OPINION PIECE

Anatomy Lessons

Reena Mary George[a] and Shefali Mathew[b]

[a] MBBS, MA (Christian Studies), Professor, Palliative Care/Radiation Oncology, Christian Medical College, Vellore, India
[b] BA, student at the English and Foreign Languages University, Hyderabad, India

Abstract

The microcosm of the human body, like the great rhythm of the universe, is silent, intricate, delicately balanced. Anatomy supports Physiology as organs and tissues connect, communicate and nourish life. In illness, they speak through the patient's history. Even in this era of cutting-edge technology, the clinical history remains the foundation of palliative and patient centred care. In listening to Anatomy speak, we understand how and where the body hurts. In health and infirmity, may we also marvel at the human form we touch and inhabit — so carefully, fearfully and wonderfully made.

Bored of Anatomy

I confess that as a student I did not like the subject of anatomy. Mathematics called for logic, the languages inspired creativity, physiology offered an intriguing interplay of feedback cycles, but anatomy demanded that I laboriously read pages of dead, boring detail. It fogged my memory with long names swirling in fumes of formalin.

Before the days of integrated medical education, the first one and a half years of pre-clinical studies in Indian medical schools were completely separated from the clinical world. We lived far away from the hospital, but only a short walk from the dissection room. The dirty grey-brown tissues on the cadavers looked nothing like the color diagrams in our atlas. Our seniors told us that the living body in the operation theatre looked very different. Since I did not have the qualities to be a surgeon, anatomy was only a subject to endure until my clinical years. Then I would search for a non-surgical discipline that seemed a natural home for my interests and limitations.

Anatomy Revisited

Radiation oncology was not a popular specialty in those days but it attracted me for many reasons. There was so much one could learn from a long relationship with patients and from ongoing discoveries in science. It offered physics and mathematics; psychology and statistics; medicine and surgery; pharmacology and pathology. It had clinical conundrums ranging from neurology to urology.

As a trainee radiation oncologist, I realized that anatomy mattered very much. We did not have a fluoroscopic simulator. Drawing upon our knowledge of surface anatomy, we would mark a field, paste radio-opaque metal markers, and take a plain x-ray. This “check film” became the litmus test of our radiotherapy planning skills. Was the pituitary fossa bang in the middle of the ‘5 by 5’ field that we had drawn? Had we correctly targeted the vertebra that had a painful deposit? We felt very happy if the check film occasionally showed we were spot on. The blue lines we had drawn on the patient’s skin did not have to rubbed out with methylated spirit and redrawn with a wooden twig dipped in gentian violet

before being tattooed for future reference. Our artistically minded ancestors must have used similar implements, vegetable dyes and twigs for cave drawings, before they progressed to doing body tattoos. “Image-guided” radiotherapy has taken on a whole new meaning beyond those primitive “check films.” Radiation oncology now uses amongst the most sophisticated and expensive technology in health care to pinpoint tumors in the three dimensions of space and through the movements of time.

Anatomy Speaks

Although my own life has moved away from the precision of radiation oncology to the complex uncertainties of palliative care, anatomy still matters. It is a good friend now because it has remained true and steady. Its fundamentals have changed less than that of many of the other subjects that I studied in medical school. I am grateful to the teachers who enabled deep, long-term learning. But it is no longer the quick fix of check films that is rewarding. It is my wonder at the design and economy in the anatomy of the human body, where structure and location so logically and elegantly facilitate function and sustain life.[1]

I was wrong to think that anatomy was a dead, boring subject. I realize now that anatomy is alive because it speaks, as creatively as any rich language, not only through the history of my patient but also in the history of humankind.

Many of our patients in India are too ill or too poor to afford MRIs and PET scans. I need the guidance of anatomy to know when to send for more expensive imaging. When my patient with lung cancer has recently become happy go lucky and expansive, my own heart sinks. It may not be because he has moved from grief to acceptance and positive thinking. Very often the imaging will show frontal lobe secondaries in the brain — that sanctuary from chemotherapy.

