



COLOUR ATLAS OF
FORENSIC
TRAUMATOLOGY

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Version 1

Drowning

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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. Sarangi Amarakoon is a Temporary Research Assistant at the Department of Forensic Medicine. She obtained her MBBS in 2023 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 lay out and formatting the booklet. The compilation of the case and photographs for publication was initiated by Dr. Deshani Herath, continued by Dr. Shashika Weerasinghe and finalized by Dr. Sarangi Amarakoon.

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

Any clarifications, suggestions, comments or corrections are welcome.



COLOUR ATLAS OF
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ILLUSTRATIVE CASES

Drowning



Drowning

A simple definition of drowning is 'death following aspiration of the fluid medium while the deceased is immersed or submerged'. The fluid is usually water. Drowning can be accidental, suicidal, or homicidal. Death in drowning may be due to asphyxial and non-asphyxial (vagal inhibition when cold water hits the post-nasal mucosa or hypothermia - pink colour hypostasis is a prominent finding) mechanisms. If the person died due to a laryngeal spasm, the lungs are dry, and it is called dry drowning. Medico-legal issues that arise related to a body recovered from water are the cause of death (drowning vs killed and dumped in the water), circumstances of death (accidental/suicidal/homicidal), whether the person was alive at the time of entering into the water, place of entering, identification of the body, time since death, etc.

There are no pathognomonic postmortem findings to confirm drowning and the diagnosis is based on the circumstances of the death, together with non-specific findings that depends on the mechanism of death. If the deceased had been in the water for more than 1-2 hours, the hands and soles show a "washerwoman" appearance, where the skin becomes wrinkled, pale, and sodden. After some days in the water, the keratin layer on the hands and soles gets detached and peeled off. White wrinkled hands (washerwoman's hands), water flora, sand, silt, and mud on the body which may be present, are signs of immersion, and not drowning. Cutis anserine, a generalized pimpling of the skin due to the contraction of the erector pilae muscle attached to each hair follicle, is a common but non-specific finding in immersed bodies. In emphysema aquosum, a characteristic mushroom-like froth that is white or pink continuously comes out of the mouth and nostrils. This froth indicates that the person was not incapacitated at the time of drowning. When a person struggles against drowning, due to emersion and re-emergence, water, surfactant, and air in alveoli are mixed up to form a froth which causes the lungs to be expanded. Rib indentations are seen on the lungs. Lungs are not floppy and stand on the table. In edema aquosum, the respiratory passages are flooded, causing a mechanical obstruction and water may be seen pouring out of the mouth and nostrils. This is seen in those who are weak or unable to struggle. (E.g. extremes of age, intoxicated, unconscious). In this case, water is not mixed with surfactant and air. Lungs are not expanded. Rib indentations are not seen. The presence of foreign material beyond secondary bronchioles indicates active breathing at the time of drowning. The presence of sand and mud in lung precipitate is highly suggestive of drowning. Microscopic findings are dilated alveoli with intra-alveolar edema, compression of septal capillaries, and reduced number of alveolar macrophages.

Diatom studies are useful to identify the water body in which the person was drowned. If the diatoms found in the femur are identical to that found in a sample of water taken from where the body was found, it is indicative of drowning in that body of water. However, it can be negative if the person died due to vagal inhibition, laryngeal spasm or the concentration of diatoms is very low in that body of water.

History

A 39-year-old male was found gasping for air while on his back in the water. He died after unsuccessful resuscitation.

External Examination

The sclera and the conjunctiva were without petechial haemorrhages. Mild congestion was seen. The ears, nose, and mouth were without congenital deformities. A small amount of froth appeared at the mouth at the time of evisceration.



Figure 1: Froth at the mouth

Internal Examination

Respiratory Tract: The larynx, trachea, and main stem bronchi have congested mucosal surfaces. A small amount of froth was present in the lumen but is free of other foreign bodies or other silt material. The hyoid bone and the thyroid cartilage were intact. The right and left lungs weighed 732 grams and 734 grams respectively. Multiple adhesions were present on the pleural surfaces between lobes and in the chest cavity. The lungs were hyperinflated with rib markings. On cross-section gross pulmonary edema was present. No focal lesions were grossly noted.



