# Advanced Neuroimaging and CSF Metagenomics to Expedite Subarachnoid Neurocysticercosis Diagnosis in a Non-Endemic Region

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## BACKGROUND

Neurocysticercosis (NCC), caused by *Taenia solium* larvae, is a major contributor to neurologic morbidity worldwide and the most common reversible cause of epilepsy. NCC has variable presentation in the central nervous system (CNS), including intraparenchymal and extraparenchymal cysts that can range from asymptomatic calcifications to subarachnoid cysts causing obstructive hydrocephalus and significant morbidity. NCC is prevalent in low-and-middle-income countries, where testing is readily available with serology, urine antigen, and PCR testing. However, in developed countries such as United States, clinical unfamiliarity and limited options for rapid confirmatory tests pose significant diagnostic challenges. We present case of severe subarachnoid NCC that was rapidly diagnosed with advanced imaging and CSF metagenomic next-generation sequencing (mNGS), which expedited management and led to a good clinical outcome.

## PATIENT CASE TIMELINE

63y.o Mexican woman reports 1 year of **new headaches** and **pulsatile tinnitus.** Serial MRIs with **progressive non-obstructive hydrocephalus** [Figure 1].

**HD 0** – **Hospital presentation** for 1 week of new **confusion** and **gait imbalance.**

**HD 1** – **MRI-CISS** with stable ventriculomegaly**. LP** markedly abnormal with increased OP [Table 1]. **Empiric ABX started**.

**HD 2** – **Close review of MRI-CISS** [Figure 2] with multiple cysts in posterior fossa. **Serum *T. Solium* serology** sent to ARUP.

**HD 4** – **Worsening HA** and N/V concerning for ICP crisis, **DelveBio mNGS [Figure 3]** sent from CSF.

**HD 6** – **mNGS with + *T solium*. Empiric ABX stopped**, prophylactic EVD and steroids treatment started.

**HD 8** – **Close ICU monitoring** for **initiation of anti-parasitic treatment** for risk of severe cystic inflammation.

**HD 13** – **Serum serologies + *T. solium*** and **+ *Echinococcus***, which often has cross-reactivity. No Rx change.

**HD 19** – **No clinical worsening**, EVD removed, patient discharged home **without deficits** to continue antiparasitic regimen

