pancreatic function. Alternatively, micronutrient deficiency could be implicated in production of oxidative stress which is well known to be implicated in pathogenesis of CP. Supplementation of folic acid and zinc could be useful additions to traditional antioxidant preparations used for medical management of CP.

Moreover, the etiologies of CP are getting blurred with increase in alcohol use in the population. Unlike previously where ICP patients were mostly patients who never consumed alcohol, now many of them imbibe alcohol in small amounts. Thus, there is a mixed picture. The classical tropical pancreatitis is seldom seen now. A rise in prevalence of smoking has also been noted which is a risk factor in progression of disease especially in development of early calcification and is also an independent risk factor for pancreatic cancer.

We observed a rise in proportion of ACP cases which now comprise about one-third of CP cases with increasing prevalence over the last few years. The rise in ACP reflects an increase in alcoholism in Kerala. This disturbing trend needs to be addressed by appropriate interventional measures.

Apart from alcohol abuse and smoking, there is also an increased consumption of high fat, high calorific foods associated with increased prevalence of metabolic syndrome. Hence, high BMI and related metabolic factors appear to form the background in a subset of CP cases today. Lifestyle interventions are likely to be beneficial and may find a place in the management of CP in this setting.

We also feel that our approach of health care delivery through a Pancreas clinic with dedicated personnel capable of offering clinical care, patient education, regular follow-up and documentation is useful in providing comprehensive care resulting in significant improvement in quality of life for this chronic disease. This clinic includes a gastroenterologist with special interest in pancreatic diseases (pancreatologist) along with a team comprising of clinic coordinator, social worker, and dietician working in close collaboration, and a diabetologist. Our clinic has managed to achieve substantial improvements in alcohol and smoking cessation and decreased need for interventions for pain.
We have previously reported differences in drinking patterns between alcoholic liver cirrhosis (ALC) and alcoholic chronic pancreatitis (ACP). Older age of onset, cumulative alcohol intake were seen in ALC. ALC of disease, longer duration of drinking, and higher alcoholic chronic pancreatitis (ACP). Older age of onset was obtained. However, a negative FNA result could not conclusively exclude malignancy.

We found that pancreatic cancer complicating CP was seen in patients and was diagnosed late in most patients. Early diagnosis of pancreatic cancer in setting of CP and complications.

DISCUSSION

Splenic and SMA pseudoaneurysms typically had a clinical presentation of “pain in child syndrome. Hence, high BMI and related metabolic factors. Oxidative stress and antioxidant depletion appear to play a vital though often not well understood role. Further, micronutrient deficiency could be implicated in pathogenesis of CP. Supplementation of folic acid and zinc could be useful additions to current management of CP.

We believe that the etiopathogenesis of TCP. It is likely that there is an interaction of multiple genetic and environmental factors. Oxidative stress and antioxidant depletion now appear to present later and have a seemingly milder course. The possible reasons for the latter are not clear. However, early intervention with a team comprising of clinic coordinator, social worker, clinical dietitian, physiotherapist, and psychologist working in a multidisciplinary, comprehensive care model in chronic pancreatitis appears to reduce its value in differentiating a benign from malignant mass on a basis of sonographic appearances. However, it typically had a clinical presentation of “pain in child syndrome. Hence, high BMI and related metabolic syndrome. Hence, high BMI and related metabolic factors. Oxidative stress and antioxidant depletion appear to play a vital though often not well understood role. Further, micronutrient deficiency could be implicated in pathogenesis of CP. Supplementation of folic acid and zinc could be useful additions to current management of CP.

A significant finding in our experience over the last 15 years in the Pancreas Clinic at AIMS, Kerala, is the apparent reduction in alcohol use and smoking cessation and decreased need for interventions for pain. A team comprising of clinic coordinator, social worker, clinical dietitian, physiotherapist, and psychologist working in a multidisciplinary, comprehensive care model in chronic pancreatitis appears to reduce its value in differentiating a benign from malignant mass on a basis of sonographic appearances. However, a negative FNA result could not conclusively exclude malignancy.

Chronic Pancreatitis: Experience of the last 15 years in the Pancreas Clinic at AIMS

References

ABSTRACT

Melioidosis is an uncommon environmental disease prevalent in South-east Asia, caused by Burkholderia pseudomallei. It has been reported to be very rarely from Kerala. We report the case of a 39-year-old male Indian farmer diagnosed with this infection. Accurate early microbiological diagnosis, septic foci drainage and effective antibiotic treatment of melioidosis with ceftazidime salvaged the patient’s life and he was discharged totally cured. Presenting clinical features, diagnosis, management and relevant literature are discussed.