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Figure 2: Hyperinflated lung

Cause of death

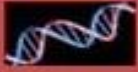
Drowning

History

A 21-year-old male was swept away in the rough sea and was found face down 80 meters away. He was partially submerged when found. The deceased had consumed a couple of beers prior to this incident. When he was taken out of the water he was not breathing and CPR was commenced, to no avail. His family advised that he suffered from mild depression and may have been on medication for this.

Internal Examination

Respiratory System: The pleural cavity was free of adhesions and there were no collections of air, fluid, or blood. The larynx, trachea, and main stem bronchi were unremarkable externally and contained fine white froth within the lumina. The hyoid bone and the thyroid cartilage were intact. No haemorrhagic areas were noted among the neck organs. The right and left lungs weighed 924 grams and 810 grams respectively. The lungs were hyperinflated. The pleural surfaces were smooth and glistening. The pulmonary parenchyma manifested extensive pulmonary edema and fine white froth that was exuding from the cut surfaces of the bronchi. No focal lesions were grossly noted.



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06c 289

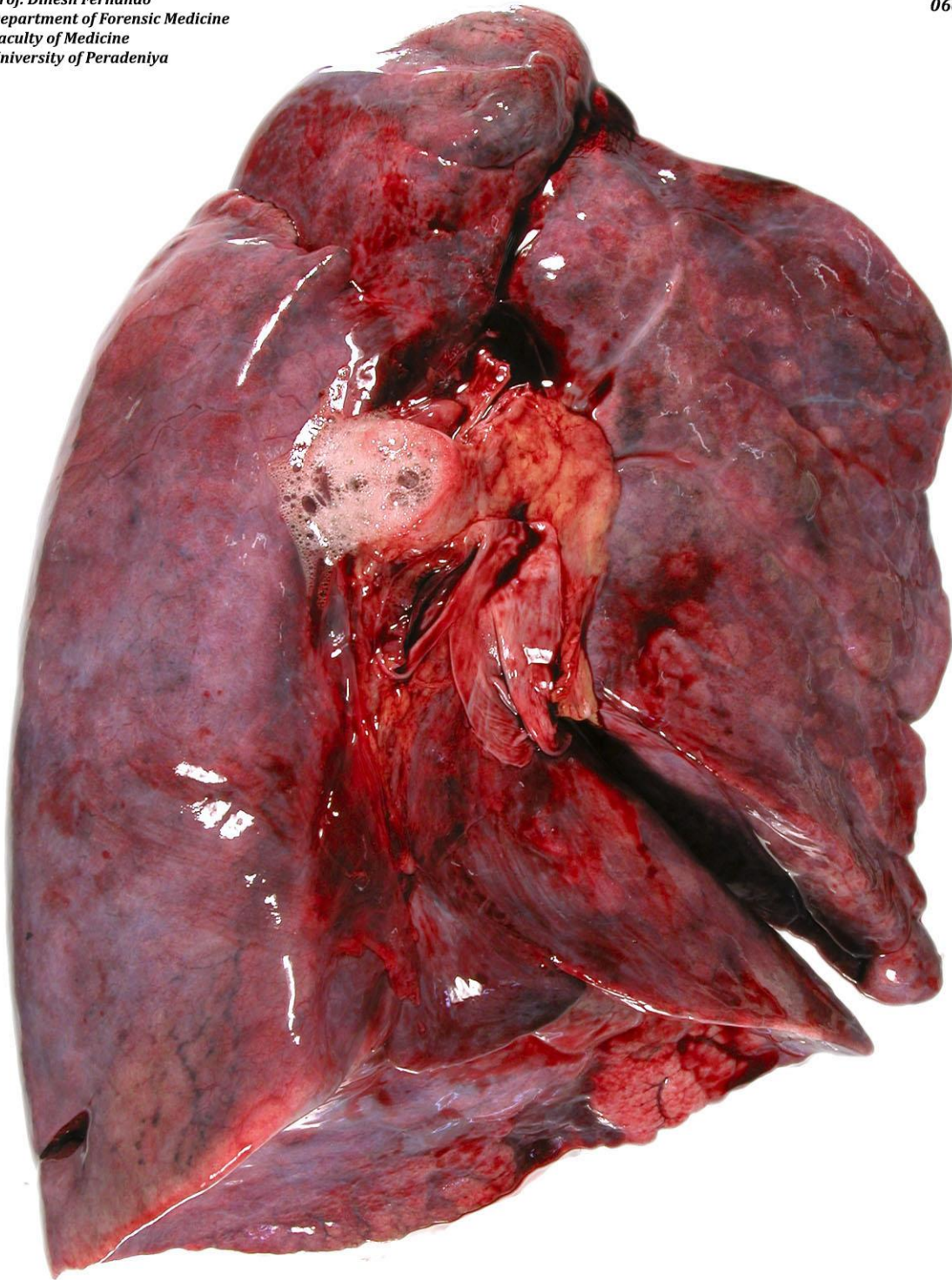
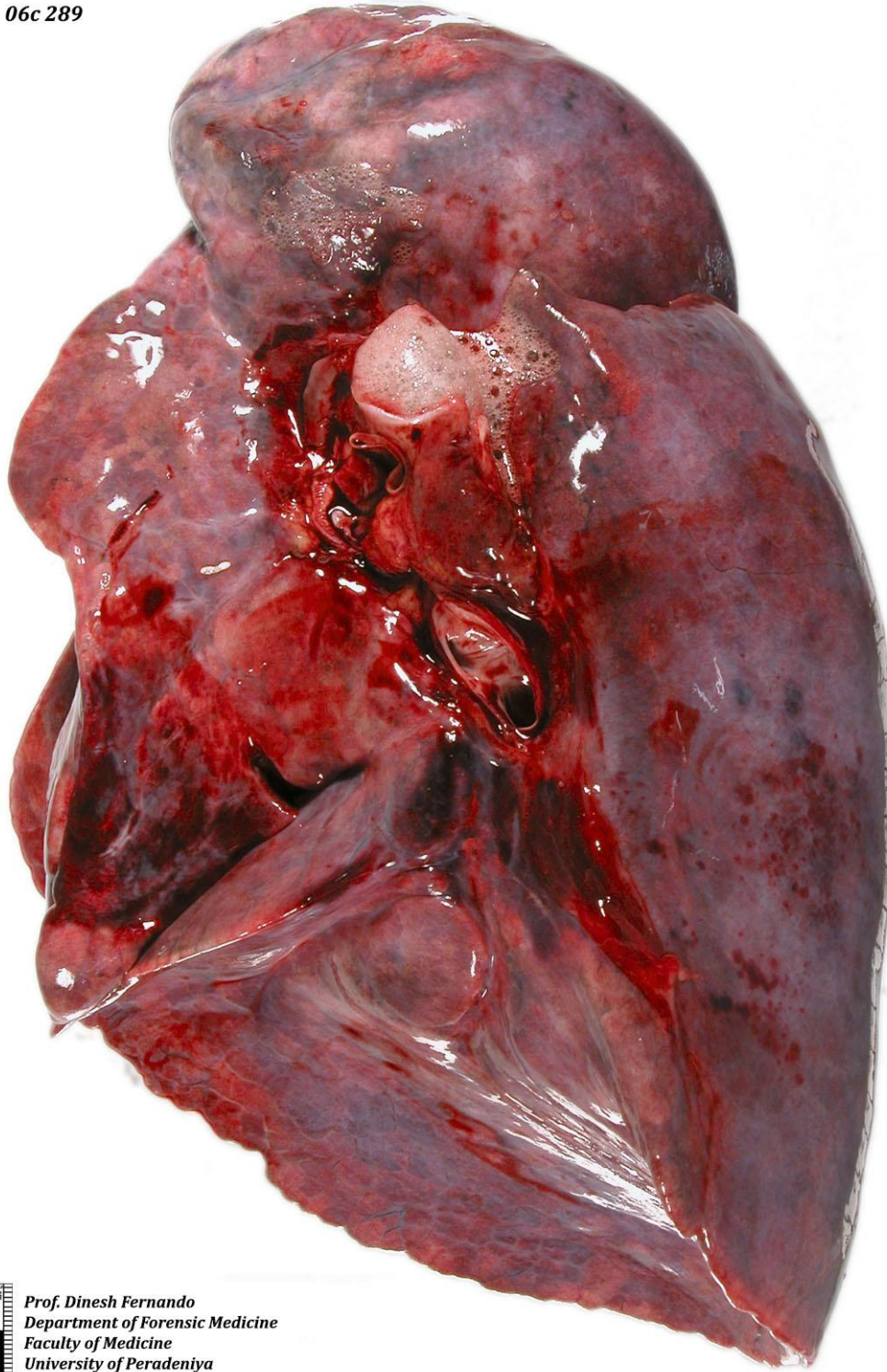