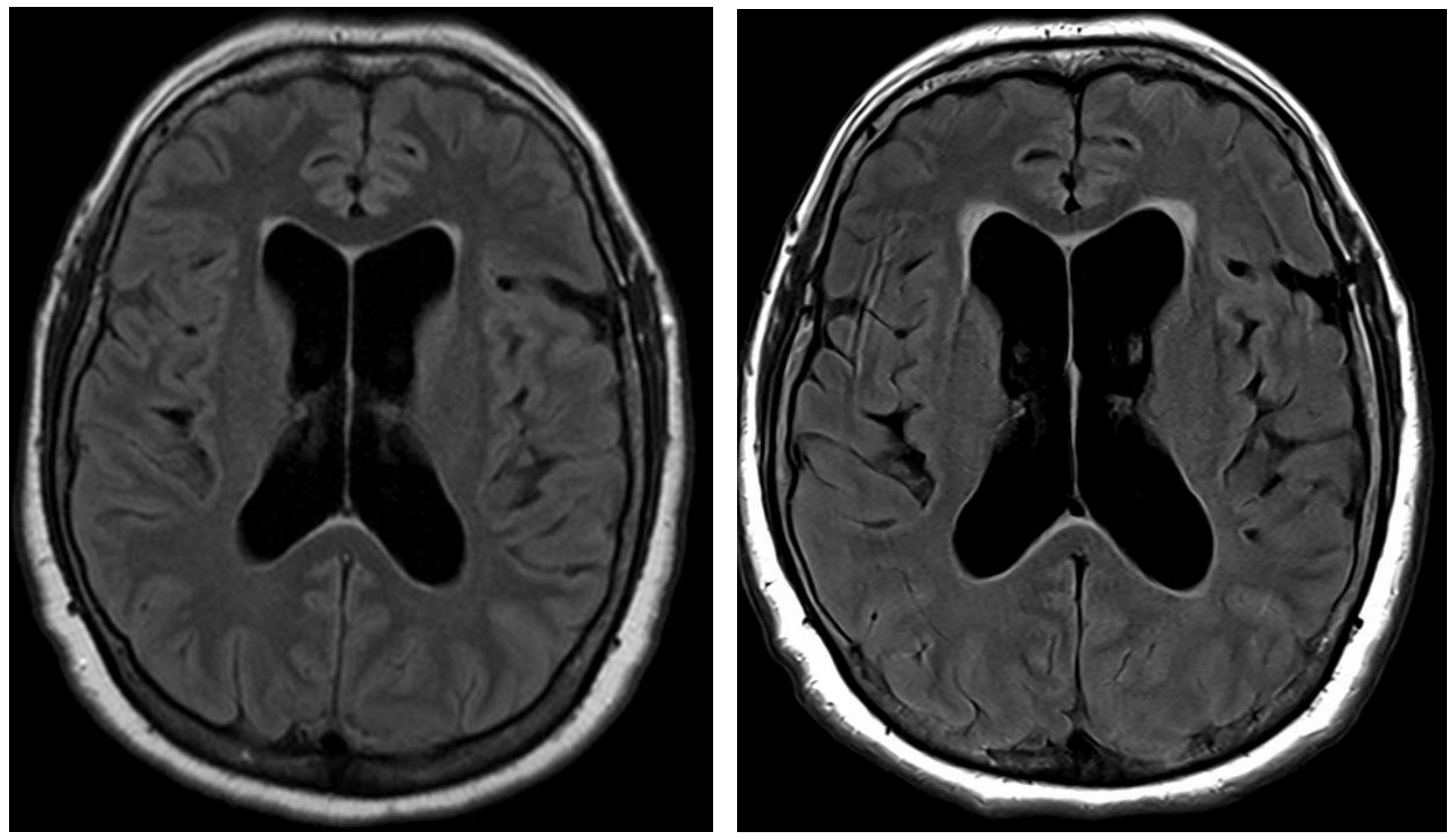
**COURSE WITH ADVANCED DIAGNOSTICS**

- HD 1–HD 6: **Empiric CNS antimicrobials** given diagnostic uncertainty, without anti-parasitics
- HD 6 onward: **Effective ICP control, guideline management of subarachnoid NCC** with pre-treatment steroids and anti-parasitics

**HYPOTHETICAL COURSE WITH CONVENTIONAL DIAGNOSTICS**

- HD 1: **Empiric CNS antimicrobials** without anti-parasitics
- HD 4: Increased ICP complications **without EVD**
- HD 6: **Continued empiric ABX, no pre-treatment steroids**, delay initiation of anti-parasitics treatments
- HD 13: Unclear seropositivity, will **require further testing**.
- HD 19: Prolonged course, uncontrolled ICP, delays, **worse outcomes**

