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CASE REPORT

Paediatric Tuberculous Meningitis Supported by Stool-Based GeneXpert and Complementary Radiologic Findings in Somalia: A Case Report

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ABSTRACT

Tuberculous meningitis (TBM) is the most severe form of extrapulmonary tuberculosis in children and is associated with high morbidity and mortality, particularly in resource-limited settings where early diagnosis remains challenging. We report a paediatric case of TBM in Somalia in which microbiological support was obtained using stool-based GeneXpert testing alongside clinical and radiological findings.

An 11-year-old boy presented with a three-month history of weight loss, followed by nine weeks of intermittent fever and six weeks of persistent headache, with progressive neurological deterioration. Brain magnetic resonance imaging (MRI) showed diffuse enhancement of leptomeninges and basal cisterns due to TBM with communicating hydrocephalus. In addition, stool GeneXpert MTB/RIF showed the presence of multidrug-resistant Mycobacterium tuberculosis.

Despite initiation of appropriate second-line anti-tuberculous therapy, the patient's condition deteriorated, and he died due to complications of advanced disease.

This report highlights the difficulties faced in diagnosing TBM in children and the serious results of delays in diagnosis. It also supports the potential role of stool-based molecular testing as a non-invasive diagnostic adjunct in children unable to produce respiratory specimens in resource-limited settings.

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Introduction

Tuberculosis (TB) remains a major global public health challenge and is one of the leading causes of death from infectious diseases worldwide [1]. Children account for a substantial proportion of the global TB burden, representing approximately 11% of all TB cases, yet paediatric TB remains significantly underdiagnosed and underreported, particularly in low- and middle-income countries [1].

Early and accurate diagnosis of TB in children is essential to reduce morbidity and mortality. However, paediatric TB often presents with nonspecific clinical features, and microbiological confirmation is frequently difficult due to the paucibacillary nature of the disease [2]. In addition, many children are unable to expectorate sputum, limiting the use of conventional diagnostic

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methods and contributing to delays in diagnosis and treatment.

Alternative diagnostic approaches, such as gastric aspirates and bronchoalveolar lavage, have been utilised to improve diagnostic yield. These are, however, complex and invasive procedures and generally not available in resource-constrained settings [3]. Consequently, there is a growing need for simple, non-invasive, and accessible diagnostic methods for paediatric TB.

Stool has emerged as a promising non-invasive specimen for TB diagnosis in children, based on the detection of swallowed Mycobacterium tuberculosis bacilli [4, 5]. The Xpert MTB/RIF assay has demonstrated encouraging performance in stool samples for the diagnosis of paediatric pulmonary TB and is increasingly being explored as an alternative diagnostic tool, particularly in settings where conventional sampling is challenging [6].

Tuberculous meningitis (TBM) is the most severe form of extrapulmonary TB in children and is associated with high mortality and significant neurological sequelae, especially when diagnosis is delayed. In resource-limited settings, early diagnosis of TBM is particularly challenging due to limited access to advanced neuroimaging and microbiological confirmation.

In Somalia, where TB remains endemic and healthcare resources are constrained, evidence regarding the use of stool-based molecular testing in paediatric TB, particularly in extrapulmonary forms such as TBM, is extremely limited. To our knowledge, this case may represent one of the first reported paediatric cases of tuberculous meningitis in Somalia in which stool-based GeneXpert testing supported the diagnosis alongside clinical and radiological findings. This report highlights the diagnostic challenges of paediatric TBM in resource-limited settings and underscores the potential role of stool-based molecular testing as a supportive, non-invasive diagnostic approach.

Case Presentation

An 11-year-old boy from the Hodan district of Mogadishu, Somalia, who had never been vaccinated with Bacillus Calmette-Guerin (BCG), came to Kalkal Hospital on March 23, 2024, with a progressively worsening illness.

The disease started slowly about three months before the presentation and was mainly manifested by a severe, unintentional loss of body weight. This was followed by intermittent high-grade fever for nine weeks and persistent headaches for six weeks. Furthermore, the patient started suffering from worsening brain-related symptoms, such as changes in the mental state and seizure attacks involving the whole body.