Figure 3: Hyperinflated left lung with a smooth glistening pleura

06c 289



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Figure 4: Hyperinflated right lung; note the fine froth from the cut surface of bronchi

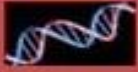


Figure 5: Fine froth from the cut surface of the bronchi

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Figure 6: Larynx and trachea containing froth in the lumen

Cause of death

Drowning



History

A 30-year-old male, with a history of depression, was found face down in the sand on the beach.

External Examination

The sclerae were not icteric and the conjunctivae were free of petechial haemorrhages. Mild congestion of the conjunctivae and sclera was present.

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06c 217

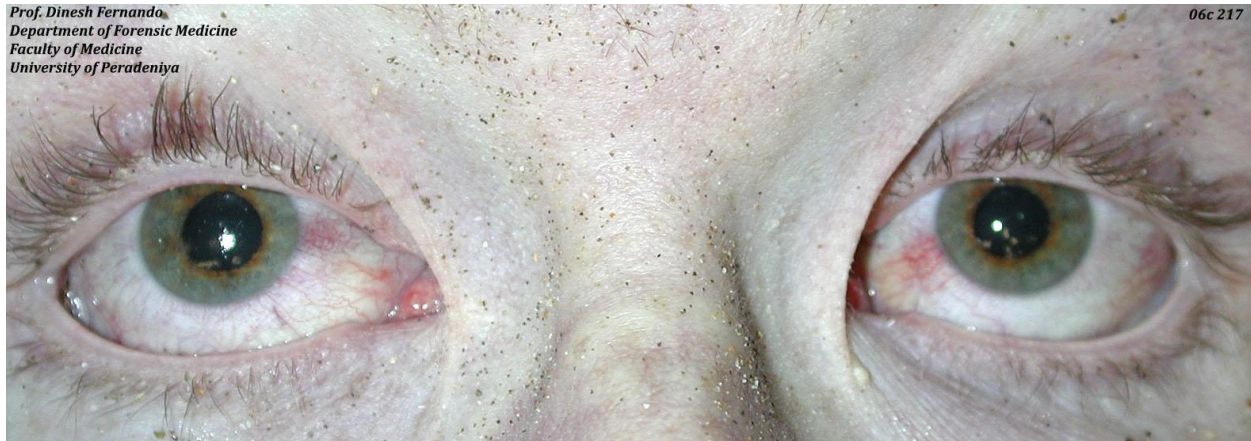


Figure 7: Mild congestion of the sclerae. Pupils are in mid dilation. Note the sand particles on the skin.



