

COLOUR ATLAS OF
**FORENSIC
PATHOLOGY**

RESPIRATORY SYSTEM

COLOR ATLAS OF FORENSIC PATHOLOGY

Version 1

RESPIRATORY SYSTEM

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FOREWORD

The greatest pleasure I experience as a teacher, is to see my students excel in their chosen careers and perform even better than myself. The series of e-booklets prepared to better equip medical officers to handle common conditions likely to be encountered in their day to day forensic practice by Professor Dinesh Fernando, is a good example of one of my students doing better than me!

Dinesh is the son of Emeritus Professor of Community Medicine, Former Head, Department of Community Medicine, Former Dean, Faculty of Medicine and Vice Chancellor of the University of Peradeniya, Malcolm Fernando, who was an illustrious medical academic. Following his father's footsteps, he joined the University of Peradeniya in 2003.

Dinesh was one of my post graduate trainees at the Department of Forensic Medicine and Toxicology, Faculty of Medicine, Colombo, and obtained the doctorate in Forensic Medicine in 2003. He underwent post-doctoral training at the Victorian Institute of Forensic Medicine, Melbourne, Australia, with my colleague and contemporary at Guy's Hospital Medical School, University of London, Professor Stephen Cordner. During this period, he served as the honorary forensic pathologist of the Disaster Victim Identification team in Phuket, Thailand following the tsunami, and was awarded an operations medal by the Australian Federal Police.

He has edited, and contributed chapters to, 'Lecture Notes in Forensic Medicine' authored by the former Chief Judicial Medical Officer, Colombo, Dr. L.B.L. de Alwis and contributed to 'Notes on Forensic Medicine and Medical Law' by Dr. Hemamal Jayawardena. He is the editor of the Sri Lanka Journal of Forensic Medicine, Science and Law. Continuing his writing capabilities, he has compiled an important and unique set of e-booklets which will be a great asset to undergraduate and post-graduate students of Forensic Medicine, and also to our colleagues. Its succinct descriptions of complicated medico-legal issues and clear and educational photographs are excellent. It makes it easy for the students to assimilate the theoretical knowledge of each topic as they have been augmented with histories, examination findings, macroscopic and microscopic photographs of actual cases. In some areas, photographs from multiple cases have been included, so that the students can better appreciate the subtle differences that would be encountered in their practice.

I sincerely thank my ever so grateful student Dinesh, for giving me this great honour and privilege to write the foreword.

Professor Ravindra Fernando

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About the authors.....

Dr. Dinesh Fernando is a merit Professor in Forensic Medicine at the Faculty of Medicine, University of Peradeniya and honorary Judicial Medical Officer, Teaching Hospital Peradeniya. He obtained his MBBS in 1994 with Second class honours from the North Colombo Medical College, Sri Lanka, and was board certified as a specialist in Forensic Medicine in 2004. He obtained the postgraduate Diploma in Medical Jurisprudence in Pathology from London in 2005, and possesses a certificate of eligibility for specialist registration by the General Medical Council, UK. He underwent post-doctoral training at the Victorian Institute of Forensic Medicine, Melbourne, Australia. He has also worked at the Wellington hospital, New Zealand, as a locum Forensic Pathologist and as an Honorary Clinical Senior Lecturer at the Wellington School of Medicine and Health Sciences, University of Otago, New Zealand. He was invited to visit and share experiences by the Netherlands Forensic Institute in 2019.


Dr Gayan Kumarasinghe is a postgraduate trainee in Forensic Medicine at the Department of Forensic Medicine, Faculty of Medicine, University of Peradeniya. He obtained his MBBS in 2010 from the Faculty of Medicine, University of Kelaniya.

PREFACE

Forensic Medicine in Sri Lanka encompasses, both, examination of patients for medico-legal purposes and conducting autopsies in all unnatural deaths, in addition to those that the cause of death is not known. In the eyes of the justice system in Sri Lanka, all MBBS qualified medical officers are deemed to be competent to conduct, report and give evidence on medico-legal examinations of patients and autopsies conducted by them, as an expert witness. However, during their undergraduate training, they may not get the opportunity to assist, nor observe, a sufficient variety of representative of cases that may be encountered in the future.

Therefore, a series of e-booklets has been prepared to better equip medical officers to handle common conditions that are likely to be encountered in day to day forensic practice. This case on Tuberculosis was conducted by Dr. Gayan Kumarasinghe under the supervision of Prof. Sarathchandra Kodikara. The compilation of the case and photographs for publication was done by Dr. Gayan Kumarasinghe under the supervision of Prof. Dinesh Fernando. Ms. Chaya Wickramaratne did a yeomen service in design, lay out and formatting the booklet

The content herein may be used for academic purposes with due credit given. Any clarifications, suggestions, comments or corrections are welcome.



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ILLUSTRATIVE CASES

Tuberculosis



TUBERCULOSIS

Tuberculosis (TB) is one of the ancient infectious diseases among mankind. It is estimated that currently, a quarter of the world population is infected with TB and that 2.3 million die of it each year.

The infection is brought about by gram positive aerobic bacteria with a waxy cell wall, namely *Mycobacterium tuberculosis* and *Mycobacterium bovis*. However, due to proper food handling methods the latter is almost unheard of in the modern day. *M. tuberculosis* is spread by inhalation and primarily affects the lung, but it can affect, virtually any organ system in the body. It is characterized by chronic granulomatous inflammation with caseous necrosis.

