Brain CT Scans in Clinical Practice
Brain CT Scans in Clinical Practice

Usiakimi Igbaseimokumo
With 109 Figures, 50 in Full Colour
Across emergency rooms all over the world, thousands of patients are referred for brain CT scans daily. A radiologist often has to interpret the scan or a consultation has to be made to a neurosurgeon to review the scan. Most of this happens late at night and is a significant source of discontent. Thus having frontline physicians to be proficient in interpreting the emergency brain CT scan improves the efficiency of the whole pathway of care and is potentially life saving as time is of the essence for many patients with severe brain injury or stroke.

Underlying all of the above and the primary reason for writing this book is because the skill required to determine an immediate life threatening abnormality in a brain CT scan is so basic and can be learned in a short time by people of various backgrounds and certainly by all physicians. ‘Indeed the emergency head CT scan is comparable to an electrocardiogram in usefulness and most definitely as easy to learn.’ This book is therefore written for caregivers the world over to demystify the emergency CT brain scan and to empower them to serve their patients better. It is obvious to me from the response from people I have had opportunity to teach this subject that not only is there a desire to learn this basic skill but also people learn it quickly and wonder why it has not been presented so simply before.

It is to fulfil this need and to reach a wider number that I have put together these basic, proven steps in the interpretation of emergency brain CT scan for ER physicians, primary care physicians, medical students and other primary care givers.
Interpretation of the emergency CT brain scan is a visual art. Comparison is made between the image in front of you and a reference image. For the experienced person, this reference image is imprinted in the mind, therefore comparison is quick. For the beginner, you can either carry several examples of every possible appearance of normal and abnormal scans to compare with or read this book! This book contains a few proven ways of quickly learning to interpret a brain CT scan, irrespective of your previous experience.

The radiologist’s experience is related to the number of hours he or she has spent looking at CT scans. The radiologist conveys his evaluation of the CT scan in words that often come in a particular sequence and combination. This book is about helping you to rapidly understand and confidently use the same language used by the radiologist.

The difference is that whereas the radiologist aims for perfection, you aim for functionality. For instance it will be acceptable and clinically safe if an intern physician looks at the brain CT scan in Fig. 1 and can make a judgement of the urgent action required like ABCs (airway, breathing and circulation with c-spine) and call a neurosurgeon immediately. This is life saving and efficient without the need for a long list of differential diagnoses before deciding on this action. The skill to act decisively about the CT scan in front of you can be acquired in a very short time. And the author has reduced that time to less than one day using this book!

Korgun Koral, MD
Associate Professor of Radiology
University of Texas Southwestern
FIGURE 1. Emergency action required! ABCs and call Neurosurgeon!
My heartiest gratitude goes to my wife Ebitimi and my kids Gesiye, Ilayefa and Binaere who volunteered the real cost in time to prepare this book. My eternal gratitude to The Isouns – Professor Turner T. Isoun, PhD and Dr. Miriam J. Isoun, PhD – for spiritual, financial and intellectual support on this and every other project I ever embarked upon, thank you.

I would like to thank those who read the manuscript and made useful suggestions including especially my classmate and friend Dr. Eme Igbokwe, MD. I would also like to thank Dr. Korgun Koral, MD for finding the time to read the manuscript and making pertinent suggestions. Dr. Jim Brown, MD and Dr. Kristen Fickenscher, MD were a very present source of encouragement and critique.

I would like to acknowledge Stacy Turpins for the original drawings and the framing of the illustrations.

My sincere gratitude to Medical Modeling for the prototype of the cover image.