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06c 217

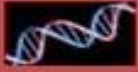
Figure 8: "Washerwoman" appearance of the hand, which is in rigor. Note the sand particles and linear scars on the anterior aspect of forearm

Internal Examination

Respiratory System: The pleural cavity was free of adhesions and there were no collections of air, fluid or blood. The larynx, trachea and main stem bronchi were unremarkable externally and a small amount of white thick tenacious froth was present within the trachea and main stem bronchi. The trachea and bronchi were free of foreign bodies, sand particles or other substances. The lungs were not hyper inflated or crepitant. The pulmonary parenchyma was spongy and was not oedematous or congested.

Cause of death

Drowning



Examination of the scene

A dead body of a 27-year-old man was found floating in a stream. He had been missing for 24 hours by the time the police officers found him. According to the history given by his family, he did not know how to swim.



Figure 9: The dead body that was floating few meters away from the place where he had kept his belongings



Figure 10(a): The socks and shoes of the deceased, together with his back pack was found close to the place the body was floating. The contents of the backpack was taken out by the police for the purpose of identification

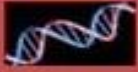


Figure 10(b): Amongst his belongings, his name tag (covered) and badges indicating the deceased was an army soldier of the Gemunu regiment, were found



Figure 11: Marbling on the lateral aspect of abdomen; indicating early putrefaction

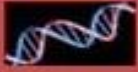
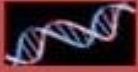


Figure 12: 'Washerwoman' appearance of the hand and soles, indicative of immersion



Figure 13: Post-mortem predation around the lips caused by aquatic fauna; note the swollen face and the peeling of the skin of the neck



Additional information

Cadaveric spasm

It is known as a rare form of instant rigor, which occurs in sudden deaths during severe physical activity or emotion (e.g. suicide, battle field, drowning). It usually occurs in the hands, and the fingers are bent and buried in the palm. The part of the body that undergoes cadaveric spasm does not have a period of primary flaccidity and therefore, the clenched weeds are not released. Cadaveric spasm disappears when rigor mortis disappears.

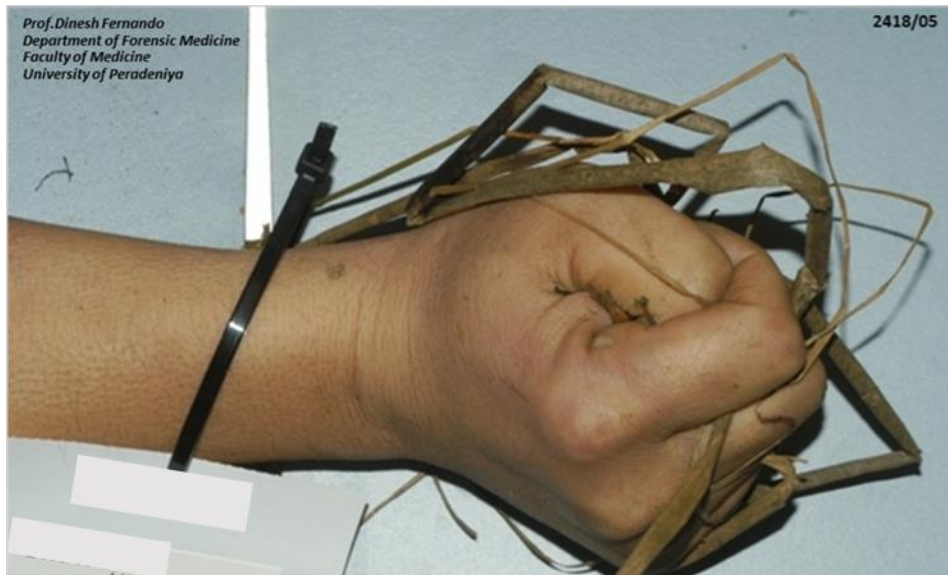


Figure 14: Cadaveric spasm with grass tightly clenched in the hand.



