COLOUR ATLAS OF FORENSIC TRAUMATOLOGY

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Version 1

Thoracic Injuries

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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.He was conferred a Fellowship by the College of Forensic Pathologists of Sri Lanka in 2021.

Dr. Diniki Agalawatte is a Temporary Lecturer at the Department of Forensic Medicine. She obtained her MBBS in 2025 with Second class honours from the Faculty of Medicine, University of Peradeniya.

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. The case histories, macro and micro images are from cases conducted by Prof. Dinesh Fernando. Ms. Chaya Wickramarathne did a yeomen service in the initial designing of layout and formatting the booklet. The compilation of the cases and photographs for publication was done by Dr. Diniki Agalawatte.

The content herein may be used for academic purposes with due credit given.

Any clarifications, suggestions, comments or corrections are welcome.

COLOUR ATLAS OF

FORENSIC TRAUMATOLOGY

ILLUSTRATIVE CASES

Thoracic Injuries

Thoracic Injuries

The chest is vulnerable to both blunt and penetrating trauma, which can compromise respiration by affecting chest movement, musculature, or wall integrity; potentially leading to asphyxiation. Traumatic asphyxia can result from external chest compression, seen in road traffic collisions when trapped under a vehicle, building or mine tunnel collapses, or restrained individuals, such as in custodial settings. Restrictive positions, especially in intoxicated persons, are termed positional asphyxia. This may also occur in healthy individuals in awkward positions (e.g., getting stuck while climbing through a small window).

Blunt trauma can cause rib fractures. While a few rib fractures may only cause pain in healthy adults, they pose significant risks in individuals with respiratory diseases. Multiple rib fractures, especially if adjacent, can impair chest wall function, possibly leading to a 'flail chest,' characterized by paradoxical chest wall movement during inspiration. The severity of clinical outcomes depends on injury extent and the individual's respiratory reserve. For instance, minor injuries might cause fatal respiratory failure in an elderly person with chronic lung disease, while only mildly affecting a healthy young person.

Rib fractures can lead to serious complications. Inward displacement of sharp bone fragments may penetrate the pleura or lung, causing a pneumothorax. If blood vessels are also damaged, a haemopneumothorax can result from combined air and blood leakage. In some cases, fractured rib edges may be forced outward through the skin, also leading to pneumothorax. Children generally tolerate rib fractures better than adults, but in forensic medicine, such injuries in children are significant as they may indicate non-accidental injury (child abuse), making them a critical marker in forensic evaluations. Rib and sternal fractures in adults are commonly found during post-mortem following CPR or cardiac massage. These are typically anterior or lateral, affecting ribs under compression zones, and are often symmetrical. If death occurred during CPR, these fractures usually lack haemorrhage.

Penetrating chest injuries from stab or gunshot wounds can damage thoracic organs and vessels. The outcome depends on the structures affected. Penetration can cause pneumothorax, haemothorax, or haemopneumothorax. Lung injuries contribute to air leakage (pneumothorax), while vascular injuries lead to internal bleeding. Several litres of blood may accumulate unnoticed in the pleural cavities or mediastinum, with little external bleeding.

History

The deceased was a front seat passenger in a car with three other occupants. The vehicle had turned onto a state highway and was struck on its side by another vehicle. The deceased had been alive at the scene and was transferred to the hospital. Despite medical interventions, death occurred 1 hour later.

External Examination

There was an irregular grazed abrasion measuring 3 cm x 2 cm on the posterolateral aspect of the lower right thigh and an abrasion measuring 1 cm x 3 cm on the anteromedial aspect of the left thigh.

Internal Examination

Respiratory Tract: The right pleural cavity contained 750 ml of blood. The larynx, trachea and main stem bronchi contained blood. Haemorrhage was present subpleurally and within the substance of the right lung. The right lung was partially collapsed.

Reticuloendothelial System: The spleen had multiple lacerations.

Musculoskeletal System: The fifth, sixth and seventh ribs were fractured laterally on the left side and the second to sixth ribs were fractured laterally on the right side.

Central Nervous System: A thin subarachnoid haemorrhage was present over the base of the brain and cerebellum.