On initial presentation at Kalkal Hospital, the patient appeared chronically ill and cachectic. He was febrile (temperature approximately 38.5°C) and mildly dehydrated. Neurological examination revealed irritability, intermittent confusion, and neck stiffness suggestive of meningeal irritation, without focal motor deficits.

The patient had been given empirical treatment for malaria and typhoid fever at various healthcare facilities, but his condition did not improve. He stated that no one in his house had been exposed to TB or had a persistent cough.

Due to progressive neurological deterioration, the patient was referred to Mogadishu Somali-Türkiye Training and Research Hospital for advanced evaluation.

Brain magnetic resonance imaging (MRI) revealed diffuse leptomeningeal and basal cisternal enhancement, multiple small peripherally ring-enhancing nodular lesions, and communicating hydrocephalus (Figures 1A–B). Areas of restricted diffusion identified by diffusion-weighted imaging (DWI) which were located in the basal ganglia and basal cisterns were indicative of a live infectious disease (Figure 2A–B). These findings were highly suggestive of tuberculous meningitis.

Immediately following the MRI, the patient developed generalised seizures associated with respiratory distress, necessitating oxygen therapy and urgent admission to the paediatric intensive care unit. On ICU admission, he had a depressed level of consciousness with a Glasgow Coma Scale score of approximately 9/15. Clinical signs possible for increased intracranial pressure included decreased response to stimuli and repeated seizure activity requiring ongoing monitoring and supportive treatment.

A presumptive diagnosis of tuberculous meningitis was made based on clinical presentation and neuroimaging findings.

For the next step in diagnosis and treatment, the patient was sent to the Banadir Hospital tuberculosis centre. The tests consisted of a gastric lavage, chest X-ray, cerebrospinal fluid (CSF) examination, and stool testing conducted by the GeneXpert MTB/RIF assay. Although CSF results could not be microbiologically verified, the stool GeneXpert test identified multidrug-resistant Mycobacterium tuberculosis, thereby offering microbiological evidence for the diagnosis (Figure 3).

The patient was then sent to Lazaretto Forlanini Hospital to begin second-line anti-tuberculous therapy for multidrug-resistant TB. At this stage, his body weight had declined from 34 kg to 27 kg over a three-month period, reflecting significant disease progression and nutritional deterioration.

However, even with intensive supportive management such as emergency endotracheal intubation and the initiation of appropriate anti-tuberculous therapy, this patient was clinically deteriorating still. Eventually, he died due to complications related to advanced tuberculous meningitis.

CSF analysis did not provide microbiological confirmation, probably because the infection was of a very low bacillary load. Hence, stool-based GeneXpert testing was employed as a non-invasive supplementary diagnostic technique, especially when conventional

samples gave limited diagnostic results.

He was subsequently managed at Mogadishu Somali Türkiye Training and Research Hospital on March 30, 2024, then transferred to Banadir Hospital on April 5, 2024, and later to Lazaretto Forlanini Hospital on April 7, 2024.

Discussion

Tuberculosis remains a major global public health challenge, with a substantial proportion of cases remaining undiagnosed or unreported, particularly in low- and middle-income countries [7]. These "missing" cases continue to drive ongoing transmission and delay timely initiation of treatment.

One of the major challenges in paediatric TB diagnosis is the difficulty in obtaining appropriate respiratory specimens, particularly in younger children who are unable to expectorate sputum. Consequently, the availability of non-invasive and easily obtainable diagnostic specimens has the potential to significantly improve case detection and clinical outcomes in this vulnerable population.

Tuberculosis control efforts in Somalia face even greater difficulties due to the country's health system challenges that have lasted for a long time. These include ongoing conflict, displacement of the population, and limited healthcare infrastructure. As a result, there are delays in diagnosis, care is disjointed, and many cases are missed. In such settings, patients frequently present late with advanced disease after multiple healthcare encounters, as observed in this case. Strengthening early diagnostic capacity and improving access to integrated care services are essential to address these systemic barriers [8].