### Figure 1. Initial Serial MRIs with Progressive Hydrocephalus

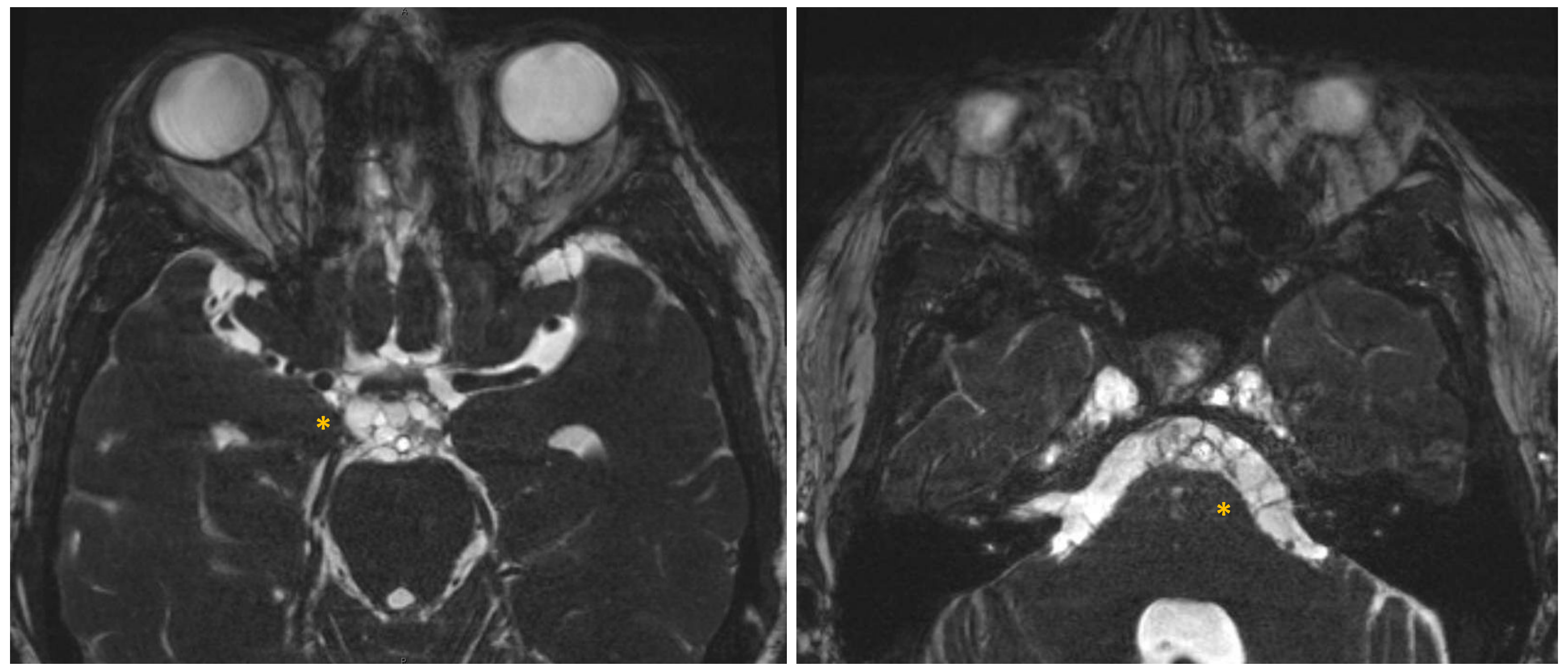


MRI brain FLAIR sequences from 7 months (left) to 1 month prior (right to hospitalization. Progressive "non-obstructive" hydrocephalus with interval worsening of transependymal flow