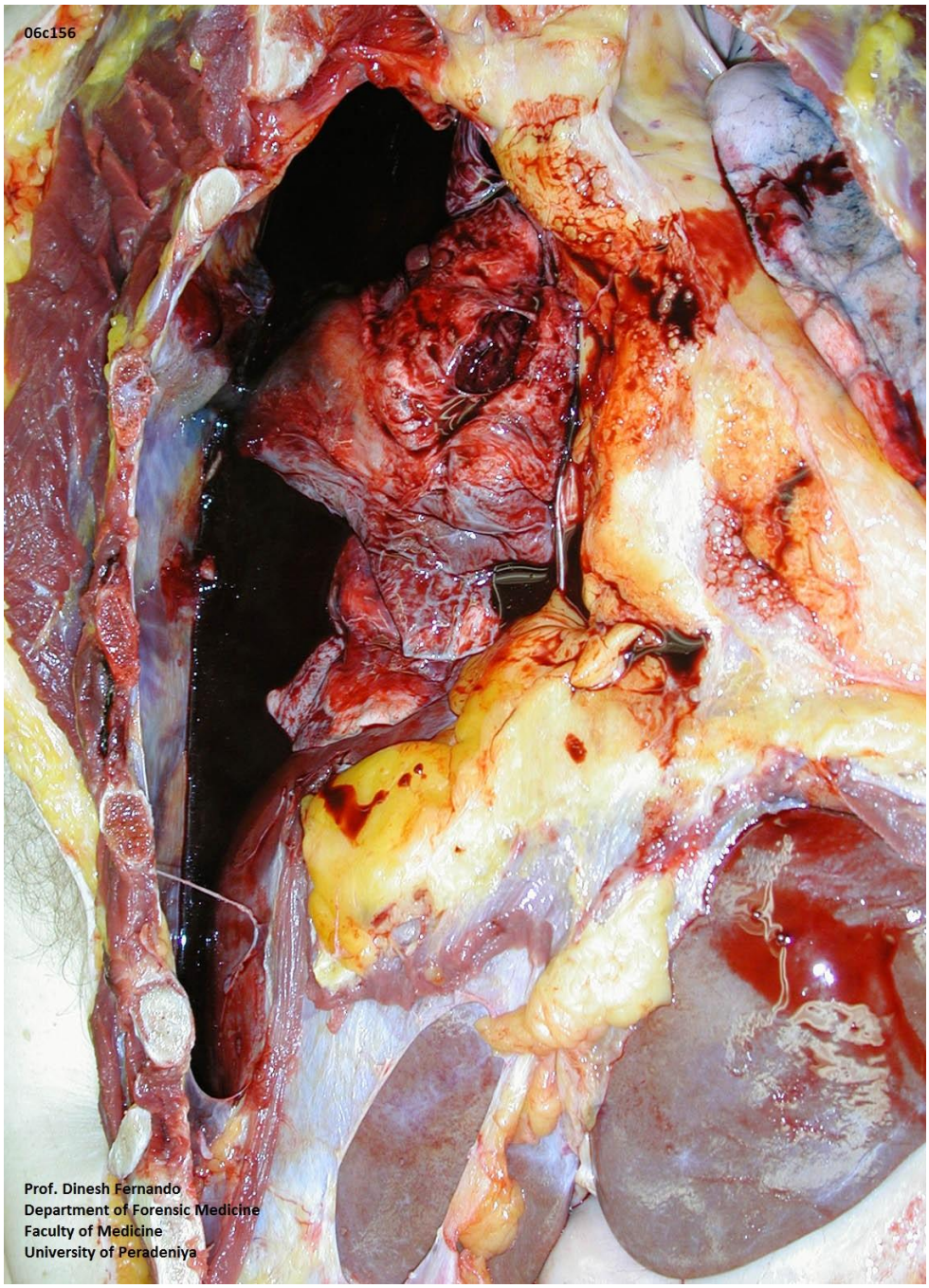

Figure 1: Haemothorax with a collapsed right lung.

Figure2: The second to sixth ribs are fractured laterally on the right side. Note the haemorrhage around the fracture site