Depending on the exposure it is divided into primary and secondary/post primary TB. Primary TB commonly affects the lung with sub-pleural Ghon's focus with enlarged draining lymph nodes collectively termed as Ghon's complex. Inhaled bacilli trigger an acute inflammatory response which is ineffective in eradicating the TB bacilli, leading to engulfment by macrophages and multiplication within them. Thereafter, they drain to the regional lymph nodes and result in lymphoid granulomas. 90% of primary TB cases heal by fibrosis and calcification of lesions and the remaining 10% results in complications: pneumonia, lung collapse, pleural effusions, TB pericarditis, milliary TB and end organ TB.

When few bacilli are carried to distant sites via the circulation, they remain dormant in the end organs and get reactivated giving rise to end organ TB. It may present as tuberculomas in the brain, Pott's disease of spine, psoas abscess, TB lymphadenitis, lupus vulgaris in the skin, haemorrhagic pericarditis, renal and bladder TB, salpingitis and endometritis in women causing subfertility, prostatitis in men and TB adrenalitis resulting in hypoadrenalism.

When heavy widespread bacteraemia occurs it is referred to as milliary TB which is universally fatal without treatment. It consists of diffuse 1-2 mm grey white lesions resembling millet seeds. Usually involving the lungs, liver, kidneys, lymph nodes and meninges.

Post primary TB occurs as a result of endogenous reactivation of dormant bacilli within the tissues or following exogenous secondary infection. This usually involves the posterior and apical segments of the upper lobe or superior segment of lower lobe of the lungs and presents as consolidation which later discharges into air ways to form cavities. Complications include TB bronchopneumonia, pleural effusions, lymphatic or blood spread, and intestinal TB.

For screening purposes demonstration of bacilli using Zeihl-Neelsen stain and fluorescence micrography can be used. Even though TB PCR is available, TB culture remains the gold standard in diagnosing TB although it takes about 4-6 weeks to grow in the culture medium. (Lowenstein-Jensen medium)

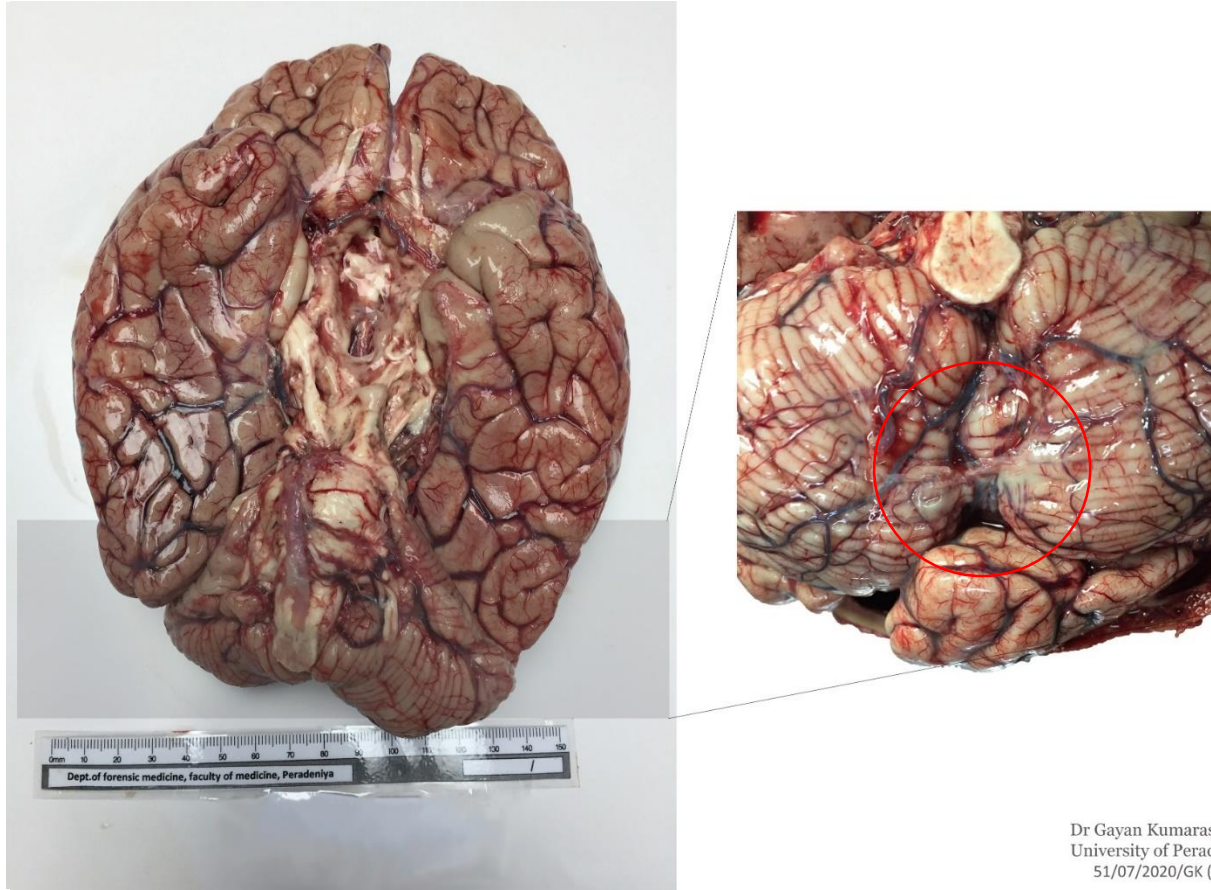
History

A 61-year-old male with no significant past medical history presented with drowsiness and general ill health of three days duration. He also complained of malaise, loss of appetite, poor feeding and poor responsiveness. There was no history of fever. There was no recent travel history, heavy metal exposure or drug abuse. His condition rapidly deteriorated and he died within hours of admission.

