VOLUME-8, ISSUE-2, FEBRUARY-2019 • PRINT ISSN No 2277 - 8160

Original Research Paper

Neurosurgery

# A LOGICAL MODEL FOR ANATOMICAL LOCALISATION IN NEUROLOGICAL DIAGNOSIS

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## ABSTRACT

**Objectives:** The authors postulate a logical model which will help in arriving at anatomical localisation of neurological lesion.

**Methods:** This model was applied randomly to 30 neurological cases admitted in the Neurosurgery ward of the Bangalore Medical College and Research Institute. All the symptoms are first enumerated in a neurological patient. Under each symptom (as a heading) all the possible sites of lesion resulting in the particular symptom are listed out. The "common factor" in these lists will be the site of the lesion.

**Results:** In all cases an accurate anatomical localization could be achieved. In two patients multiple (two) lesions could be diagnosed using this model.

**Conclusion:** The above model is useful for residents and junior consultants of neurology and neurosurgery to arrive at an accurate anatomical localization of the neurological symptoms and even signs.

**KEYWORDS** : logical model, neurological diagnosis, anatomical localization, neurology teaching

## INTRODUCTION

Neurological diagnosis and localization is a mathematical process. Most of us recognize this early in our career and adapt ourselves to this process of thinking and analysis. However, the residents take time to recognise this and find neurological localization puzzling. We have made an attempt to simplify this process by introduction of a logical model which will help all concerned in arriving at anatomical localisation of neurological lesion. This model could also be extended to pathology in a multisystemic disorder.

The practical use of these models is based on the fact that they can be kept realistic enough. Of course, this doesn't mean to include every possible detail, but rather of every major mechanism.(1)

## Materials and methods:

All the symptoms are first enumerated in a neurological patient. Under each symptom (as a heading) all the possible sites of lesion resulting in the particular symptom are listed out. The "common factor" in these lists will be the site of the lesion more often than not. Let us take an example which will illustrate this better.

A patient presents with the following:

- Headache - 6 months
- Seizures - 4 months
- Difficulty in walking - 3 months
- Memory loss - 2 months
- Disorientation - 2 months

All the possible sites are enumerated against every symptom except headache as it is not a localising symptom. On examining the example in question (Table 1) we find that the frontal lobe is the common factor in all the symptoms. Hence, it is mathematical and logical sense that the lesion is in the frontal lobe. Further localisation can be made depending on the examination findings.
The same was confirmed by imaging.

**Table 1**

**Logical Model for anatomical localization**

| DISORIENTATION – 2 mths | SEIZURES -4 mths | DIFFICULTY IN WALKING – 3 mths |
|---|---|---|
| •Parietal lobe (Spatial)<br>•**Frontal Lobe**<br>•Temporal Lobe<br>•Basal Ganglia<br>•Brain stem | •Cortex (Motor)<br>•**Premotor Cortex** | •**Frontal Lobe**<br>•Cerebellum<br>•Extrapyramidal<br>•Sensory<br>•Pyramidal tract<br>•Brain stem<br>•Ant horn cell<br>•Peripheral nerve<br>•Muscle<br>•Vision |
| **MEMORY LOSS – 2 mths**<br>•Fornix<br>•Mamillary Body<br>•Hippocampus<br>•Amygdala<br>•**Frontal Lobe**<br>•Thalamus | | |
| **HEADACHE 6 mths** | | |

What happens if two symptoms have a common factor and the others have a different common factor?

This means that there are two lesions. The value of this model is even more enhanced in the presence of multiple lesions.

This model can be used in multisystemic disorders too, It has also been used in diagnosis and treatment of idiopathic intracranial Hypertension(2) and peripheral pulmonary lesions(3)

For example (Table 2) if the main pathological presentation of a patient are multiple intracranial mass lesions and pancytopenia, then all the causes of each are enumerated.

The common factors here were:

- ALL - chloroma
- AML - chloroma
- Lymphoma
- Tuberculosis
- Langerhans cell histiocytoses
- Multiple myeloma

Incidentally this was a case presented at a clinicopathological conference by the author. The final diagnosis turned out to be lymphoma.

