KARIUS® | CASE STUDY

The Use of the Karius Test in the Diagnostic Workup of BCG Aortitis

Diagnosis of BCG Aortitis Aided by Plasma Metagenomic Sequencing

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The use of the Karius Test allowed for non-invasive diagnosis of BCG-associated endovascular infection in a patient much faster than AFB cultures and PCR.

PATIENT HISTORY

68-year old male with prior history of hypertension and bladder cancer treated with intravesical Bacille Calmette-Guerin (BCG) vaccine complicated by BCG-osis and aortic aneurysm.

The patient presented several years later with two weeks of fevers, chills, night sweats and back pain.

DIAGNOSTIC WORKUP

CT scan indicated aortitis with periaortic abscess and mycotic aneurysm raising concerns for BCG aortitis.

Blood cultures were negative and AFB cultures of endovascular tissue samples post graft replacement surgery were pending results at the time of ordering the Karius Test.

RESULTS

The Karius Test detected *Mycobacterium tuberculosis* (MTB) complex at 48 hours. Further analysis of the sequencing data strongly suggested the presence of *Mycobacterium bovis*.

The surgical AFB tissue cultures were positive for MTB complex by PCR at nine days.

The Karius Test was able to non-invasively identify this organism prior to the surgical cultures.

810

Diagnosis of *Mycobacterium bovis* Aortitis by Plasma Metagenomic Sequencing

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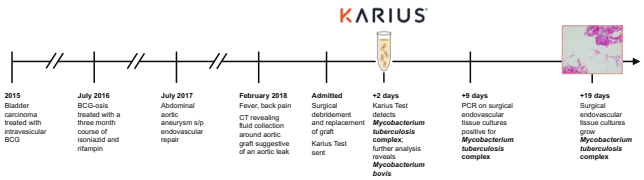
Background

We present a case of *Mycobacterium bovis* infra-renal abdominal aortic aneurysm and iliopsoas abscess two years after Bacillus Calmette-Guérin (BCG) treatment diagnosed by the plasma-based Karius next-generation sequencing (NGS) test that detects pathogen cell-free DNA (cfDNA).

- Intravesicular BCG is an attenuated strain of *Mycobacterium bovis* used as an immune-adjuvant therapy for bladder carcinoma.
- Typical complications of BCG application include fever, malaise, and dysuria. More severe complications have been reported including granulomatous pneumonitis, BCG sepsis, and vascular infections[1].
- Mycotic aneurysms due to BCG are diagnosed by AFB stains and culture from endovascular surgical specimens or at autopsy.
- Mycobacterial cultures require 6-8 weeks for growth. Positive results require >10,000 organisms per gram of tissue.

Diagnostic Timeline

68 year-old male with bladder cancer treated with intravesicular BCG therapy complicated by *Mycobacterium bovis* aortic aneurysm identified with the Karius Test

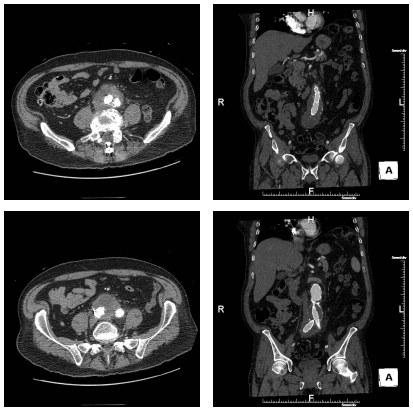


The Karius® Test

- The Karius NGS test identifies microbial cfDNA in plasma from bacteria, DNA viruses, yeasts, mold, and protozoa
- Next day results* are reported from a single blood draw processed at CAP-accredited and CLIA-licensed laboratory

*About 80% of specimens received by 8:30 AM (PT) Monday through Saturday are reported the next day.