Internal examination

Autopsy revealed a well-built male with no external injuries or any stigmata of medical illness. His brain showed congested vessels with a locus of pus at the base of the brain. Both lungs, liver, kidneys and spleen showed features of milliary TB with diffuse milliary lesions.

Histology confirmed basal meningitis with inflammatory cell infiltrate and characteristic TB granulomas with caseous necrosis and Langhans type giant cells in lungs, liver and kidneys. CSF analysis showed mononuclear cell infiltrate with increased protein level. Direct smear from base of the brain was positive for tuberculous bacilli by Zeihl-Neelsen staining and culture was positive for *Mycobacterium tuberculosis*.



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Figure 1. Base of the brain: Congested vessels are visible on the external surface. Encircled area shows collections of pus.

Note: Organisms that may be responsible for basal meningitis are Tuberculosis, fungi and rabies.

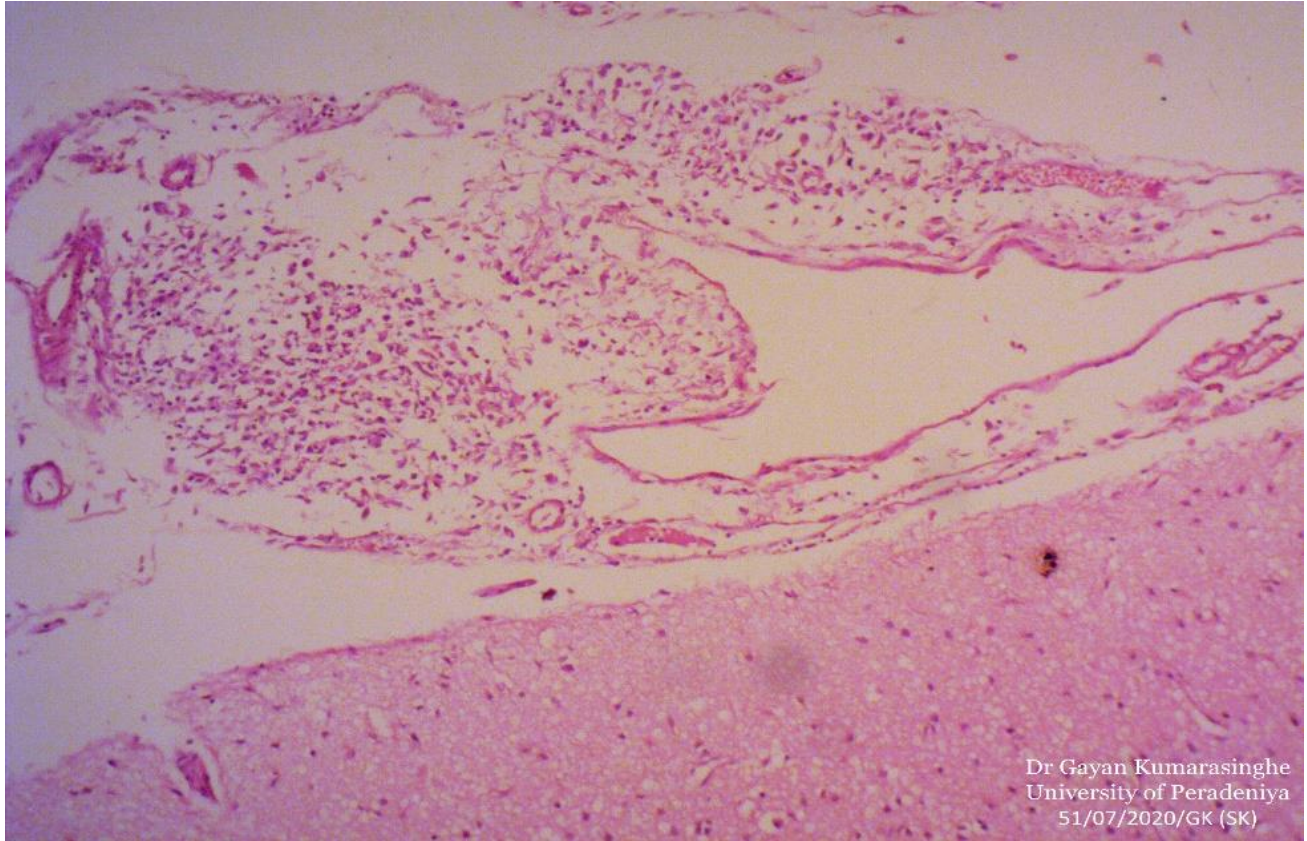


Figure 2. Brain H & E x4: Leptomeninges are flooded with inflammatory cells. Underlying brain parenchyma does not show inflammatory cell infiltrate.