In this case, stool-based GeneXpert MTB/RIF testing provided important microbiological support for the diagnosis of tuberculosis in a child with suspected tuberculous meningitis. Although Stool Xpert is primarily utilised in pulmonary TB, it may detect swallowed Mycobacterium tuberculosis bacilli in disseminated disease, including central nervous system involvement. Previous studies have reported encouraging findings supporting Stool Xpert as an alternative diagnostic specimen in paediatric TB [9]. The results of these investigations support using stool-based molecular testing as an additional diagnostic tool, especially when standard respiratory specimen collection is problematic and difficult to perform.

Studies from Ethiopia, Kenya, and Pakistan have demonstrated high sensitivities of stool Xpert, ranging from 88.9% to 100%, when compared with gastric aspirate culture as the reference standard [10]. However, diagnostic performance may vary depending on disease severity and bacillary load. In paediatric TB, the paucibacillary nature of the disease can reduce sensitivity, particularly in clinically diagnosed cases. In the present case, the positive stool GeneXpert result, together with compatible clinical and radiological findings, strengthened the overall diagnostic confidence.

Tuberculous meningitis represents the most severe form of extrapulmonary TB in children and is associated with high mortality and significant neurological sequelae, particularly when diagnosis and treatment are delayed. It highlights the urgent need for early detection and treatment, particularly in underprivileged areas where facilities for brain imaging and labs for testing are barely available or missing altogether.

In paediatric patients who cannot expectorate, gastric aspiration is still a widely used way to obtain samples from the lungs, but it requires trained personnel and suitable facilities and is considered an invasive procedure [11]. Stool specimen collection, on the other hand, is non-invasive, safe and relatively easy (especially in young children). The Stool Xpert assay can significantly reduce laboratory burden and turnaround time with relatively simple processing steps. These advantages make stool-based molecular testing particularly attractive in resource-limited settings. Regardless, in a case where there is a clinical suspicion of having TB, there should be no delay with treatment if a negative result was given via the stool Xpert test; additional diagnostic tests should be performed whenever possible.

The delay in diagnosis in this case was multifactorial, including initial misdiagnosis at earlier healthcare encounters and limited access to advanced diagnostic tools. These factors are indicative of wider systemic issues in low-resource environments, and they would likely have been influential in leading the patient to present with more advanced disease.

In this context, the use of stool-based GeneXpert MTB/RIF testing provided valuable microbiological support for diagnosis. While stool GeneXpert has been primarily evaluated in paediatric pulmonary tuberculosis, its application in this case of central nervous system tuberculosis highlights its potential role as a non-invasive adjunct diagnostic tool when conventional specimens are difficult to obtain. This case emphasises even more the necessity of combining clinical, radiological, and innovative diagnostic methods to raise the level of outcomes in high TB-burden areas like Somalia.

This case has several limitations. First, only a single stool specimen was analysed due to resource constraints, which may have reduced diagnostic sensitivity. Previous studies suggest that testing multiple consecutive stool samples can improve detection rates. Second, as a single case report, the findings cannot be generalised; however, they provide important clinical insight into the potential role of stool-based molecular testing in the diagnosis of paediatric TB in resource-limited settings.

Conclusion

This case highlights the diagnostic challenges of paediatric tuberculous meningitis in a resource-limited setting and the severe consequences of delayed diagnosis. To our knowledge, this case is among the first reported cases in Somalia in which stool-based GeneXpert detection of

Mycobacterium tuberculosis supported the diagnosis alongside clinical and radiological findings.

The use of stool-based GeneXpert testing provided valuable microbiological support in a child unable to produce sputum, demonstrating its potential as a non-invasive adjunct diagnostic tool. Strengthening early clinical recognition, access to neuroimaging, and child-friendly diagnostic approaches is essential to improve outcomes in high-burden settings.

Consent for Publication

Written informed consent was obtained from the patient's parent for publication of this case report and all accompanying clinical images.

Ethical Approval

Ethical approval was not required for this case report in accordance with institutional and national guidelines. All procedures were conducted in accordance with the principles of the Declaration of Helsinki.

Disclosure

The authors declare no conflicts of interest related to this work.

Authors' Contributions

Ahmed Adam Osman: Conceived and designed the study, performed radiological image interpretation, and drafted the initial manuscript. He served as the corresponding author and critically revised the manuscript for important intellectual content.

Mohamed Abdirahman Omar: Contributed to epidemiological and public health aspects of the case, participated in data acquisition and contextual analysis, and assisted in manuscript drafting and revision.