The body carefully shelters what is most vulnerable. The small, fragile pituitary that determines human size and virility is kept safe in the bony vault of the sphenoid. Close to it, in their own osseous bunkers, are the nerves of our major sense organs. The eyes are protected by two parents — tough bony brows and tender, sensitive eyelids. We used to tell our patients with maxillary cancers to keep their eyes open and gaze into the cobalt beam. The maximum dose of radiation then fell behind the cornea, and it reduced the risk of a corneal opacity. The eyes, the windows to the soul for the poet, are the peep-hole to the living body, for the physician. With an ophthalmoscope, we can witness the inner ravages caused by raised intracranial tension when brain secondaries grow.

The ear pinna resembles the diaphragm of our stethoscope, wide open to receive sound waves. And like the instrument’s rubber tubing, the middle ear shepherds the sound waves through a narrow path guiding them to audibility. The middle ear canal is far shorter than my stethoscope’s tubing because it has the incus, malleus, and stapes to amplify the signals. These tiny ossicles with imperious names sit beneath the brain, deep inside a petrous submarine. Only the Eustachian periscope peeps into the nasopharynx. I remember an old man whose partial deafness and middle ear effusion was caused by an undetected, nasopharyngeal cancer blocking the Eustachian tube. It was only when the tumor grew to infiltrate the base of the skull and neuropathic pain demanded an investigation that the enemy was uncovered. No one had heeded what the secret agents in the middle ear had been whispering for months.

There is an economy, not only in structure and location but also in function. Air, before it reaches the lungs, wafts smells through the perforated cribriform plate to waiting olfactory nerves. Air also makes a little detour from the pharynx into the mouth so that the sweet, salt, sour, and bitter of our taste buds become a thousand flavors of the world's cuisines. A common cold reminds us that the tongue is not the only organ of taste. Changes in smell, taste, and saliva all contribute to the altered “taste” after radiotherapy. Conformal techniques have reduced the gustatory price to pay for a cure.

The slender, minimalist human neck can also swivel, if not to the same degree as a radiotherapy machine. The flexible neck allows us to look beyond the tunnel vision of our bone-sheltered eyes. The eyes, ears, and the nose are placed high to enable our human ancestors to look, listen, and breathe above the forest undergrowth. The neck connects the processing engines within the abdomen and thorax to the outside world of food and air. Fleet-footed air speaks and sings its way through the flute of the larynx. With less delicacy, food pushes its way down the esophagus. Bullied by the bolus, the esophagus remains silent and hides behind the trachea. Very rarely does it speak up. We are worried when a patient with esophageal cancer coughs on swallowing. "Drink a few sips of water," we say, and in the clinic, a trachea-esophageal fistula may hoarsely announce its presence even before a confirmatory endoscopy.

Unlike most other parts of the body, the thorax and the abdomen can expand and contract. Both have to accommodate what enters from the outside, and so they have adapted to the needs of their residents. The latticed window of the thoracic cage allows both ventilation and protection. The lungs and the heart coordinate our gas supply. The body's biggest and busiest vascular channels run between them. In the body's economy, it is natural that these organs are in proximity. When things go wrong in the vital communication between the heart and the lung, the story of the pulmonary embolus can be breathlessly acute and scary.

Various body fluids keep their organ masters in good humor. We acknowledge them only when the patient complains of a post-radiotherapy stenosed vagina, dry mouth, or dry eye. Newer radiotherapy techniques recognize the value of tears.

I never understood the term “a potential space” throughout my pre-clinical studies. It sounded as mysterious and unreal as the wardrobe to Narnia. Finally, in my clinical years, I saw the potential space becoming oppressively real in a patient with a malignant pleural effusion. I admire the clinicians of yesteryears who discovered for us that vocal fremitus decreases with fluid in the pleural cavity but increases with the consolidation of the lung parenchyma. A helpful clinical distinct-ion when the patient is not able to come to the hospital for an x-ray. Left untreated, an ipsilateral tracheal shift is the next danger sign the lung has collapsed, after a knockout punch inflicted by just a few liters of pleural effusion.