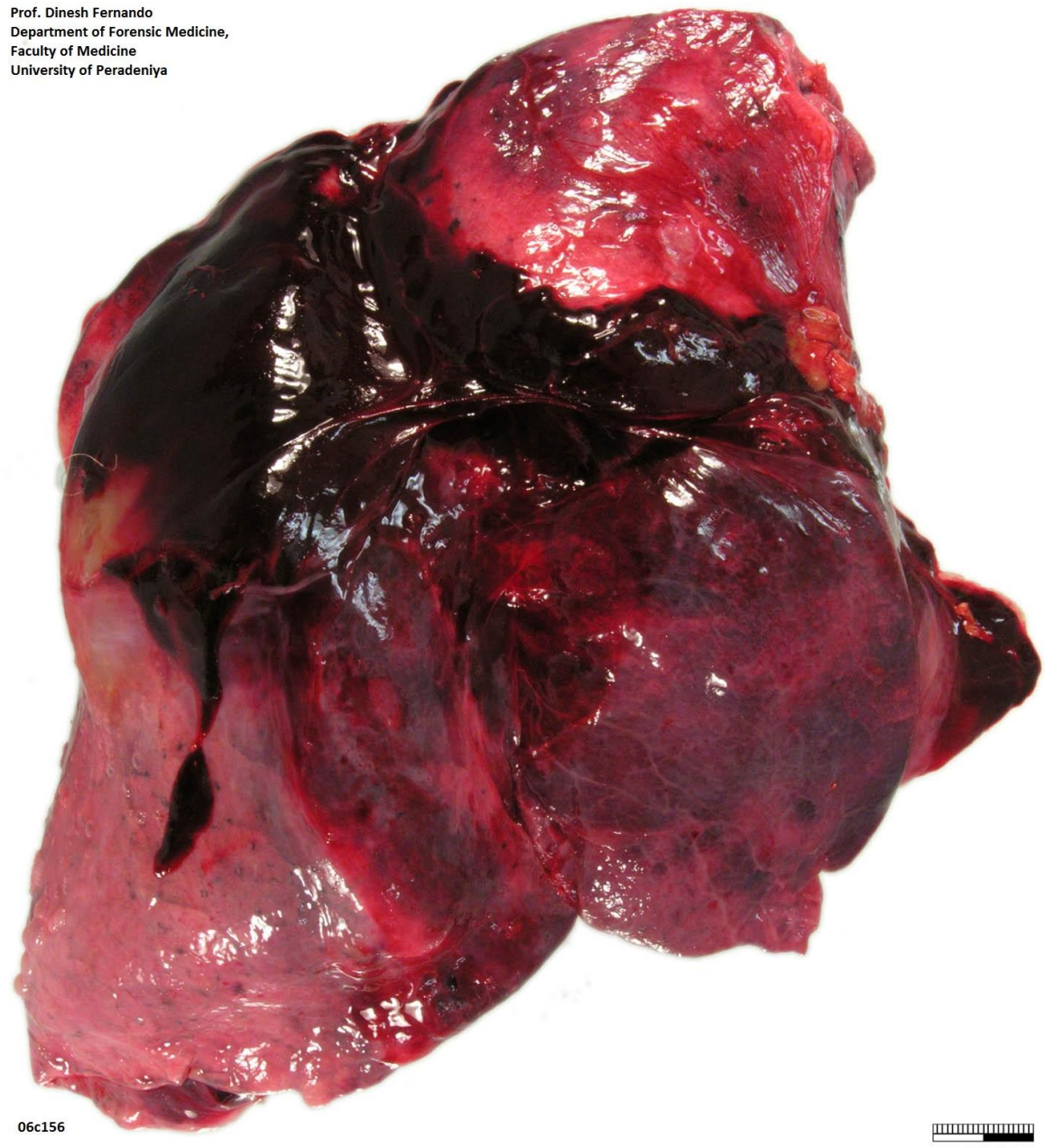

Figure 3: Haemorrhage within the substance of the right lung.

Cause of death

Chest injuries.

History

The deceased was a psychiatric patient with suicidal tendencies. She had jumped off a motorway bridge. The approximate distance of the fall was 7 meters. The Glasgow coma scale was 14 on arrival at the emergency department. She developed septic shock and ARDS and died after 7 days.

External Examination

Contusion measuring 25 cm x 22 cm overlying the left hip.

Internal Examination

Cardiovascular System: Right lung had a thrombus in a branch of the main pulmonary artery.

Respiratory Tract: The left pleural cavity had a small amount of bloodstained fluid. Extensive laceration was present on the posterior aspect of the left lower lobe. The lung parenchyma was solid to touch, friable and had a mottled appearance. Cut section manifested pus exuding from the cut surfaces of the bronchi Please refer to page 5, chapter on Bronchopneumonia in volume I of the Colour Atlas of Forensic Pathology. Pulmonary haemorrhage was present in relation to the laceration on the left lower lobe.

Reticuloendothelial System: The 152 gram spleen had a laceration of the capsule on its lateral surface which had not involved the parenchyma. Two wedge shaped haemorrhagic infarcts were present within the parenchyma.