Key words: Burkholderia pseudomallei; water borne; septic arthritis; acute disseminated melioidosis; ceftazidime.

INTRODUCTION

The facultative intracellular aerobic motile non spore-forming Gram negative bacterium Burkholderia pseudomallei (formerly known as Pseudomonas pseudomallei, Bacillus pseudomallei, Bacillus whitmori or Bacille de Whitmore, Mallomonas pseudomallei) is an environmental saprophyte found in soil and fresh surface water of endemic areas and was first isolated in 1911 by Captain A. Whitmore, a British pathologist at Rangoon General Hospital. The diseases caused by the organism were first known as Whitmore's disease and in 1921, the term melioidosis was coined. The disease resembles glanders, a pulmonary disease in asses caused by Pseudomonas mallei. Synonyms include Pseudoglanders, Vietnamese time bomb, Whitmore's disease and Rangoon beggar's disease. Melioidosis has been a major cause of morbidity and mortality resulting in serious public health hazards and has significant economic consequences. It is prevalent in southeastern Asia and northern Australia and is the most common cause of community-acquired bacteremia pneumonia. The bacterium is resistant to penicillin, ampicillin, first and second-generation cephalosporins, gentamicin, tobramycin, and streptomycin. Infection is either through inhalation of contaminated dust or water droplets, ingestion of contaminated water, or contact with contaminated soil, through skin abrasions. The bacterium can survive in a variety of hostile conditions, including nutrient deficiency, acidic and alkaline environment, disinfectant and antibiotic solutions, antibiotic exposure and extremes of temperatures. The glycocalyx polysaccharide capsule of the bacterium is an important virulence determinant. The incubation period may range from one day to many years. Symptoms appear two to four weeks after exposure. The infection is classified as acute, subacute, chronic, and subclinical septicemia. Acute melioidosis is life threatening, accounting for up to 60% of all the infections of its kind. Mortality rate can reach as high as 90% in the absence of effective intervention, and 50%, even after antibiotic therapy.

Melioidosis can manifest as localized infection, acute pulmonary infection, acute bloodstream infection, or disseminated infection. Sub-clinical infections are also observed. Localized infection manifests as an ulcer, nodule, or skin abscess with associated fever and myalgia and may progress rapidly through the bloodstream. Mild bronchitis to severe pneumonia is the commonest presentation of pulmonary melioidosis which is characterized by high fever, headache, anorexia, and myalgia. Chest pain is common, but a nonproductive or productive cough with normal sputum is the hallmark of this form of melioidosis. Cavitary lesions on chest X-ray resemble pulmonary tuberculosis. Diabetes and renal insufficiency make patients vulnerable for blood stream infection, which usually results in septic shock. Symptoms include fever, headache, respiratory distress, abdominal discomfort, joint pain, muscle tenderness, and disorientation. Disseminated melioidosis may be acute or chronic and presents with abscess formation in various organs of the body, and may or may not be associated with sepsis. Liver, lung, spleen, prostate, joints, bones, viscera, lymph nodes, skin, or even brain may be affected. Besides fever, patient may have weight loss, stomach or chest pain, muscle or joint pain, headache or seizure.

Current interventions are early intravenous administration of antibiotics, ceftazidime or carbapenems, for 10 to 14 days, followed by oral administration of co-trimoxazole or doxycycline for 3-6 months. Although ceftazidime was reported to be the most effective antibiotic for melioidosis, its therapeutic response is disappointingly slow in most cases, probably because its efficacy is multifactorial and dependent on

CASE REPORT

Escape From Disseminated Melioidosis Of Tropics: A Case Report And Literature Review


CASE REPORT

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the properties of the organism and the clinical symptoms and immune status of the host. Carbapenem, the MIC of which was found to be relatively low in an in vitro experiment, is currently considered a preferred antibiotic. This, combined with one or more other antibiotics, yield a better therapeutic outcome. Melioidosis in India has been reported in a child by Raghavan et al in 1991. A series of 28 patients of septicemia melioidosis over 10 years has been reported from Vellore.

Major risk factors for contracting this disease are diabetes, liver disease, renal disease, thalassemia, cancer or other immune-suppressing conditions not related to HIV, chronic lung disease (such as cystic fibrosis, chronic obstructive pulmonary disease, and bronchiectasis). We had the rare opportunity to cure a 39 year old male patient who had been referred to our tertiary care centre at Kochi, due to septicemia caused by Burkholderia pseudomallei infection.