A few liters of ascitic fluid do not tell such a violent story. The abdomen does not have ribs to constrain its expansion. Easygoing, it expands with a smiling umbilicus. This laxity enables it to make room for the growing fetus and to stock up food reserves. Its capacity fluctuates as food changes to fluid, flatus, and feces. We were taught these various F's in the differential diagnosis of a distend-ed abdomen by our clinical teachers.

But like most students, we forget what we do not reinforce through regular use. A pair of senior physicians were debating over a sinisterly hard, but very mobile lump in the abdomen. Was it benign or malignant? A gynecologist friend laughingly pointed out that it was the fetal head swimming in amniotic fluid. I would not have believed this story if I had not heard it first-hand. We may not realize when our professional knowledge erodes our human wisdom. I remember a medical teacher who said, “If we are not careful, as the years pass we will know more and more about less and less.” That is why, not just patients, but even the health care system, needs its general practitioners. Common diagnoses are common, but common sense, sadly, is not.

Within the abdomen, the more delicate vulnerable structures are housed with extra care. The vascular liver and spleen are protected in the basement of the bony thorax. In the sterile retroperitoneum, the kidneys lie not far from the major vessels whose blood they have to purify. Many of the catecholamines and mineralocorticoids that control the pressures and chemical balance of our inner world are produced by the adrenals that humbly wait upon the kidney. Very few of the medications we use in oncology are produced by the body itself. But the “original glucocorticoid molecules,”

indispensable to oncology, palliative care, and to life itself, were first synthesized by the adrenals. The adrenals determine life and death, hunger and thirst, love, fear, and happiness through electrolytes, hormones, and neurotransmitters. Yet, they remain content with a name subsidiary to the kidney. Perhaps they were labelled when we judged them by their position and not by their vital contribution. I think of those who quietly work hard to keep our big hospitals running every day: the electricians, the secretaries, the accountants, the cleaners, the plumbers.

The liver, the largest organ in the abdomen, is close enough to the upper gut to take over the portal circulation. It is as if the body has outsourced the processing of nutrient-laden blood to this factory of portal circulation. The liver adds chemical preservatives, conjugates, sorts, and stores after the pancreas has done the enzymatic slicing and chopping of food. It was in a patient with pancreatic cancer that I first realized how anatomy tells stories. It was a sad story of a tumor in the pancreas that had blocked the common bile duct. The skin and urine were a deep yellow, as were the desperate, wide-open eyes of a young man who would not live to see his children grow up.

Anterior to the retroperitoneum, in the roomy abdominal cavity, many meters of intestines and miles of villi happily cohabit in a common dormitory. The near constant supply of food and drink keeps them in good spirits. The ileum is especially trouble-free. We see very few cancers there. Frequent surveillance endoscopies of the ileum would be both difficult to perform and unpleasant to experience. The ileum goes the extra mile when other routes are blocked, emerging as an ileostomy or even an ileal conduit for urine, another quiet, faithful, unappreciated worker with an undistinguished name.

In good health, the peritoneum provides smooth, thick, waterproof insulation. The visceral peritoneum protects the abdominal cavity from the murky contents of the gut. A perforated bowel cancer changes the easygoing abdomen into a tense guarded structure that rebounds in pain. Cancer that seeds the peritoneum, more insidiously, sows discord within a once happy intraabdominal family. When cliques of matted omentum advance upon their wounded neighbor, even bowel resection surgery cannot bring catharsis and reconciliation. It is left to palliative care physicians to impose an uneasy curfew with anticholinergics and numb the deep visceral pain caused by broken relationships.

Pain is the most frequent spokesperson for anatomy in oncology. Unlike visceral pains, nociceptive and neuropathic pains are quite precise in their history telling. But sometimes you have to know from where they are coming. If a patient with breast cancer starts getting supra-scapular pain, I worry about recurrence near the deep brachial plexus, even if the chest wall is pristine. I also remember the patient whose high interscapular pain turned out to be an extra mucosal recurrence of a post-cricoid cancer goring into the prevertebral tissues. A patient may have multiple bone metastases, but when his deep tendon reflexes are brisk, we cannot ignore these hyperactive nerves — danger is near. An MRI is needed to screen for cord compression.