Musculoskeletal System: The second, third and fourth ribs on the left were fractured close to the sternum and the second to tenth ribs were fractured posteriorly on the left. The right side was free of fractures. A fracture of the base of the skull at the left side of the foramen magnum which extended to the occipital condyles and multiple pelvic fractures were present.

Central Nervous System: Multiple coronal sections of the cerebral hemispheres revealed flattening of gyri and obliteration of sulci.

Microscopic Examination

Respiratory system: Sections of the lungs showed a recent haemorrhagic infarct and bilateral pneumonia affecting all lobes. Some showed a bronchopneumonia pattern while others showed a lobar pneumonia pattern Please see images in chapter on Bronchopneumonia in volume I of the Colour Atlas of Forensic Pathology.

Central nervous system: Sections of the upper cervical spinal cord showed some axonal retraction balls. Please see images on page 13, chapter on head injuries, Volume I, Colour Atlas of Forensic Traumatology. Other sections of the brain were unremarkable and did not show any features of hypoxia or herniation.

Figure 1: Contusion overlying the left hip. Note the colour change.

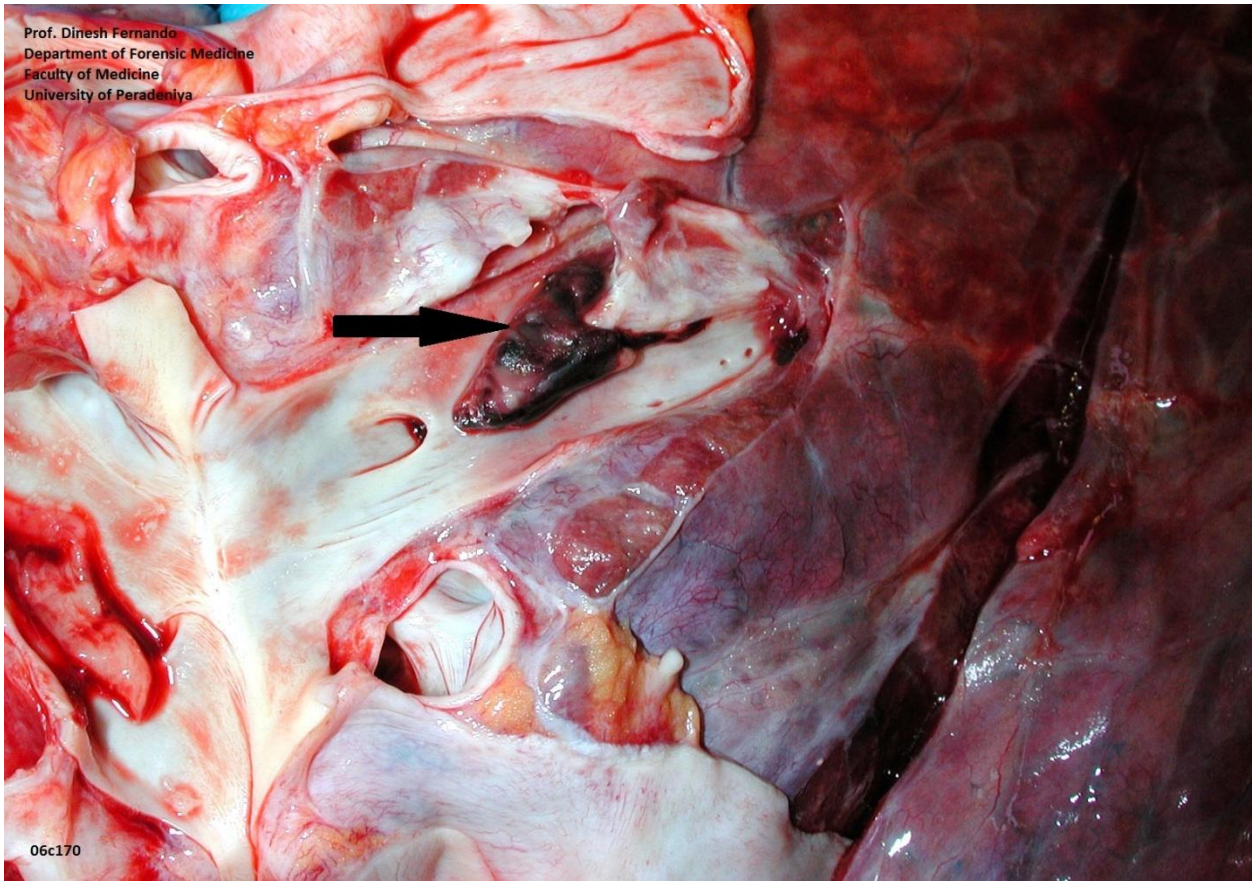

Figure 2: Pulmonary artery opened showing a thrombus within a branch of the right pulmonary artery.