Nuradin Mohamed Hussein: Contributed to clinical data collection, patient management, and review of tuberculosis-related clinical aspects.

Ali Haji Adam: Contributed to coordination and provided oversight from the Ministry of Health perspective, including support for national programmatic interpretation.

Mohamed Mohamud Ali Fuje: Contributed to infectious disease expertise, academic supervision, and critical revision of the manuscript.

Mohamed Jafar Salah: Provided expert input from the National Tuberculosis Program, contributed to clinical and programmatic interpretation of tuberculosis findings, and critically reviewed the manuscript for public health relevance.

All authors read and approved the final manuscript and agree to be accountable for all aspects of the work.

Somali Summary

SOO KOOBID

Cudurka qaaxada maskaxda (Tuberculous meningitis – TBM) waa nooca ugu daran ee qaaxada ka baxsan sambabada ee carruurta, waxaana uu la xiriiraa heer sare oo xanuun iyo dhimasho ah, gaar ahaan meelaha leh kheyraad caafimaad oo xaddidan halkaas oo ogaanshaha hore uu weli caqabad yahay. Waxaan soo bandhigaynaa kiis carruur ah oo TBM ah oo ka dhacay Soomaaliya, halkaas oo taageero microbiological ah lagu helay iyadoo la adeegsanayo baaritaanka GeneXpert ee saxarada, iyadoo lagu daray natiijooyin caafimaad iyo raajo (imaging).

Wiil 11 jir ah ayaa la soo bandhigay isagoo leh taariikh saddex bilood ah oo miisaan lumis ah, oo ay ku xigtay qandho soo noqnoqota muddo sagaal toddobaad ah iyo madax xanuun joogto ah muddo lix toddobaad ah, iyadoo ay sii kordhayeen calaamadaha neerfaha. Sawirka maskaxda ee MRI ayaa muujiyay leptomeningeal iyo basal cisternal enhancement oo faafa, iyo hydrocephalus isgaarsiin leh, kuwaas oo la jaanqaadaya TBM. Baaritaanka GeneXpert MTB/RIF ee saxarada ayaa muujiyay jiritaanka Mycobacterium tuberculosis oo u adkaysata daawooyin badan (MDR-TB).

Inkasta oo la bilaabay daaweyn ku habboon oo ah heerka labaad ee qaaxada, xaaladda bukaanka ayaa sii xumaatay, ugu dambeyntiina wuxuu u geeriyooday dhibaatooyin la xiriira cudurka oo heer sare gaaray.

Kiiskan wuxuu muujinayaa caqabadaha ogaanshaha TBM ee carruurta iyo saameynta daran ee ka dhalata dib u dhaca ogaanshaha. Waxa kale oo uu taageerayaa doorka suurtagalka ah ee baaritaanka molecular-ka ee saxarada oo ah hab aan duullaan lahayn oo ka caawin kara ogaanshaha carruurta aan awoodin inay soo saaraan xaako, gaar ahaan meelaha leh kheyraad xaddidan.

EREYADA MUHIIMKA AH

Qaaxada maskaxda, qaaxada carruurta, qaaxada ka baxsan sambabada, GeneXpert saxaro, qaaxada u adkaysata daawooyin badan, MRI, meelaha kheyraadkoodu xaddidan yahay

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Figure Legends

Figure 1A

Post-contrast axial T1-weighted MRI demonstrating diffuse leptomeningeal and basal cisternal enhancement (black arrowheads), consistent with meningeal inflammation.

Figure 1B

Post-contrast axial T1-weighted MRI showing multiple small peripherally ring-enhancing nodular lesions (orange arrowhead), suggestive of tuberculomas.

Figure 2A

Diffusion-weighted imaging (DWI) demonstrating areas of restricted diffusion in the bilateral basal ganglia and basal cisterns (green arrowheads), indicating active infectious involvement.

Figure 2B

Corresponding apparent diffusion coefficient (ADC) map showing hypointensity in the same regions (red arrowhead), confirming true diffusion restriction.

Figure 3

Stool GeneXpert MTB/RIF assay result demonstrating detection of multidrug-resistant Mycobacterium tuberculosis, providing microbiological support for the diagnosis.