CASE REPORT

A 39-year-old male farmer hailing from Kozhenschery (Pathanamthitta district), a place inundated by the rivers Manimala and Pamba, was admitted on February 2012, at a Medical College hospital (Thiruvalla) with 5 days history of fever, chills, rigors and painful inflammation of left ankle and elbow joints. He was on regular treatment for type 2 diabetes mellitus, systemic hypertension and dyslipidemia, for the last 8 years. He was in the habit of consuming around 90-150 ml of alcohol per day for the last 10 years, which he stopped 25 days prior to hospitalization. Upon admission in the local hospital, he was conscious, febrile, tachycardic, normotensive and lab reports showed TC 14400/ ESR 131/ Hemoglobin 10.9/ Creatinine 0.86/ SGOT 109/SGPT 165/ALP 512/FT4 17.21. He was provisionally diagnosed to have septic arthritis and treatment was initiated with intraarticular aminoglycoside injection after sending the blood and joint pus aspirate for culture & sensitivity. Gram staining of joint aspirate revealed plenty of pus cells and few GNB. Cultures, provisionally were suggestive of non-fermenting Gram negative bacilli suspected of Burkholderia species sensitive to ceftazidime and imipenem, but resistant to polymyxin B. However, there was no therapeutic efficacy and his symptoms of fever and cough continued, chest X ray worsened and he developed type 1 respiratory failure. Subsequently, he was admitted in our Emergency room ICU at Kochi.

His vital signs upon arrival were: temperature 100 degree F; pulse 107 beats/min; respiratory rate 22 breaths/min; blood pressure 130/90 mmHg; peripheral oxygen saturation 96% on 2 litre O2 nasal prongs. He was conscious, with coarse breathing sounds from both lungs. ABG showed pH 7.513/pCO2 23.6/pO2 89.6/-sO2 95.3/ lac 1.7/ HCO3- 19.1 on 2 litre O2 nasal prongs. Abdominal examination was normal. The skin overlying medial aspect of left ankle showed erythema with diffuse tenderness around entire ankle joint with mild restriction of movements. The left elbow dorsal aspect had a minor swelling with associated painful restriction of elbow movements. The patient denied a history of trauma, but had a habit of walking barefoot in his farm. He had never been to any South East Asian countries or Australia in his lifetime.

The subsequent laboratory tests performed showed: white blood cells, 17x109/L; ratio of neutrophils to white blood cells 85.9%; ESR 60 mm/h; C-reactive protein 261.6 mg/L; Albumin 2.12; Globulin 3.6; Serum Creatinine 0.65; Serum Urea 20.6. A chest radiograph showed minimal infiltrates in bilateral hilar areas (Figure 1).

Ultrasound scan showed hepatomegaly with mild coarsening of echotexture with splenomegaly and cholelithiasis. Transthoracic echocardiography revealed a good left ventricular systolic and diastolic function and 50% of ejection fraction with no RWMA, valves normal, no effusion/clot. Aerobic & anaerobic blood culture samples were sent to lab for analysis. Left elbow and ankle synovial fluid was sent for culture and sensitivity after performing arthroscopy & drainage (under regional block) in Feb 2012. After admission, the following diagnoses were made: (I) Septic arthritis (II) Early pneumonia (III) Melioidosis. Subsequently i.v vancomycin, i.v piperacillin sodium USP and tazobactam sodium combination, doxycycline tablets & i.v clindamycin were initiated and later on the antibiotic regime were changed to imipenem i.v, clindamycin i.v, ceftazidime i.v, vancomycin i.v and trimethoprim 160mg + sulfamethoxazole 800mg combination double strength tablets. Sugars were managed with insulin according to sliding scale.
Serum latex agglutination test for rheumatoid factor was negative. His aerobic blood culture came out to be positive for Gram-negative bacterium Burkholderia pseudomallei (Figure 2), which was subsequently confirmed in the ankle and elbow synovial fluid culture reports in late Feb 2012.

The bacterium showed sensitivity to imipenem, ceftazidime, chloramphenicol, cotrimoxazole, tigecycline and doxycycline. From day eight onwards, patient remained afebrile, joint pains subsided and he improved symptomatically, blood counts normalized, CRP decreased and he was shifted to ward. With adequate physiotherapy, joint mobility dramatically improved and he was discharged from the hospital on March 2012 with Inj. Imipenem 2 g iv BD, Inj. Ceftazidime 2 g iv BD and Trimethoprim 160mg + Sulfamethoxazole 800mg combination double strength tablets 2 tablets thrice daily, all for a week and was subsequently followed up for next 6 months with no relapse.