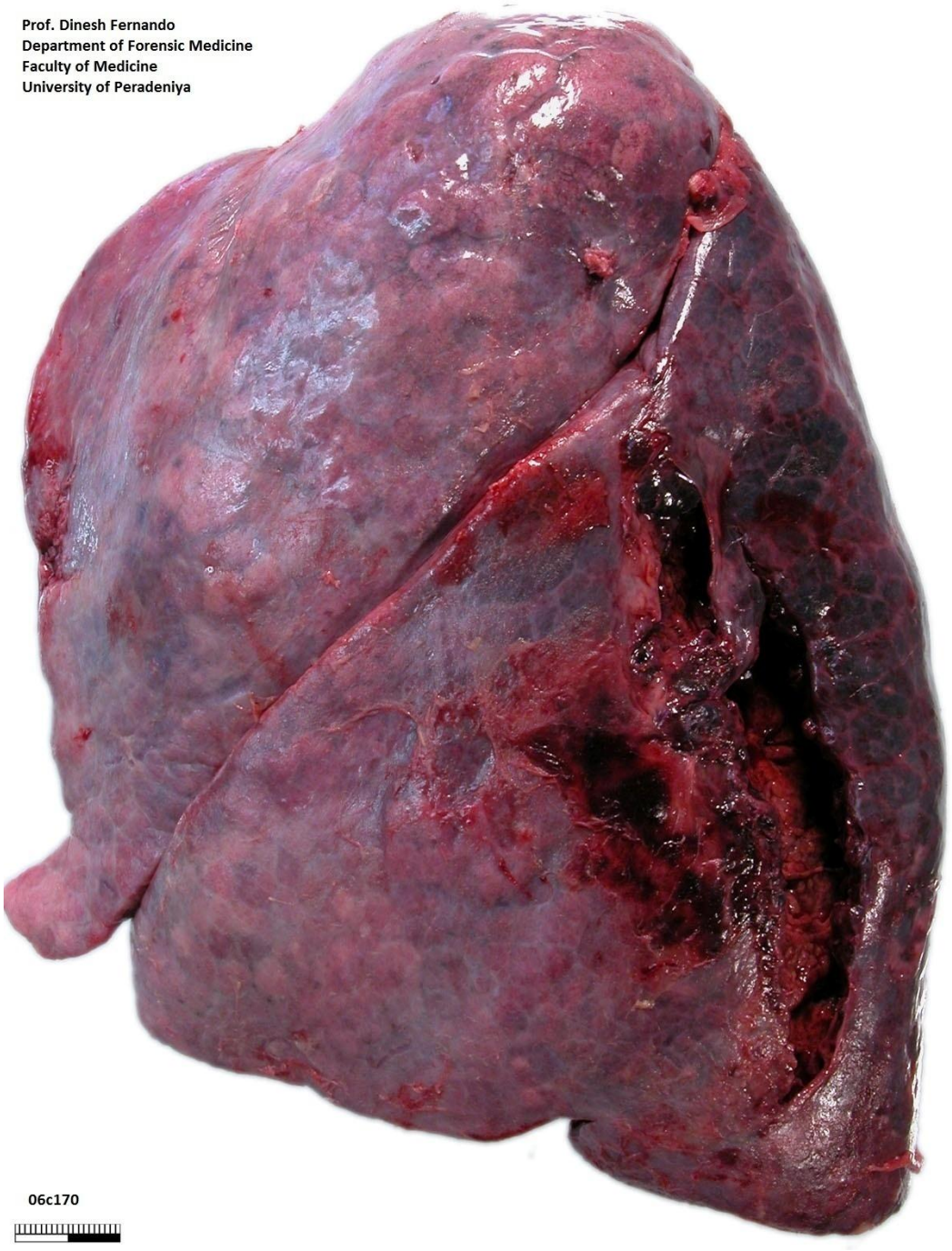

Figure 3: Lacerations on the posterior aspect of the left lower lobe.

Figure 4: Pulmonary haemorrhage in relation to the laceration on the left lower lobe.