Lastly despite their best thoughts and efforts, any error remains singularly mine and please contact me with any suggestions.
Epilogue on CT Scan for SAH .......................... 59
Spontaneous Intracerebral Haematoma .................. 59
Usual Locations and Aetiology .......................... 61
Basic CT Scan Internal Landmarks ...................... 62
Ischemic Stroke (Cerebral Infarction) .................... 66
T~ Stands for the Territory – the Vascular Territory .. 69
H~ Stands for Hypodensity ............................... 69
O~ Stands for Oedema ................................... 70
S~ Stands for Swelling and Shifts ....................... 71
E~ Stands for Evolution .................................. 71

4 Hydrocephalus ........................................... 73
Introduction ................................................ 73
The Temporal Horns and Third Ventricle in Early Hydrocephalus ........................................... 74
Effacement of the Sulci .................................... 77
Disproportionately Small Fourth Ventricle ............. 77
The Frontal and Occipital Horns ......................... 79
Periventricular Lucencies ................................. 81
Previously Diagnosed Hydrocephalus .................... 83
Causes of Hydrocephalus .................................. 84
Foramen of Munro – Colloid Cyst ....................... 86
Cerebral Aqueduct of Sylvius ............................ 87
Fourth Ventricle Obstruction ............................. 88

5 Tumours and Infections (☞ SOL) ....................... 89
Introduction ................................................. 89
M is for Mass Effect ....................................... 90
E is for Enhancement ..................................... 91
A is for Appearance ....................................... 96
L is for Location .......................................... 97
Special Locations ......................................... 99
Red Flags .................................................. 100

6 Advanced Uses of Brain CT Scan ...................... 103
3D Renditions: Craniosynostosis .......................... 103
3D Renditions: CT Angiography .......................... 104
Subtleties! ................................................. 104

Index ...................................................... 107
Chapter 1
Introduction to the Basics of Brain
CT Scan

THREE BASIC DENSITIES OR DIFFERENT SHADES OF GREY

The first secret is that we describe CT scan findings as ‘densities’, of which there are three common easily identifiable ones to learn. ‘In general the higher the density the whiter the appearance on the CT scan and the lower the density the darker the appearance on the brain CT scan.’ The reference density (the one you compare with) is the brain, usually the largest component inside the skull. Anything of the same density as the brain is called ISODENSE, and it is characterised by a dull greyish white appearance (Fig. 1.1). Thus the brain is the reference density. Anything of higher density (whiter) than the brain is called HYPERDENSE, and the skull is the best example of a hyperdense structure that is seen in a normal brain CT scan. The skull is easily identified as the thick complete white ring surrounding the brain. Similarly, anything of lower density (darker tone) than brain is described as HYPODENSE.

The cerebrospinal fluid (CSF) is the typical example of a hypodense structure in the brain CT scan (Fig. 1.1). Air is also hypodense and surrounds the regular outline of the skull in CT, just as the air surrounds the head in life. Between the pitch formless blackness of air and the greyish white appearance of the brain, the cerebrospinal fluid presents a faint granular hypodense appearance, which may vary slightly but is identified by its usual locations. You will come to realise later that ‘appreciating the usual locations of CSF is the key to understanding brain pathology on CT scan’ (Igbaseimokumo 2005). We will come back to this idea later, but for now suffice it to say that the skull is highly whitish in appearance (Fig. 1.1) and is clearly identified as an oval white ring surrounding the brain. The brain is greyish white, and
FIGURE 1.1. The different densities of CT scan.

the CSF is dark and faintly granular on close inspection (but not as dark as air) and has specific normal locations.

How to Identify an Abnormality on the CT Scan
Similar to the normal densities, abnormalities on the CT scan are also described simply as high density, low density or the same density as brain. So what could a hyperdense (high density) appearance on a CT scan represent? This is perhaps the one most
important fact you will get to learn about CT scans. The answer is simple – **blood** is the most common hyperdense abnormality found on a brain CT scan (Fig. 1.2). So if a hyperdense appearance is not in the right location for bone then it must be *blood until proven otherwise*. So the rule of thumb is that ‘anything white in the CT scan is either blood or bone’.

There are two common exceptions to the above rule. You might as well learn them now. The pineal gland is a little calcified