**Table 2**

**Logical Model for pathology**

| MULTIPLE INTRACRANIAL LESIONS: | | CAUSES OF PANCYTOPENIA: |
|---|---|---|
| 1. INFECTIONS:<br>• Tuberculoma<br>• Aspergilloma<br>• Amyloidoma<br>2. INFLAMMATORY:<br>• LCH<br>• Rosai Dorfman disease<br>3. NEOPLASTIC:<br>• Primary CNS lymphoma – T Cell / B Cell<br>• Chondrosarcoma<br>• Osteogenic sarcoma<br>• Chordoma<br>• Multiple meningioma<br>• Malignant melanoma | 4.SECONDARY:<br>• Metastases<br>• Multiple Myeloma<br>• ALL<br>• AML<br>• Leptomeningeal Carcinomatosis | 1. Congenital: Fanconi, Diamond-Blackfan anaemia, Congenital neutropenia, Shwachman-Diamond syndrome, Amegakaryocytic thrombocytopenia<br>2. Radiation<br>3. Chemicals: Benzene, OP, DDT, organochlorines<br>4. Drugs: Busulfan, Melphalan, cyclophosphamide, anthracyclines, nitrosoureas.<br>• Drugs with occasional marrow suppression: Chloramphenicol, sulphonamides, gold, anti-inflammatory, anti thyroid, psychotropic, anticonvulsant, anti depressant.<br>5. Viral: hepatitis B virus, Epstein-Barr virus, parvovirus B19<br>6. Neoplastic: Acute leukaemia, myelodysplasia, myeloma infiltration with lymphoma, solid tumours<br>7. Inflammatory/ Infection: Tuberculosis, SLE, LCH<br>8. Hematological: Megaloblastic anaemia, Myelofibrosis<br>9. Paroxysmal nocturnal haemoglobinuria<br>10. Miscellaneous: Haemophagocytic syndrome, Increased peripheral destruction – Splenomegaly, Idiopathic, Decreased bone marrow function, aplasia |

This model was applied randomly to 30 neurological cases admitted in the Neurosurgery ward of the Bangalore Medical College and Research Institute.

No ethical committee approval was required as no patient treatment or management was involved in any way in this paper. The model was only applied on the history as documented in the case record.

**Results:**
In all cases an accurate anatomical localization could be achieved. In two patients multiple (two) lesions could be diagnosed. Both were cases of multiple neuofibromatosis type 2. In one case of multisystemic disorder this model helped in considerably narrowing down the diagnosis.

**DISCUSSION:**
The assumption underlying the most frequently used mathematical models for diagnosis is that of independence of symptoms. Bayes' theorem. with the joint probability distribution estimated by the product of the marginal probabilities of the symptoms, has been applied to the differential diagnosis of numerous diseases(4,5).

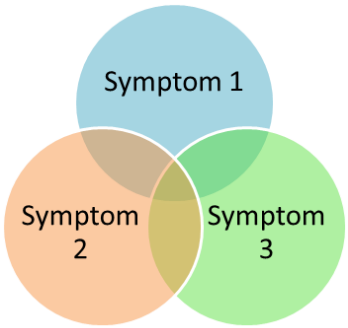
It is apparent that anatomical localization is a mathematical process and is based on sound logic. However, the residents and even some junior consultants get confounded by the plethora of neurological symptoms and their anatomical possibilities. This logical model is an easy process which simplifies the anatomical diagnosis in neurological patients. This process follows the same process as in sets and common areas among the sets. The common area (X) represents the anatomical site of the lesion. (Figure1)

It is a fact that most of us work this out in our minds but putting pen to paper makes the process easier and more accurate. This process of enumerating all the possible anatomical areas responsible for the symptom on paper reduces the chances of any omission and thereby makes the process more accurate. The process is even more valuable when there are 2 or more lesions. In such instances there may be a common area between 2 or more symptoms and another common area between other symptoms which is different from the first one. This was encountered in 2 patients in our series.

This model will be especially useful to the residents and junior consultants who are relatively inexperienced. This model could also be extended to the signs and pathology as well. The model in Table 2 was of a patient who died of basically 2 pathologies - multiple intracranial mass lesions and severe pancytopenia. It is obvious how this model made it possible to arrive at a correct diagnosis.

**CONCLUSION:**
The above logical model is useful for residents and junior consultants of neurology and neurosurgery to arrive at an accurate anatomical localization of the neurological symptoms and even signs. We believe that inculcating this among the residents in their daily training will help them to diagnose neurological lesions easily and also induce interest in the subject among them.

**Figure 1**




**Acknowledgements: NIL**
**Conflict of Interest: NIL**
**Sources of financial grants / funding: NIL**

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