Case History and Discussion



Axial and coronal CT demonstrating aortic graft leakage and aneurysm progression

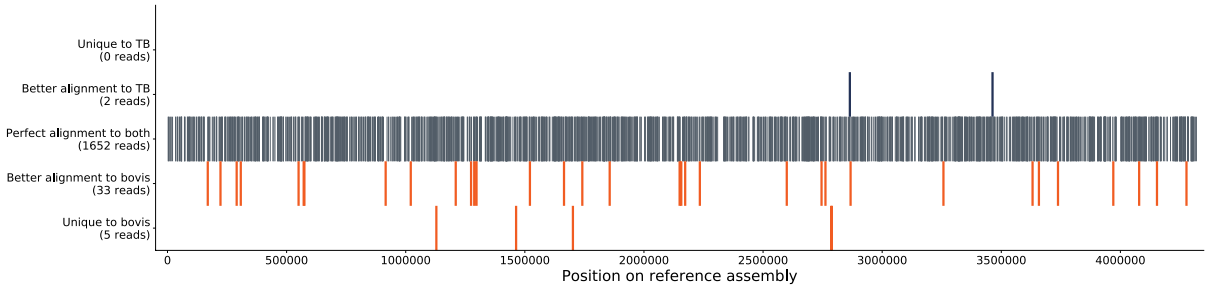
History and Presentation:

- A 68 year-old male with a history of bladder carcinoma in 2015 treated with intravesicular BCG presented in February 2018 with a two-week history of fever, night sweats and back pain.
- Prior BCG-osis (2016) had been treated with a three month course of isoniazid and rifampin and an associated aortic aneurysm (2017) was surgically repaired with an endovascular aortic graft.

Clinical Evaluation and Treatment:

- The patient was febrile with abdominal tenderness and had elevated inflammatory markers.
- A CT of the lumbar spine showed a fluid collection surrounding the aortic graft. CT angiography demonstrated an aneurysmal sac with 5.4 x 6.0 cm fluid collection along the lower abdominal aorta extending into proximal common iliac vessels suggestive of a mycotic aneurysm.
- Routine and mycobacterial blood cultures were unrevealing.
- The Karius Test detected *Mycobacterium tuberculosis* complex two days after collection. Further analysis specifically revealed *Mycobacterium bovis* within *Mycobacterium tuberculosis* complex.
- Endovascular surgical specimens were AFB positive by stain; PCR on tissue culture identified *Mycobacterium tuberculosis* complex at nine days and grew *Mycobacterium tuberculosis* complex at nineteen days.
- The patient underwent in situ reconstruction with a rifampin-soaked Dacron graft and systemic treatment with INH, rifampin, levofloxacin and ethambutol.

Identification of *Mycobacterium bovis* Using SNP Analysis of NGS Sequencing Reads



Coverage across the *M. bovis* genome: 5 NGS sequencing reads mapped uniquely to *M. bovis*, 33 to both species but with higher percent identity to *M. bovis and* 1652 reads mapped to both species with 100 percent identity. No reads mapped only to *M. tuberculosis*.

Conclusions

- Intravesicular BCG treatment for bladder cancer can lead to mycotic aortic aneurysms associated with high morbidity and mortality[2].
- Next-generation sequencing of cfDNA in plasma via the Karius Test[3,4] was a rapid, non-invasive means of detecting *Mycobacterium tuberculosis* complex and specifically *Mycobacterium bovis* in a patient with a mycotic aneurysm in a clinically actionable time-frame **two days** after sample collection and **one day** after sample receipt.
- The Karius Test enabled a more rapid, specific diagnosis than conventional testing and expedited definitive directed therapy for this serious life-threatening infection.

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2. Higashi Y, Nakamura S, Kidani K, et al. *Mycobacterium bovis*-induced Aneurysm after Intravesical Bacillus Calmette-Guerin Therapy: A Case Study and Literature Review. Intern Med 2018;57:429-35.
3. Hong DK, Blauwkamp TA, Kertesz M, Bercovici S, Truong C, Banaei N. Liquid biopsy for infectious diseases: Sequencing of cell-free plasma to detect pathogen DNA in patients with invasive fungal disease, Diagn Microbiol Infect Dis 2018; In press. https://doi.org/10/106/j.diagmicrobio.2018.06.009
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