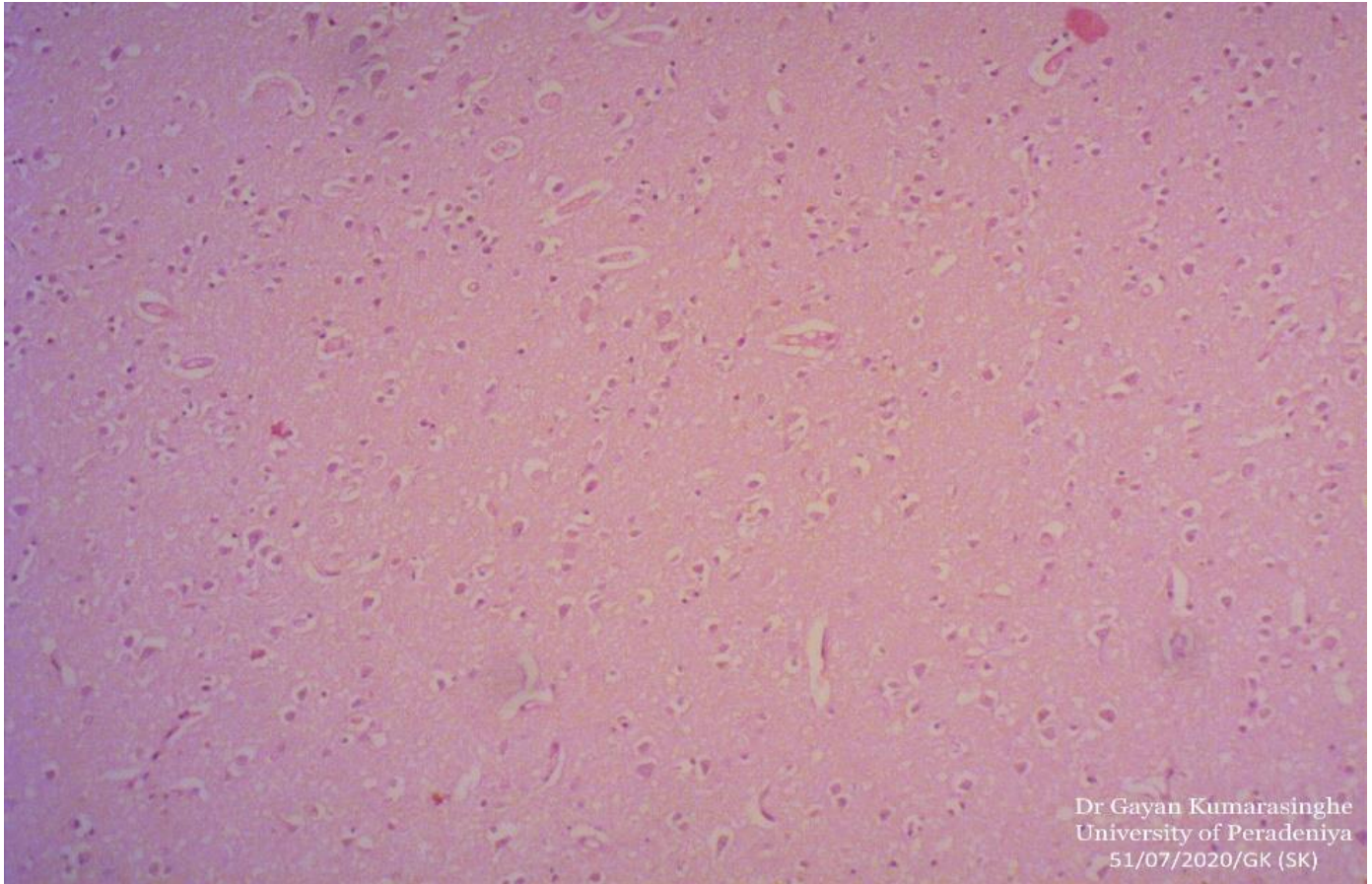


Figure 3. Brain H & E x10: Cerebral oedema noted. Inflammatory cells are not seen.



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Figure 4. Lungs: External surface exhibits diffuse miliary involvement. Magnified view clearly shows the tiny whitish spots resembling millet seeds marked by small circles.

Note: Differential diagnoses for small multiple whitish grey lesions include miliary TB, multiple abscesses and secondary deposits.



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Figure 5. Cross section of the lung: Diffuse miliary involvement in tuberculosis of the lung