Figure 15: Note the difference of the fingers in this hand which is in rigor mortis



Diatoms

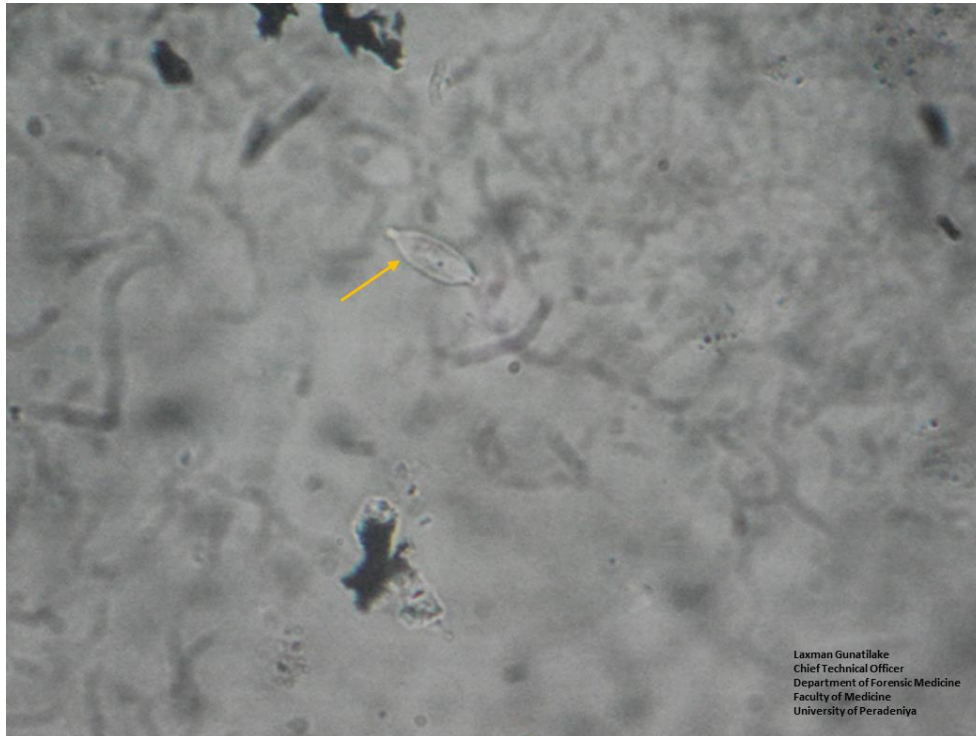


Figure 16(a): Navicula sp. (yellow arrow) found in the bone marrow of a body recovered from water