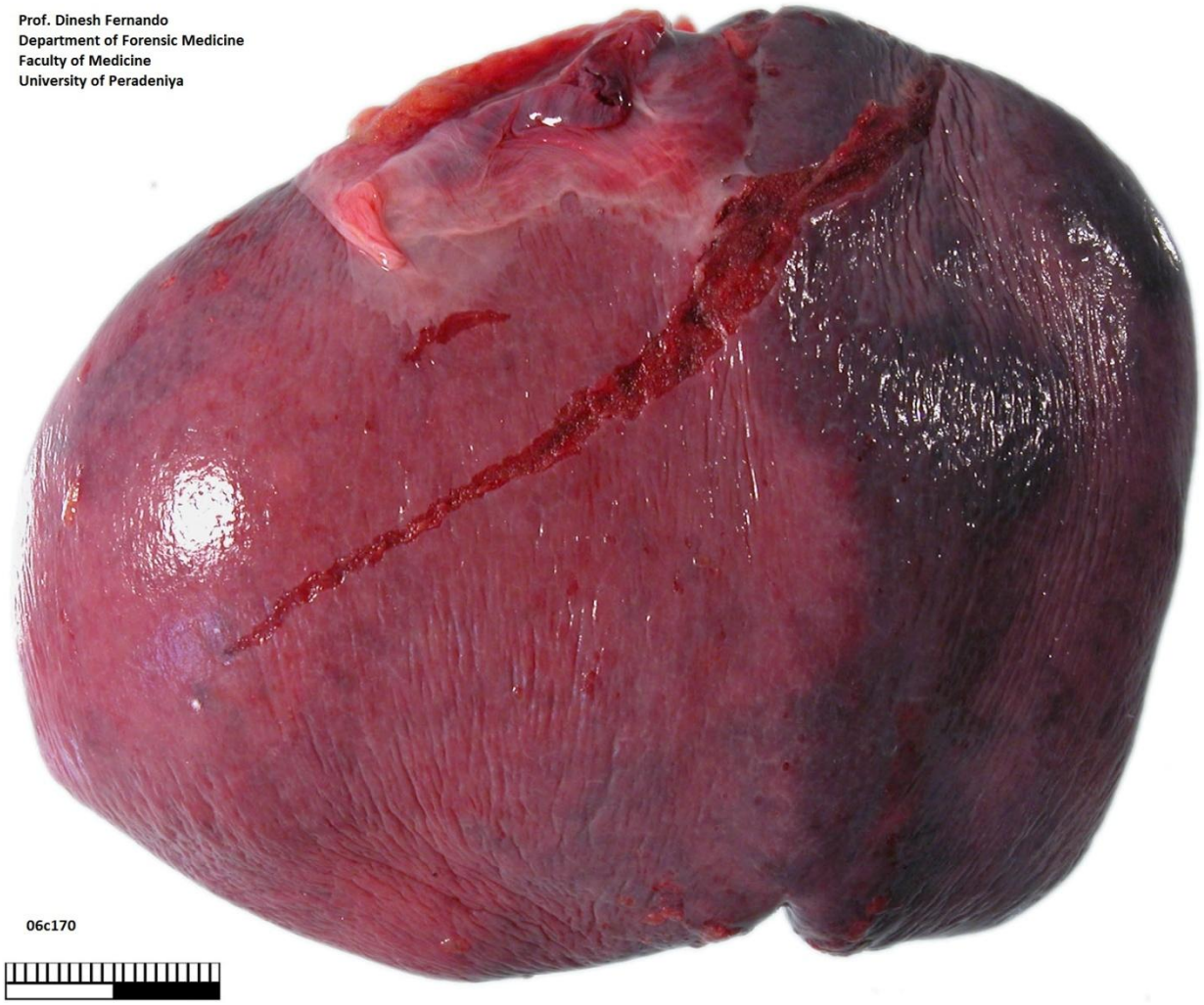

Figure 5: Laceration of the capsule of the spleen.

Figure 6: Two wedge shaped haemorrhagic infarcts within the parenchyma of the spleen.

Cause of death

Bilateral pneumonia complicating multiple injuries caused by a fall from height.

Comment: The injuries seen are compatible with the history given and reflect an impact occurring on the left side of the body. The fall had caused multiple musculoskeletal and soft tissue injuries which had given rise to laceration of the lung and subsequent pneumonia. Immobilisation and ventilation were also contributory factors to the pneumonia.

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