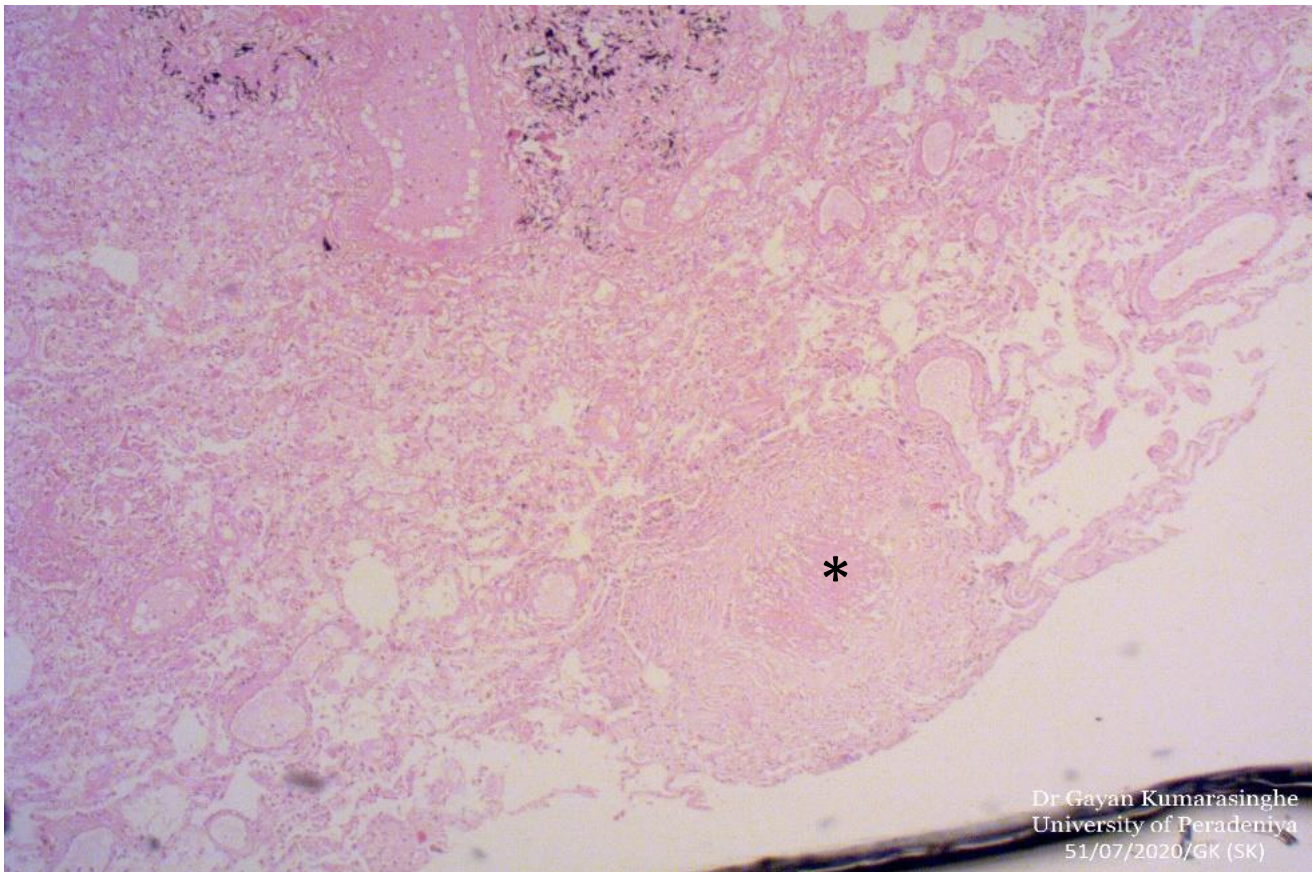


Figure 6. Lung H & E x 4: Tuberculous granuloma with central caseous necrosis. (asterix)

Note: Typical TB granuloma consisting of central caseous necrosis surrounded by pale and elongated epithelioid cells which are specialized macrophages. These coalesce to form Langhans type giant cells, encircled by a rim of lymphocytes with fibrin and fibroblasts at the periphery.



Figure 7. Millitary tuberculosis in both kidneys.