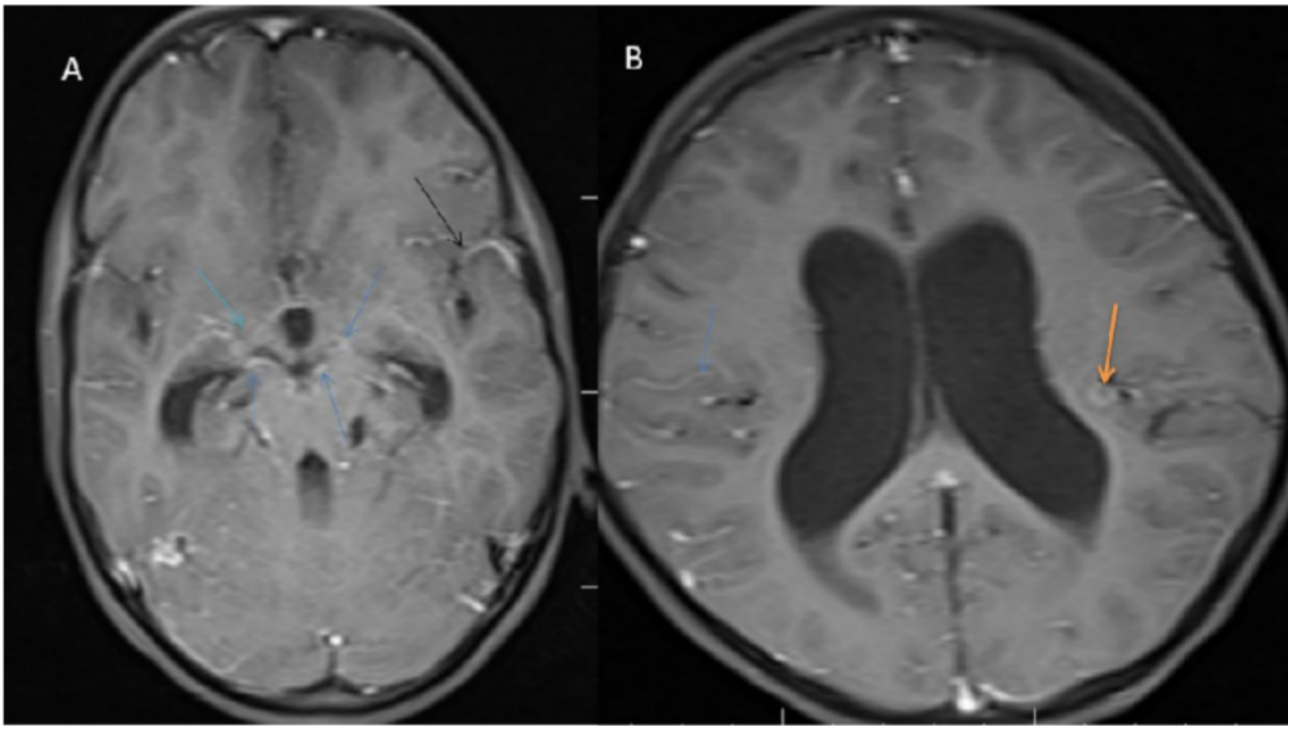


Figure 1A&B. shows a peripherally ring-enhanced small-sized nodular lesion (shown in Fig. 1B, thick orange arrowhead) and diffuse leptomeningeal and basal cistern enhancement on postcontrast images (shown in Fig. 1A, blue and black arrowheads). In addition, moderate ventricular system dilations (communicating hydrocephalus due to infectious cells filling the basal cisterns). Suggesting tuberculous meningitis.