**TABLE 1 : Review of cases in India**

<table>
<thead>
<tr>
<th>Year</th>
<th>Place</th>
<th>Clinical presentation</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>Tamil Nadu</td>
<td>Fever with insulin dependent DM</td>
<td>Ceftazidime &amp; cotrimoxazole</td>
<td>Treated</td>
</tr>
<tr>
<td>2003</td>
<td>Tamil Nadu</td>
<td>28 patients, 30 isolates from blood, 8 from pus, 3 from synovial fluid, 2 from sputum</td>
<td>Ceftazidime &amp; Cotrimoxazole</td>
<td>Death</td>
</tr>
<tr>
<td>2003</td>
<td>Hyderabad</td>
<td>Septicemia</td>
<td>Imipenem</td>
<td>Treated</td>
</tr>
</tbody>
</table>
| 2005-2006| Mangalore   | 25 cases  
3 septic arthritis with DM  
2 supraclavicular mass with DM  
1 pericardial effusion with DM  
1 scalp abscess with DM  
2 psoas abscess with DM  
2 gluteal abscess with interstitial lung disease and COPD on steroids  
5 pneumonia  
3 renal disease with DM and chronic renal failure  
1 pancreatic pseudocyst with alcoholic liver disease  
1 pneumonia/septic arthritis with DM  
3 PUO with malnutrition  
1 pneumonia without septicemia with DM | Ceftazidime & cotrimoxazole for 6 months | Death          |
| 2007     | Tamil Nadu  | Genitourinary infection with DM type 1  
Genitourinary infection with DM type 2 | Treatment could not be started | Death          |
| 2007     | Tamil Nadu  | Liver abscess- 2 cases                                                                 | Ceftazidime & cotrimoxazole                   | Treated        |
| 2008     | Pondicherry | Diabetes with splenic abscess & foot abscess  
HIV positive                           | Ceftazidime & cotrimoxazole                   | Treated        |
| 2009     | Pondicherry | Pre-term neonate                                                                       | Meropenem                                     | Treated        |

**DISCUSSION**

Literature review showed a predominance of melioidosis cases in southern coastal belts of India, but very few cases were reported from Kerala.

Our patient was diabetic, which can be compared with the study done by Vidyalaxmi et al which showed 76% correlation of Melioidosis with diabetes mellitus. Patient was an alcohol consumer and was also incidentally detected to have features suggestive of chronic liver disease in abdominal ultrasonography. Alcohol consumption is yet another proven risk factor for melioidosis. Bone involvement in our subject was also favourable to a diagnosis of melioidosis as it has been earlier reported by Morse LP et al. Septic arthritis cases similar to our subject, reported from Mangalore during 2005-2006, have ended up in 100% mortality. There could be several possible factors that might have salvaged our patient’s life. First, the causative Burkholderia pseudomallei was detected at a very early stage. Second, timely administration of appropriate antibiotics and initiation of early goal directed therapy for sepsis. Ceftazidime i.v was initiated as per globally proven studies along with carbapenem, that might have improved the overall prognosis of the patient, which has earlier been confirmed by Cheng et al. Third, prompt and early surgical debridement of the joints removed one foci of sepsis. Fourth, apart from a mild degree of liver dysfunction (probably secondary to chronic alcoholic liver disease), other systems were not affected, and he never went into septic shock, which might have contributed to his early recovery.

Based on overall data, we suspect that the septicemia caused by acute septicemic melioidosis in this victim might have been triggered by the invasion of Burkholderia pseudomallei through water borne routes, as he had a habit of walking barefoot in his farm and also was actively involved in cattle breeding and agricultural activities.

**CONCLUSION**

The medical community should be highly alert to the possibility of melioidosis in areas where the B. Pseudomallei is endemic. It may resemble TB clinically and radiologically. Therefore, B. pseudomallei has been called the ‘great mimicker’ of other infectious diseases such as...
TB, syphilis and typhoid fever\textsuperscript{19-22}. Careful investigations into the patient's history of exposure to polluted water or soil, and early bacterial examination of clinical samples are crucial for correct and timely diagnosis. Persons with exposed skin wounds with risk factors like diabetes, alcohol consumption or chronic renal disease are at increased risk for melioidosis, and should avoid direct contact with soil, excreta and standing water. Those performing agricultural activities should wear boots to prevent infection through the feet and lower legs. Standard contact precautions (like mask, gloves, and gown) should be used by healthcare workers to prevent infection.