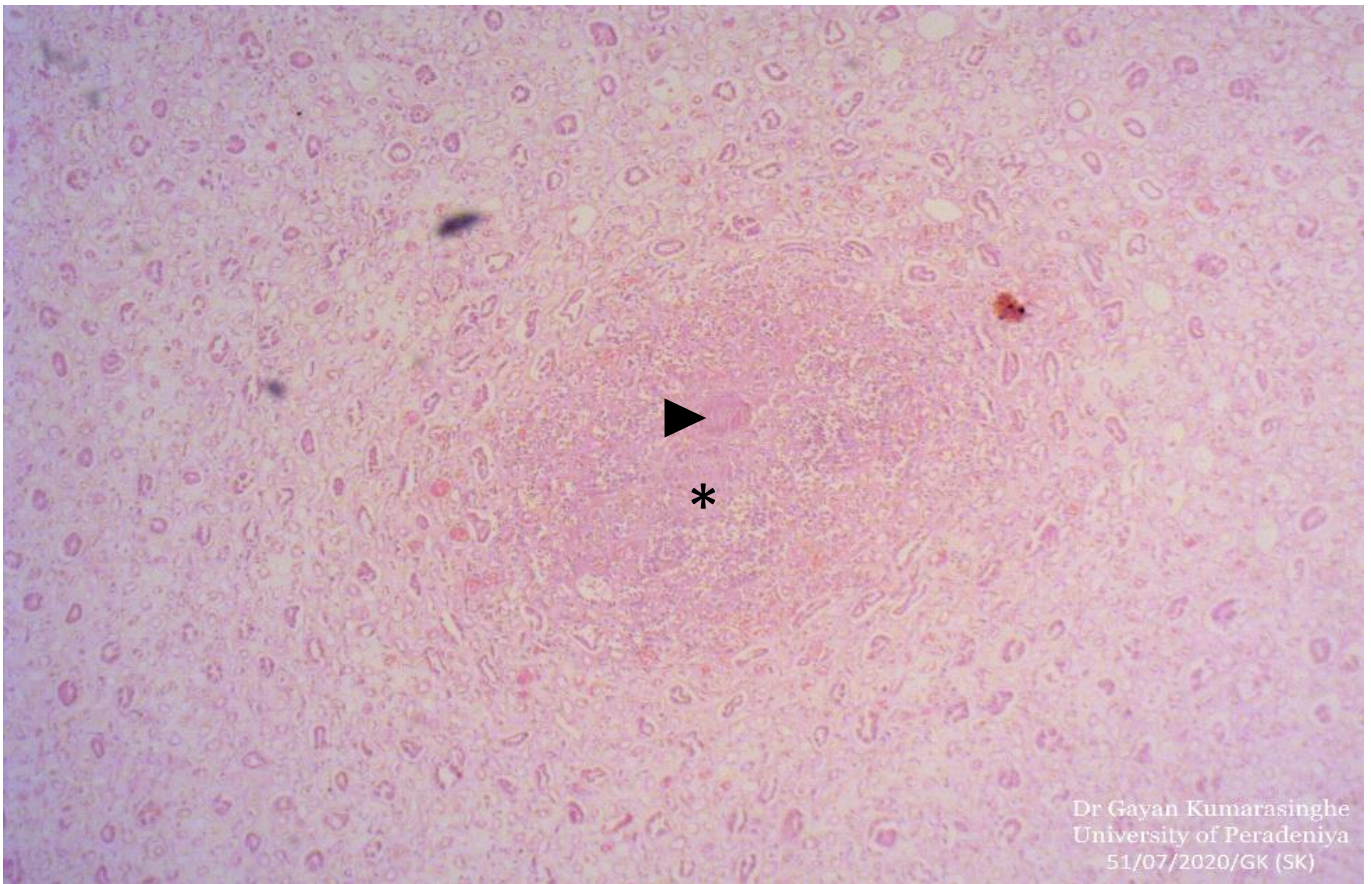


Figure 8. Kidney H & E x4: Tuberculous granuloma with central caseous necrosis (asterix) and Langhans type giant cell. (arrow head).

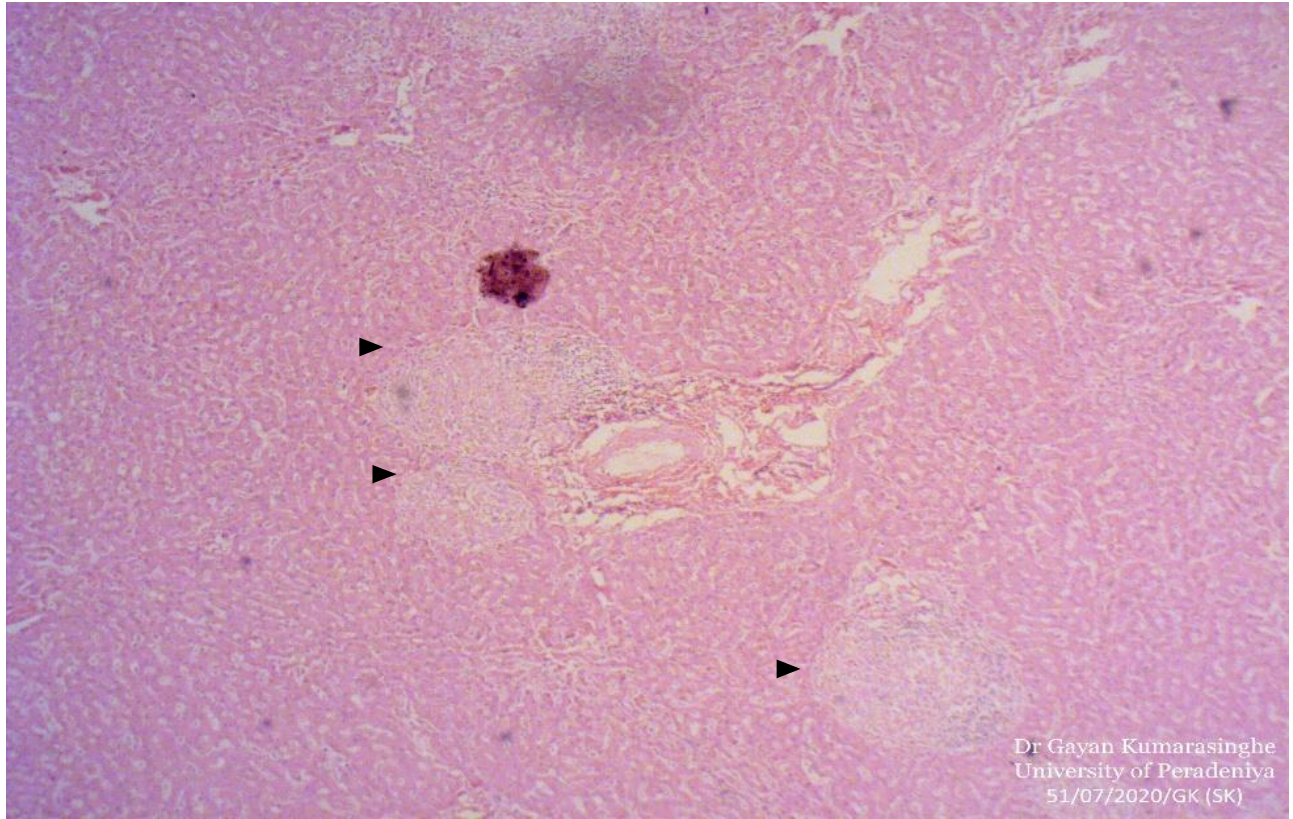


Figure 9. Liver H & E x4: Multiple TB granulomas (arrow heads) in the liver with preserved liver architecture.