ater

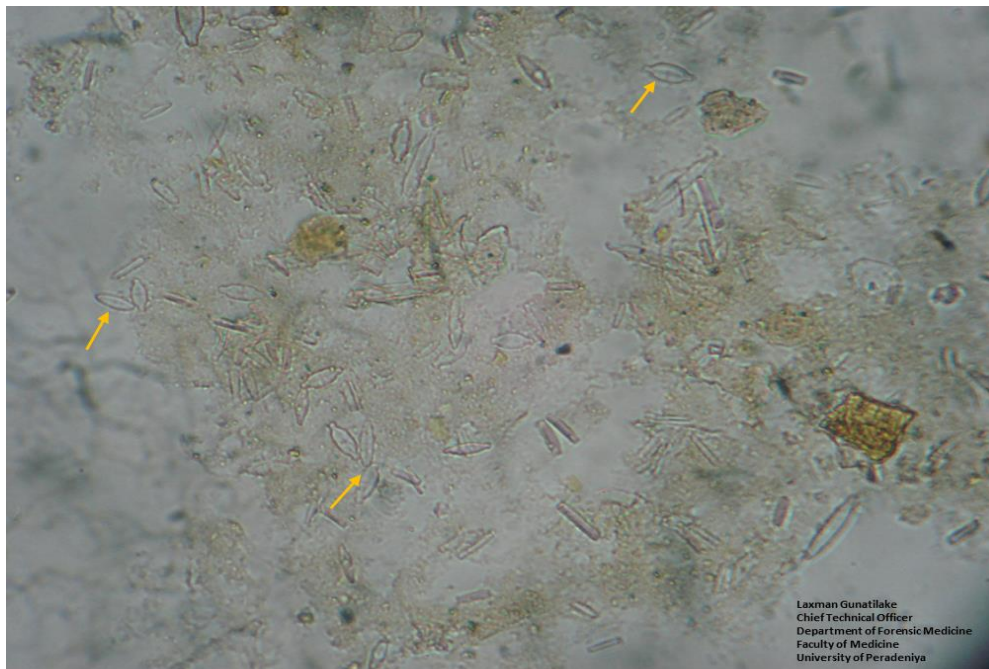


Figure 16(b): The same species (yellow arrows) was found in the water source indicating live entry and inhalation of water

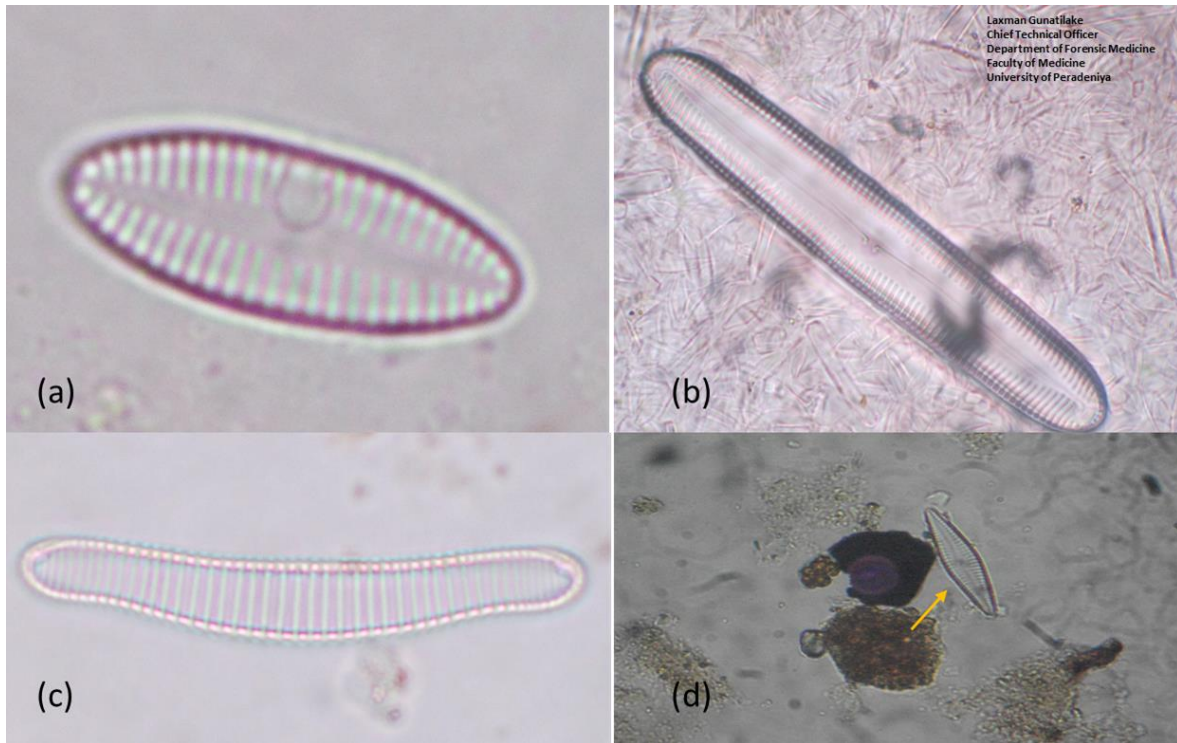


Figure 17: Other types of diatoms. (a) *Achnanthes sp.*, (b) *Punnularia sp.*, (c) *Eunotia sp.*, (d) *Gomphonema sp.*



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