At the same time, once diagnosed, timely administration of effective antibiotics and adequate fluid resuscitation to counteract hypovolemia at the early stage of therapy also help to save life. Eradication of the organism following infection is difficult, with a slow fever-clearance time, the need for prolonged antibiotic therapy and a high rate of relapse, if therapy is not completed. Mortality from melioidosis septic shock remains high despite appropriate antimicrobial therapy. The vast paddy fields and monsoons with heavy rains\textsuperscript{11} and waterlogged areas of Kerala serve as an ideal habitat for B. pseudomallei. The diagnosis of melioidosis requires clinical vigilance and an intensive microbiological support. By presenting this rare case, we hope to raise the awareness of clinicians to the existence of melioidosis in India. Presently, no effective vaccine is available against B. pseudomallei infection. Current approaches under evaluation include conjugate DNA, attenuated and heterologous vaccines, attenuated mutants with invasive capacity having reduced ability to produce a fatal infection\textsuperscript{11}. Before recommending prophylactic measures, studies to identify the prevalence of the etiological organism in the environment are urgently warranted\textsuperscript{11}. Prevention of disease and a reduction in mortality and the rate of relapse are the priority areas for future research studies.

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References

A Rare Case of Malignant Hyperthermia

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ABSTRACT

Malignant Hyperthermia (MH) is a rare disorder which is usually precipitated by inhalational anaesthetic agents and succinylcholine. We present a case of Malignant Hyperthermia that occurred in a young male patient. After induction with propofol and succinylcholine, the patient had a cardiac event. There was an elevation in temperature and end-tidal carbon dioxide. His creatinine kinase levels also were elevated significantly. The genetic testing for MH was inconclusive. There was response to dantrolene, but the patient expired subsequently.

Keywords: Malignant hyperthermia, Succinylcholine, Dantrolene, Genetic Testing.

INTRODUCTION

Malignant Hyperthermia (MH) is a rare disorder, especially in the Indian population. MH was first reported by Denborough and Lovell from Australia in 1960. There are only three cases of MH that have been reported from India following exposure to anaesthetic drugs. We are reporting a case of MH that we encountered.

CASE REPORT

Our patient was an 18 year old boy scheduled to undergo removal of implant of the olecranon process in a peripheral hospital. The details of the initial surgery, which was done four years earlier for the fixation of the olecranon process, were not available.

The patient was premedicated with glycopyrrolate and morphine. He was induced with propofol and succinylcholine. Laryngeal mask airway (LMA) was introduced and anaesthesia was maintained with isoflurane. The patient was placed in the lateral decubitus position. At this point of time, absence of peripheral pulse was noted. Hence the patient was turned back to the supine position and cardiopulmonary resuscitation (CPR) started. During CPR, patient had to be defibrillated for ventricular fibrillation (VF). After return of spontaneous circulation (ROSC), the patient had tachycardia. The LMA was removed when patient was breathing normally an hour later. Ten minutes after this the patient developed respiratory distress. He was intubated and ventilation maintained manually. There was worsening of tachycardia (~200/min). In spite of hyperventilation, the end tidal carbon dioxide concentration (ETCO2) was rising (>55mmHg). A rapid rise in temperature was noted (39.5°C). The supportive measures including cooling were continued and the patient was transported to our hospital.

On arrival here, the patient was sedated, haemodynamically unstable and on ventilatory support. There was rigidity of both upper and lower limbs. Considering the possibility of MH, we hydrated him well aiming at a urine output of 200–300 mL/h. Other supportive measures were continued. As his temperature was rising, apart from normal cooling measures, the Haemostat® (cooling device used for cardiac surgery) was also used. The initial blood analysis revealed a serum creatinine of 1.7 mg/dL, potassium of 3.5 mmol/L, creatine kinase (CPK) of 2488 IU, and blood gas analysis showed a pH of 7.29, PaCO2–47mmHg, HCO3–19mmol/L. Subsequently, there was a significant rise in the serum concentration of CPK. It reached a maximum of 244,240 IU on the 3rd postoperative day. Initially, he was maintaining a good urine output (>100mL/h). However this dropped drastically. Hence, haemodialysis was initiated from 2nd postoperative day onwards. On the 3rd postoperative day, parenteral Dantrolene Sodium was given. Subsequently, the CPK levels and body temperature decreased.

In spite of all these measures, there was no improvement in the patient's neurological or renal status. From the 4th postoperative day onwards, the brainstem reflexes were absent clinically. But all supportive measures were continued. Haemodialysis was continued till the 9th postoperative day, as he remained anuric. An EEG was done on the 8th postoperative day, which showed electro-cerebral silence. An apnoea test was done on the 11th postoperative day which was positive for brain death. We continued the ventilatory support till his cardiac death.
DISCUSSION

The three main differential diagnoses that we considered were Neurolept Malignant Syndrome (NMS), Hypoxic Ischaemic Encephalopathy (HIE) and Malignant Hyperthermia (MH).