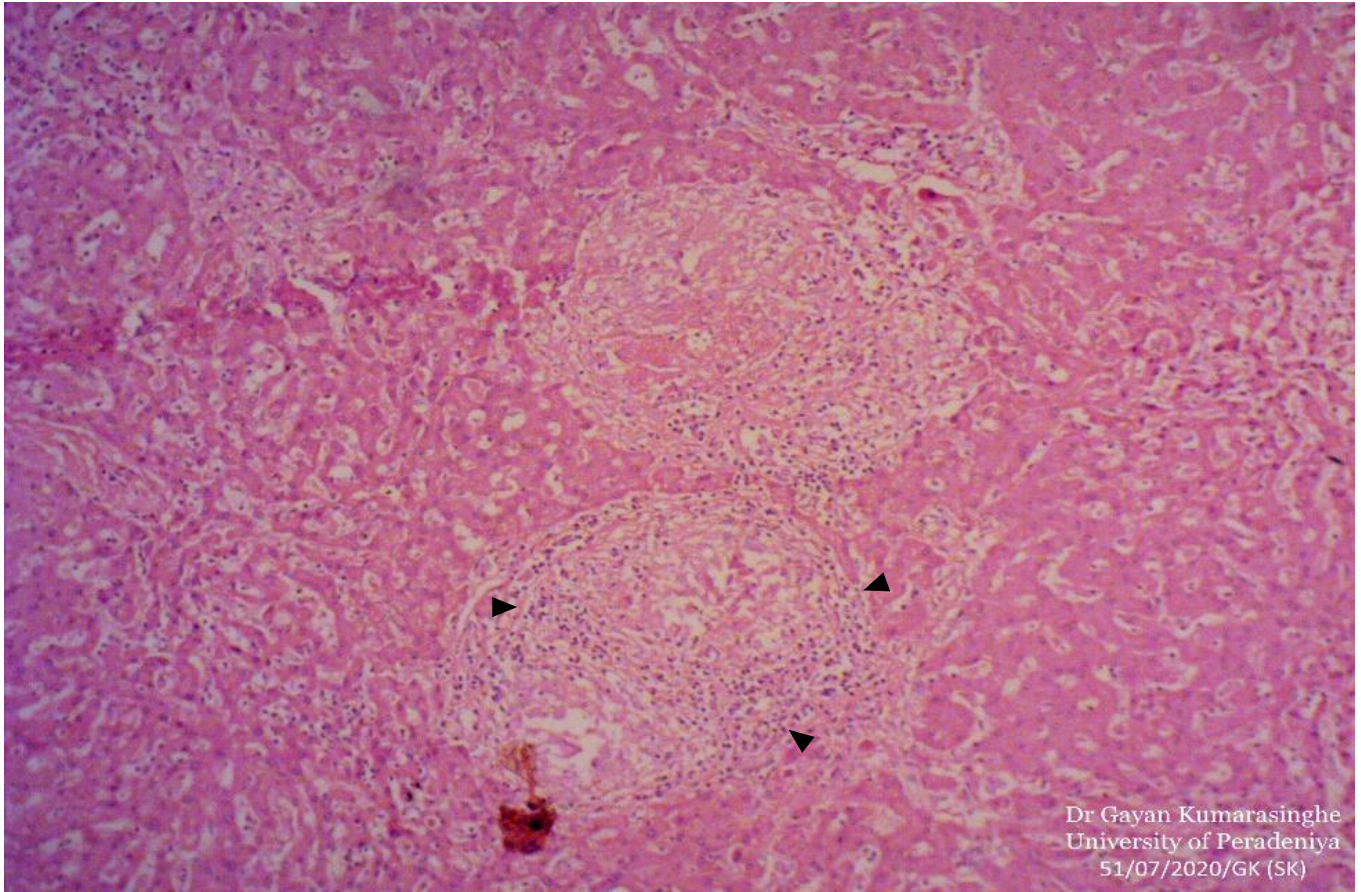


Figure 10. Liver H & E x10: Multiple TB granulomas. Lymphocytes are seen encircling the granulomas. (arrow heads)