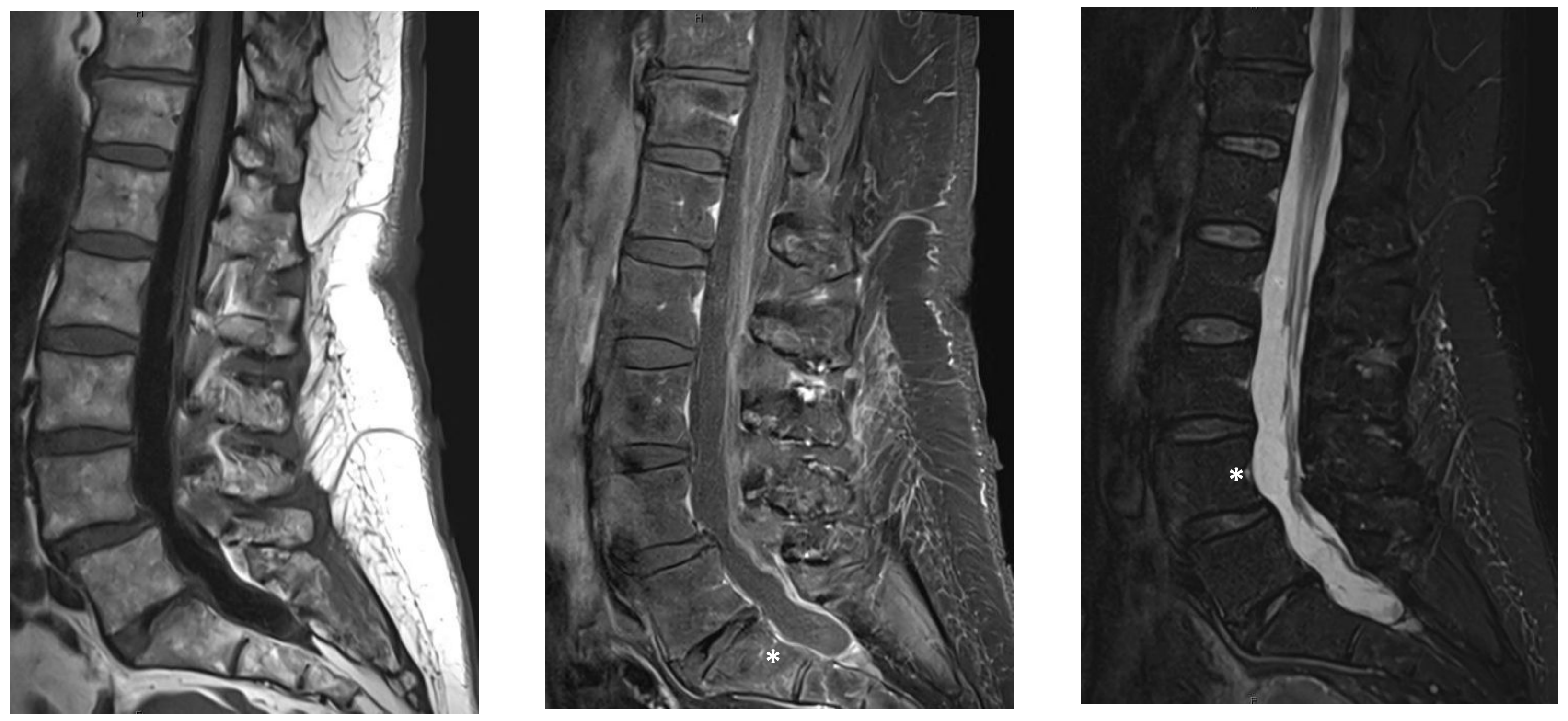
| Category | Tests with normal results | Tests with abnormal results |
|---|---|---|
| **SERUM** | WBC, HIV, RPR<br>UDS<br>Quant Gold, Fungitell<br>Strongyloides Ab, Coccidiodes Ab | **CBC differential: 8.1% eosinophils**<br>***Taenia Solium* IgG + (HD13)**<br>***Echinococcus* IgG + (HD13)** |
| **CSF** | Meningitis panel, WNV negative<br>AFB culture, CrAg | 71 WBC (69% lymphocyte, **15% eosinophils**)<br>Protein 58, **glucose < 10**<br>**DelveBio CSF mNGS (HD 6)**<br>***Taenia Solium* IgG + (HD 13)** |