Rigidity and elevated levels of CPK can be seen in NMS. However, he had not received any of the drugs that precipitate NMS. Otherwise it is clinically difficult to differentiate between MH and NMS as the symptoms and signs in both these conditions can be very similar.

The patient had a cardiac arrest during induction. It was a witnessed arrest in an operative theatre setting under the careful observation of an anaesthetist and hence the patient was resuscitated immediately. So the possibility of HIE would be unlikely. Also such extreme levels of CPK are unusual following a CPR. The hyperpyrexia also can't be explained solely based on HIE.

So our working diagnosis was that of MH. The specific treatment for MH is giving Dantrolene. Dantrolene was not immediately available. We continued supportive care including good hydration, aggressive cooling and haemodialysis. We preserved blood samples for genetic studies. Caffeine Halothane contracture test (CHCT) which is considered the gold standard for diagnosing MH is not yet available in India, though Saxena\(^2\) has reported the first ever CHCT from our country.

We also graded our patient for MH based on the clinical grading scale suggested by Larach\(^4\). A score of more than 50 is almost certain of MH. Our patient’s score was 63. This confirmed our diagnosis of MH on clinical grounds. The score is described in Table 1.

<table>
<thead>
<tr>
<th>Process</th>
<th>Indicator</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigidity</td>
<td>Generalised muscular rigidity</td>
<td>15</td>
</tr>
<tr>
<td>Muscle Breakdown</td>
<td>CPK &gt; 20000 IU after succinylcholine</td>
<td>15</td>
</tr>
<tr>
<td>Respiratory Acidosis</td>
<td>Inappropriate hypercarbia, Anaesthesiologist’s call</td>
<td>15</td>
</tr>
<tr>
<td>Temperature Increase</td>
<td>Inappropriately increased temperature &gt; 38.8 C</td>
<td>10</td>
</tr>
<tr>
<td>Cardiac involvement</td>
<td>Ventricular fibrillation</td>
<td>3</td>
</tr>
<tr>
<td>Others</td>
<td>Rapid reversal of MH signs after Dantrolene</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>63</strong></td>
</tr>
</tbody>
</table>

Subsequently we managed to get Dantrolene and the patient’s temperature and CPK levels decreased significantly afterwards. The patient initially had intact brainstem reflexes but later developed brainstem dysfunction. This could probably be due to the uncontrolled hyperpyrexia during the initial 72 hours.

The genetic testing was done in the Division of Molecular Genetics at the University of Pittsburgh Medical Centre, USA with the help of our paediatric geneticist. The patient’s blood samples were sent for analysis. The RYR gene hotspot screening studies were done on the patient’s samples. The screening did not show any deleterious changes. So the test was inconclusive for MH. The MHAUS\(^5\) guidelines for testing for MH have suggested that absence of a causative mutation does not rule out MH susceptibility.

MH is a rare genetic disorder that usually occurs following exposure to inhalational anaesthetic agents and/or succinylcholine. There are many case reports of MH following anaesthetic exposure in the western literature since the early 1960s. However there are only three reports of MH that have been published from India. The general belief has been that the Indian population is not predisposed to MH. Gupta PK and Hopkins PM\(^6\) have described how the Indian population could be susceptible to MH, contrary to what was believed earlier. There are recent case reports of MH from East Asian countries as well. Thus, the Indian population could be susceptible to MH. Anaesthesiologists need to have a high index of suspicion to diagnose MH. In the absence of muscle testing facilities and the problems with genetic testing, the clinical grading scale\(^4\) is a useful tool to diagnose MH.

In our opinion, family members of patients with MH should also be carefully screened before any surgery. Hence asking for family history of immediate relatives with minor anaesthetic complications or MH should be done as a part of pre anaesthetic check up to avoid this fatal complication.