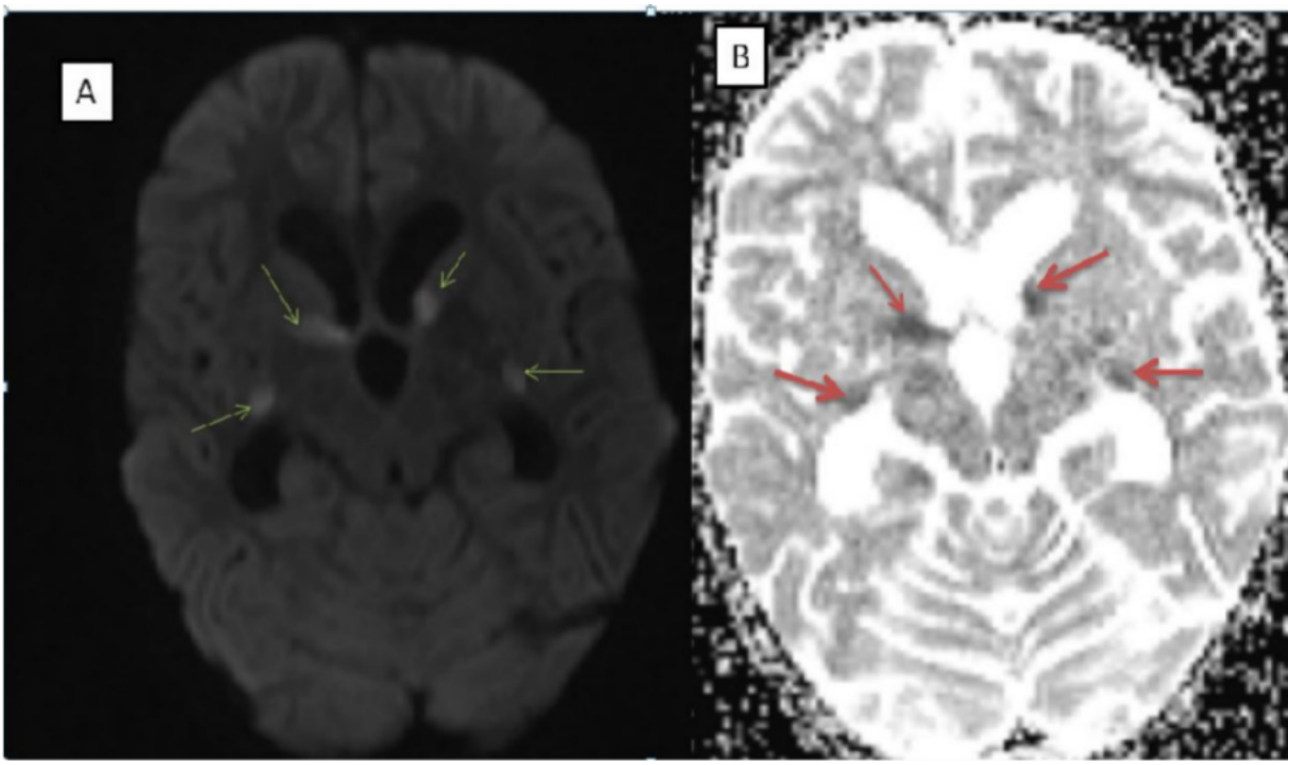
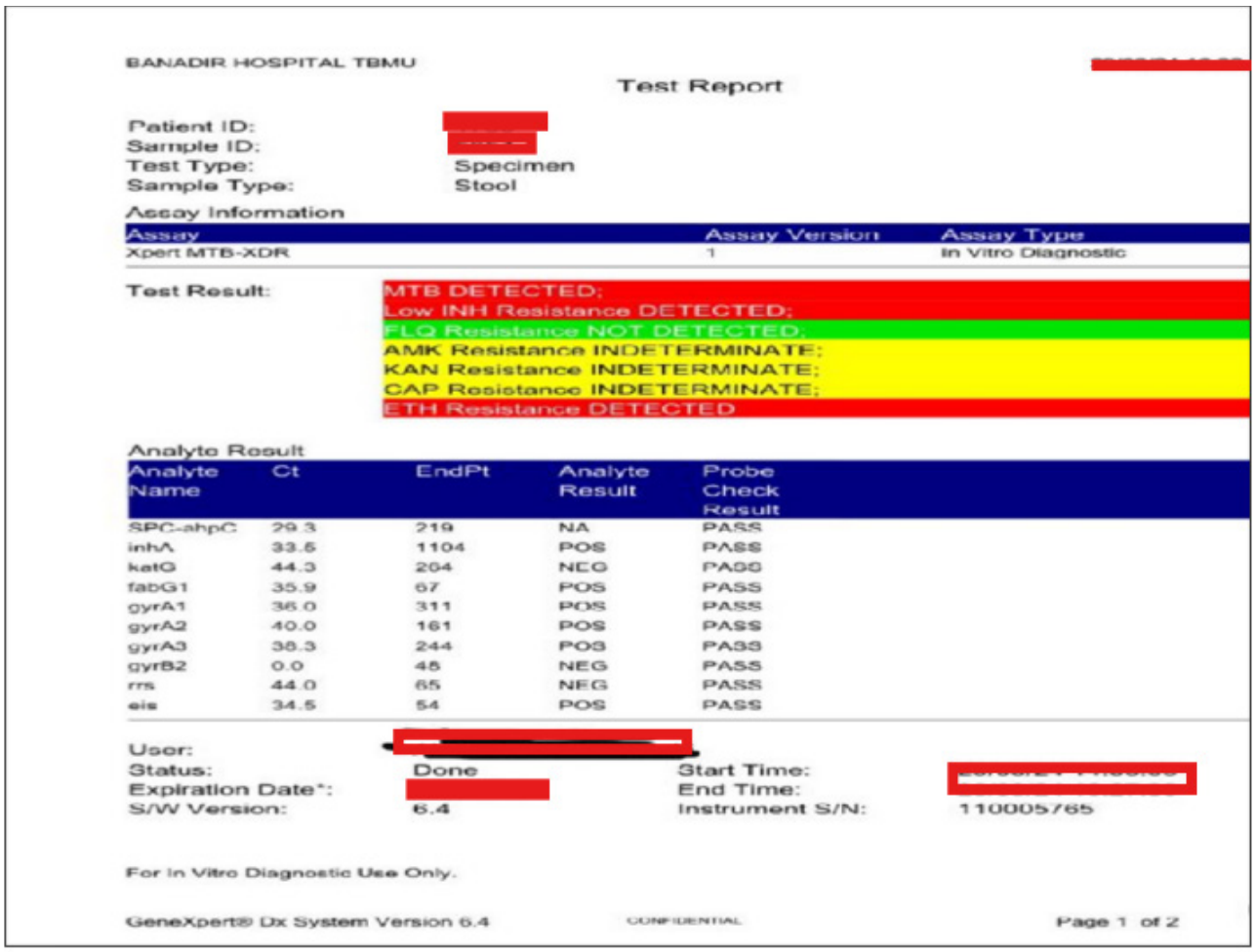