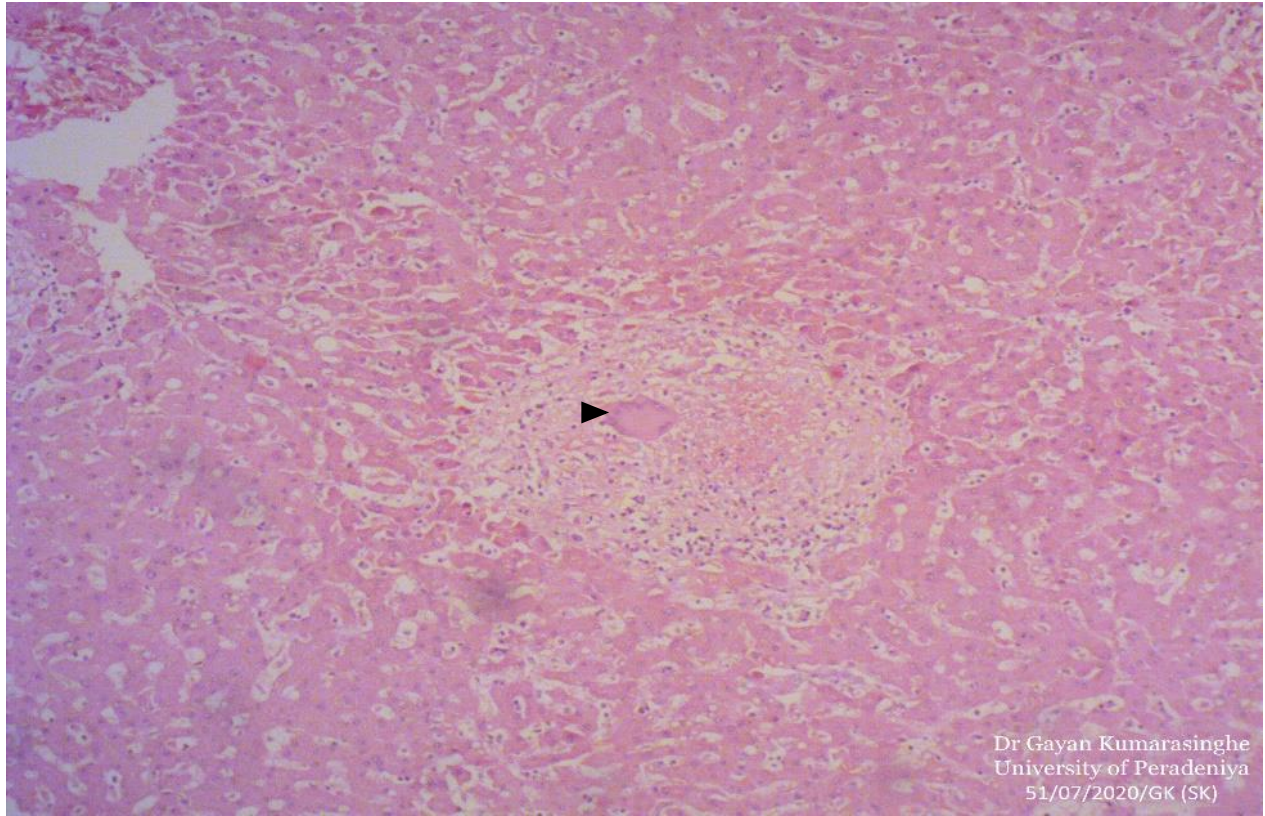


Figure 11. Liver H & E x10: Langhans type giant cell with horse-shoe shaped arrangement of nuclei. (arrow head)

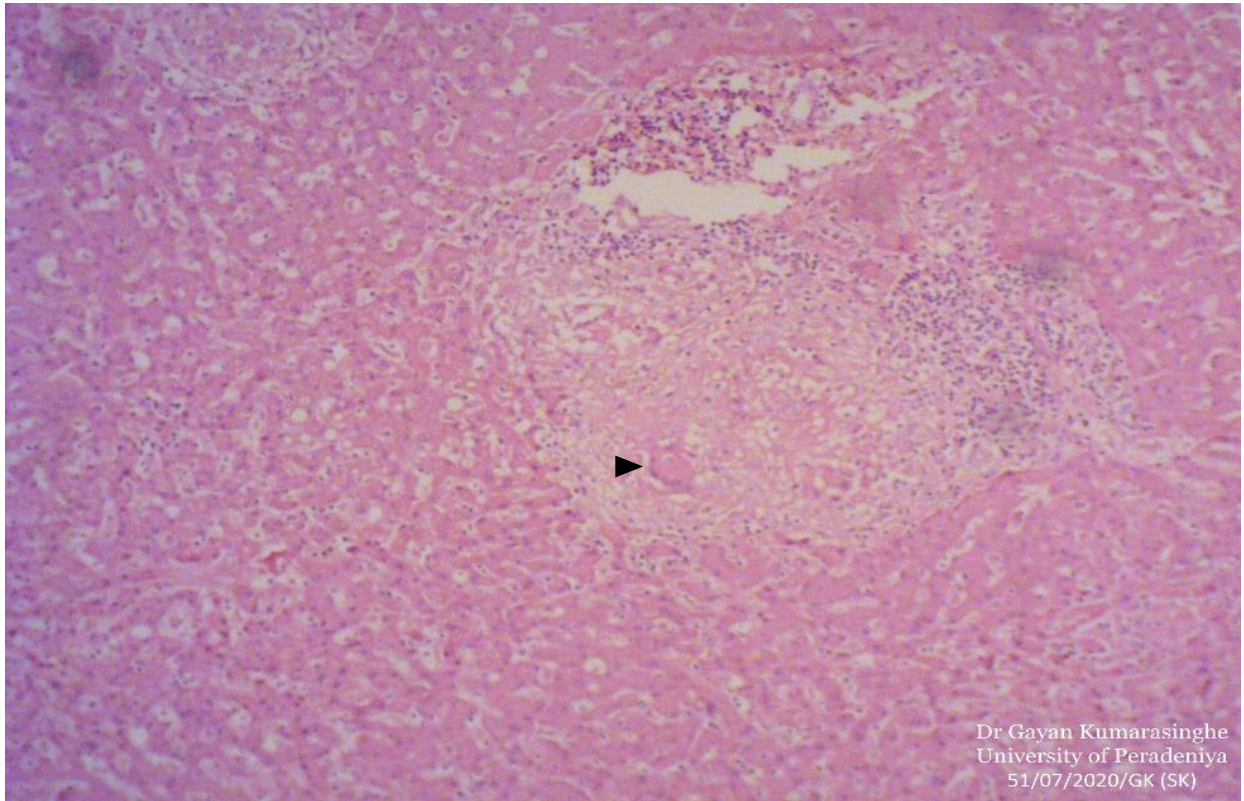


Figure 12. Liver H & E x10: Langhans type giant cell with horse-shoe shaped arrangement of nuclei. (arrow head)

Cause of death

Cause of death was concluded as tuberculous meningitis following Miliary TB due to *Mycobacterium tuberculosis*.

**CSF analysis in different conditions**

CSF	Normal	Bacterial meningitis	Viral meningitis	TB/Fungal meningitis	Respirator brain
Appearance	Clear	Turbid	Clear	Fibrin web	Turbid/ Haemorrhagic
WBC	<3	>500	>1000	100-500	150
		PMN	Monocytes	Monocytes	PMN
Protein(g/dl)	0.18-0.45	>1	<1	0.1-0.5	>>>1
Glucose(mmol/l)	2.5-3.5	<2.2	Normal	1.6-2.5	Normal
Glucose CSF:Serum	0.6	<0.4	>0.6	<0.4	0.6

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