CONCLUSION

We have reported a case of MH based on clinical and laboratory parameters. The genetic test was inconclusive. MH is definitely a rare situation which an anaesthetist may face once in his lifetime. The lesson learnt from this case is that mortality in MH is high. In our case, even though the CPK and other metabolic parameters improved significantly after starting dantrolene, there was a delay in initiation because of non availability. We need to have centres where the muscle biopsy and testing can be undertaken. Also we would like to suggest setting up an MH registry in our country so that in future, all suspected cases of MH can be reported. Dantrolene sodium, which has helped to decrease the mortality of this disorder to a great extent, should be easily available to anaesthesiologists in India. Maybe an MH hotline would probably help in achieving this.
ACKNOWLEDGEMENTS

We thank Dr. Sheela Nampoothiri, head of Paediatric Genetics, who helped us in doing the genetic testing. We also thank the Division of Molecular Genetics at the University of Pittsburgh Medical Centre for doing the genetic testing.

References

Inadvertent Insertion of Ryle's Tube into the Trachea Following Endotracheal Intubation

Mohammed Kutty K, Deepa Mirium Varghese, Mathew George, Gokuldas Menon

ABSTRACT

Insertion of nasogastric tubes are done routinely and commonly but complications of this procedure are under-reported. The traditional method of air insufflation and epigastric auscultation may not be a reliable indicator of gastric placement. It can very well miss a malposition. Radiological evidence is the gold standard for correct placement, and the NG tube position should be confirmed by an X-ray before any feeds are initiated through it. We report the case of a faulty insertion of NGT post-operatively on table, which was detected later, and corrected before any complications ensued.

Key words: Nasogastric tube, malposition, pneumothorax, pleural effusion, epigastric insufflation, X-ray chest and abdomen.

CASE REPORT

Insertion of feeding tubes although widely considered to be easy is not without complications, but the problems are under-reported. The rate of malposition of feeding tubes into the trachea and distal airways ranges from 2-2.5%. Sorokin & Gottlieb reported 50 cases of nasogastric tube malposition into the right or left bronchus out of 2000 tube insertions over a period of 4 yrs, with 2 mortalities.

We report the case of a 32 yr old man, diagnosed as a case of falcotentorial meningioma for occipital craniotomy and excision. He had no comorbidities. All the preoperative blood and radiological investigations were within normal limits. Craniotomy was panned under GA with invasive arterial and CVP monitoring. He had a standard IV induction with vecuronium for neuromuscular blockade. The patient was intubated with a cuffed oral endotracheal tube of 8.5mm internal diameter fixed at 22cm. The patient was connected to the anaesthesia workstation and ventilated in volume control mode with the following settings - FiO2 40%, TV-450ml, RR 15bpm, FGF 2l. A 16F ryles tube was inserted via the right nostril. It went in without much difficulty, fixed at 60cm mark on the nose and its position was confirmed by auscultation of epigastrium after insufflating air via the RT. The patient was positioned in a semi-prone decubitus and the surgery proceeded uneventfully. Intra-operatively it was noticed that the set tidal volume of 450 ml was not getting delivered, showing a leak of 100-120 ml. There was a steady increase in the end-tidal carbon dioxide levels, which remained persistently above 36 mm of Hg despite increasing the respiratory rate to 20/minute. An examination for obvious circuit or cuff leak did not reveal any gross leak and we assumed that the anaesthesia workstation had developed an error in flow-meter calibration. Hence the TV was increased to 600ml to increase the minute ventilation, despite which no rise in peak airway pressures were noted. There were no episodes of desaturation.

The rest of the surgery proceeded uneventfully and it was decided to electively ventilate the patient because of long duration of surgery (nearly 15hrs). Patient was ventilated in the ICU in SIMV/PS mode with FIO240%, TV 500 ml (delivering 380-400ml), RR-15/m. Morning chest x-ray in the ICU revealed a malpositioned RT, with its tip in the right mainstem bronchus. The tracheal position was further proved by demonstration of air bubbles from RT when placed under water, synchronous with breathing.

Fortunately for the patient there was no pneumothorax or pleural effusion and we hadn’t started any feeds via NG tube.

The Ryles tube was removed without any delay and the patient was extubated within a few hrs once he met the extubation criteria. The rest of his ICU stay was uneventful and he was shifted out of the ICU on second postoperative day.

DISCUSSION

Failure to recognize a malpositioned feeding tube may lead to serious injuries to the tracheobronchial pleural tract such as pneumothorax, pleural effusions and even death. Intravascular penetration although rare is also mentioned –erosion into the retroesophageal aberrant right subclavian artery, right internal jugular vein to right atrium. Tube knotting and impaction, tube double backing and kinking are a few non-thoracic complications.