**Table 1**: Initial Serum and CSF diagnostic studies

### Figure 2. MRI CISS sequences and Spinal Drop Cysts

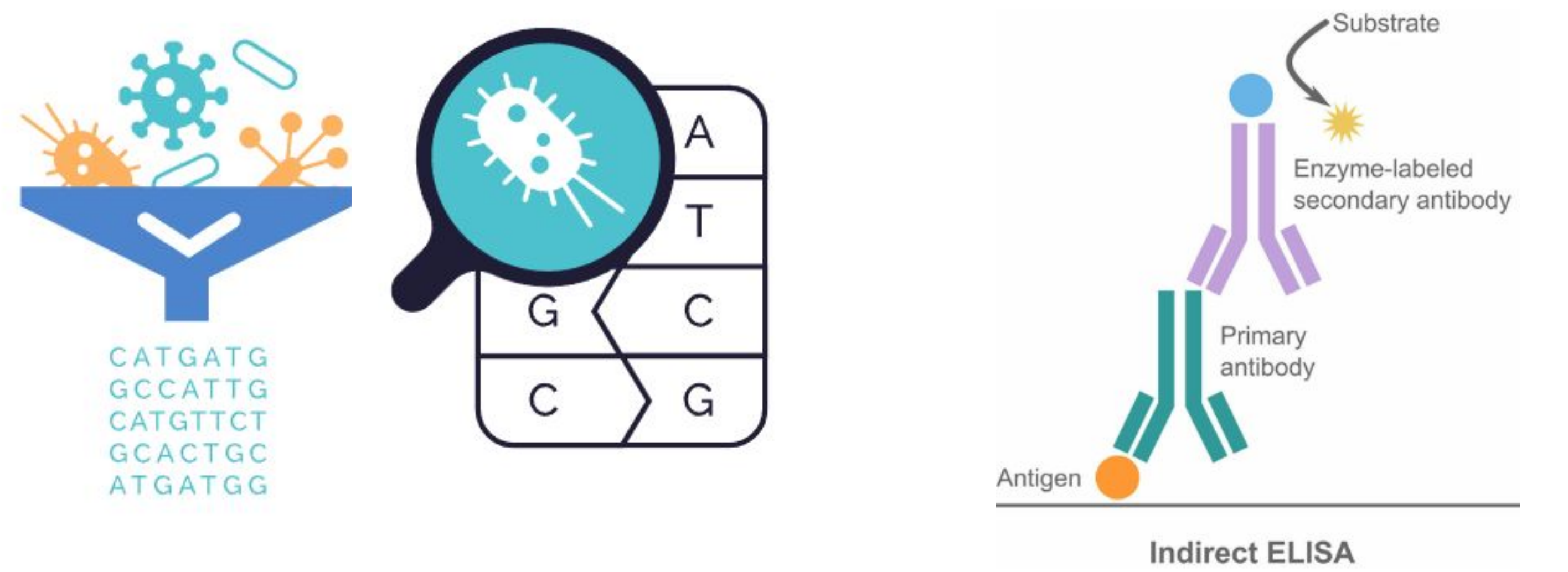


High-resolution 3D-CISS sequence on MRI highlighting multifocal thinly septated cysts in the pre-pontine and interpeduncular cisterns (yellow asterisks). No associated contrast enhancement. Cysts not appreciable on prior MRI sequences due to lack of high-resolution sequences.



Spinal MRI T1 pre, post, and T2 sequences showing subtle findings of drop NCC cysts in the lumbrosacral thecal sacs (white asterisks)

### Figure 3. CSF mNGS (DelveBio) and Conventional NCC Testing



| Metric | Value |
|---|---|
| Total DNA Reads (PF) | 22,430,909 |
| *Taenia solium* RPM Ratio | 34.19 |
| *Taenia solium* Unique Reads | 423 |
| Estimated Biomass (fg) | 2,029.96 fg |

**Table 2. Sequencing metrics for *Taenia solium* detection by CSF mNGS**
Total post-filter (PF) reads, organism-specific RPM (reads per million) ratio, number of unique reads, and estimated microbial biomass. Metrics support high-confidence detection of *Taenia solium* DNA in CSF.

| Description | Scientific Name | E-value | Percent Identity | Accession |
|---|---|---|---|---|
| ITS1, partial sequence (isolate M10) | *Taenia solium* | 1e-40 | 100.0% | EU747668.1 |
| ITS1, partial sequence (isolate M21) | *Taenia solium* | 1e-40 | 100.0% | EU760492.1 |
| ITS1, partial sequence (isolate M40) | *Taenia solium* | 1e-40 | 100.0% | EU747669.1 |
| ITS1, partial sequence (isolate M41) | *Taenia solium* | 1e-40 | 100.0% | EU747663.1 |
| ITS1, partial sequence (isolate M17) | *Taenia solium* | 6e-39 | 98.96% | EU747662.1 |
| ITS1, partial sequence (isolate Tsln K) | *Taenia solium* | 8e-38 | 97.96% | KJ207060.1 |

**Table 3. BLAST evaluation of *Taenia solium* sequences**

Representative BLAST alignments of assembled metagenomic contigs against the NCBI BLAST nucleotide database demonstrate high-confidence matches to the *Taenia solium* internal transcribed spacer (ITS) region.

Reported E-values and percent identity confirm species-level assignment.

## CONCLUSION

Subarachnoid NCC is a challenging CNS disease to diagnosis in non-endemic regions. Use of advanced neuroimaging and metagenomics can expedite management and lead to better clinical outcomes.