Figure 2A&B. Bilateral basal ganglia and basilar cistern diffusion restriction areas are shown as green arrowheads (ADC hypointense fig. 2B is shown as a thick red arrow head).



BANADIR HOSPITAL TBMU

Test Report

Patient ID:
Sample ID:
Test Type: Specimen
Sample Type: Stool

Assay Information

Assay	Assay Version	Assay Type
Xpert MTB-XDR	1	In Vitro Diagnostic

Test Result:

MTB DETECTED;
Low INH Resistance DETECTED;
FLQ Resistance NOT DETECTED;
AMK Resistance INDETERMINATE;
KAN Resistance INDETERMINATE;
CAP Resistance INDETERMINATE;
ETH Resistance DETECTED

Analyte Result

Analyte Name	Ct	EndPt	Analyte Result	Probe Check Result
SPC-ahpC	29.3	219	NA	PASS
inhA	33.6	1104	POS	PASS
katG	44.3	264	NEG	PASS
fabG1	35.9	67	POS	PASS
gyrA1	36.0	311	POS	PASS
gyrA2	40.0	161	POS	PASS
gyrA3	38.3	244	POS	PASS
gyrB2	0.0	48	NEG	PASS
rrs	44.0	65	NEG	PASS
eis	34.5	54	POS	PASS

User:
Status: Done
Expiration Date*:
S/W Version: 6.4
Start Time:
End Time:
Instrument S/N: 110005765

For In Vitro Diagnostic Use Only.

GeneXpert® Dx System Version 6.4 CONFIDENTIAL Page 1 of 2

Figure 3. Stool sample result showing positive for mycobacterium tuberculosis (MDR TB)