Thus this relatively easy procedure is not without complications. Reporting such events will make the clinicians aware about the potential morbidity and mortality associated with such a simple procedure often done unsupervised by junior staff and nurses. Further, this may lead to formulation of a plan to contain this problem, and thus enhance the safety.
Below described are a few points to enhance the chances of a successful nasogastric tube insertion:

1. The traditional air insufflation and epigastric auscultation may not be a reliable indicator of gastric placement, as good thoraco-abdominal sound transmission can lead to misinterpretation. An NG aspirate with pH < 5 may not always be from stomach – it could be from an infected pleural or respiratory secretion.

2. The X-ray remains the gold standard to verify the correct placement. The 2 step insertion is the best way to prevent complications. Initial 30 cm is the crucial damage limiting distance, as it is at the trachea-esophageal transition zone. Verify the position by an X-ray and introduce further to 50 cm and confirm by a 2nd X-ray.

3. Insertion of excess tubing is to be avoided.

4. Tracheal entry can be detected using small, disposable capnometers.

5. Newer nasoendoscopes with guidewire exchange, are very useful in difficult, prior failed or complicated attempts.

6. A few high risk groups are identified:
   - Intubated and sedated
   - Elderly
   - Mentally obtunded
   - Following lung transplantation
   - Repeated attempts after earlier pulmonary misadventures.

Reference


ABSTRACT
In a majority of patients of the paediatric age group who sustain a femur shaft fracture, the management is usually conservative with the help of casting. However in some cases where the reduction cannot be maintained, a surgical intervention maybe required. This is a case of a 5 year old boy with a shaft of femur fracture who was managed with the help of a titanium elastic nail. Post operatively he was non weight bearing for 2 months. He started weight bearing after 2 months with no complications. The implant was removed one year later. Titanium elastic nailing is a good and stable method of fixation of fracture shaft of femur in the paediatric age group, with minimal complications.

INTRODUCTION
In a majority of pediatric patients, femoral shaft fractures are managed with closed reduction and casting. But in some cases where the reduction cannot be maintained a surgical intervention may be required. There are many complications seen with other methods of fixation, which can be avoided with titanium elastic nailing, like infection and re-fracture. Titanium elastic nails have become more popular in the fixation of femur shaft fractures in children.

CASE REPORT
A 5 year old boy came to our casualty with a history of fall from a bike with direct injury to his right thigh, after which he developed pain and swelling over the right thigh. He was unable to weight bear. He had no external wounds. He had no other injuries. His distal pulses were well felt. X-ray of the femur (Fig 1a and 1b) AP and Lateral views were done which showed a displaced fracture of the shaft of the right femur, AO classification 31A2.

The patient was stabilized with an above knee slab and was planned for a closed reduction and internal fixation with a titanium elastic nail the next day (Fig 2).

Two 3mm Titanium elastic nails were inserted through the entry point which held the fracture in place (Fig 5). The reduction was re-confirmed with the help of an image intensifier. The haemostasis was checked and the wound was closed.

During the procedure the fracture was reduced and checked (Fig 3) with the help of an image intensifier. A 4 cm incision was made over the anteromedial and anterolateral aspect of distal femur.

The entry point (Fig 4) was made with the help of a drill bit above the level of the femoral physis on both sides.
implant was removed under general anaesthesia after 1 year.

The patient is mobilizing well with no discomfort.

**DISCUSSION**

A Titanium elastic nail, acts like an internal splint owing to the divergent “C” like configuration. This creates six points of fixation to achieve biomechanical stability. Elder nails act differently, through nail stacking and from canal fill. Healing is by external callus as titanium nails provide an elastic and stable fixation which allows controlled motion at the site of fracture.

In our case, the fixation was done with the help of a pair of TENS nails, as the fracture was unstable without fixation. The reduction was good with a varus angle of less than 3 degrees (upto 10 degrees is the acceptable varus)\(^1\). The patient was kept non weight bearing for 2 months. Wound healing was good. The patient mobilized well post operatively. He did not complain of pain post operatively over the nail entry site which has been found to be the commonest complication post operatively-11%\(^2,5,6\).

There were no ulcerations or bursa formation present. On follow up there was no proximal migration of the nail.

Titanium nails give good elastic and stable fixation, and allow healing by callus formation from controlled movement at the fracture site. The use of a titanium elastic nail in the fixation of the fracture helps avoid complications like pin tract infections, non-union and long term plaster application. There were no signs of compartment syndrome\(^2\). It has also been proven that the time of healing has been reduced with the use of TENS nailing as opposed to other methods of fixation. It is a closed method of fixation and has a low rate of infection.

**CONCLUSION**

TENS nailing provides good stability in young patients with fracture shaft of femur and is preferable over other methods of fixation in the paediatric age group due to the decreased rate of side effects.

**References**

The patient is mobilizing well with no discomfort.

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