Unlike most other cells in the body, the neurons travel far, communicate fast and shock us into attention. They are our high tension electric wires. Despite the speed with which our nerves convey orders, our responses are surprisingly accurate. This is partly because the motor homunculus has designated offices. The homunculus of the brain gives much more to the hands than to the feet. In spite of such unfair treatment, the feet steadily carry the load, allowing freedom for our hands to learn new skills. The loyalty of the feet has, in turn, enabled them to grow – human lower limbs are stronger, longer, and more autonomous than the lower limbs of most animals.

The big and the little toes are parallel to each other, but the thumb is placed almost perpendicular to the other fingers. This little difference has altered human history. Would we have ventured to plant seeds, light fires, cook food, sail ships, draw maps,

teach children to write, perform surgery, administer chemotherapy, or do radiotherapy contouring if we were created with thumbs that were parallel to the fingers?

The brachial plexus that enabled all of these milestones in human history can be damaged by many cancers: breast, lung, and supraclavicular nodes from different primaries. Breast cancer is very versatile in the stories it can tell. Its metastases range from choroidal to Krukenberg. Some breast cancers write long-running sagas. Every few years there is a distant site of relapse and therapy. The *cancer-en-curaisse* on the other hand, like a parochial soap opera, revels in causing may-hem and misery in its neighborhood.

The breasts, we had learnt in anatomy, develop on the mammary line that extends from the axilla to the abdomen. Other mammals have many pairs of mammary glands to feed multiple offspring. Only one pair remains in human beings. Before in-vitro fertilization and neonatology, twins sometimes survived, but triplets rarely did. A woman's only pair of breasts is located closest to where the baby can hear his mother's heartbeat as he feeds, where her elbow can comfortably cradle him, where she can smile at him, sing to him. Most mammalian offspring are not carried with such tenderness. As infants, we had to be carried because we are born helpless. Unlike puppies, calves, or foals, the newborn human being cannot run or jump to claim nourishment. Even when we can physically stand on our own feet, we cannot manage to earn a livelihood for many years.

Perhaps it is such vulnerability that created human civilization. Babies needed parents for many years just to survive. And that dependence created families. For a decade or two children are given not only food, but love, knowledge, values, and laughter. Work and creativity, faith, and learning were shared and fostered across gen-erations. One reason why the child is born almost prematurely helpless is because the head to body ratio is larger than in most animals. And before the head gets too big to escape the bony pelvis, the baby leaves the womb and moves into the care of its parents.

It seems unfair when the wombs that have been a safe home to many children are attacked by cervical cancer. The assailants come in different guises. Some invade frontally with early bloodshed. The injury is worrying enough to bring the patient to the hospital. (Except when, as a doctor from Africa said, some simple postmenopausal women rejoice that their fertility has returned and keep waiting for the next pregnancy.) The exophytic bleeding cancers that do reach a radiotherapist are usually gratifying to treat. They often shrink quickly with external radiotherapy, and then brachytherapy can deliver tumoricidal doses. The most lethal villains are the other types of cervical cancer, the ones that creep silently and suddenly garrote both ureters. Then there are obnoxious bullies who slowly torture before they kill. They gouge into the bladder or rectum, causing fistulae. Stigmatized by fetid smells, the patient, for no fault of her own, becomes the lonely pariah. Friends move away.

At the very end of the torso, are orifices born of the lowly primitive cloaca. It too has adapted to serve the body. It allows the intestines which were anteriorly placed in the abdomen to emerge posterior-most as the rectum. The ureters that were situated posteriorly in the sterile retroperitoneum drain urine through the anterior sluice valve of the urethra. Our ancient female ancestors and their babies might have more easily died of urinary or puerperal sepsis if stool came out anterior to the urethra and vagina. The occasional unfortunate patient with a rectovaginal fistula illustrates the mess when stool takes the front seat.

Living Art

It took the mutilation and mystery of cancer to teach me how anatomy works. As clinicians, we witness the tentacles of cancer rip a finely balanced work of art into a tremulous jigsaw. In listening to the patient, we try to understand how the jigsaw fits. Through individualized, attentive treatment we try to put back the pieces.

Yet, we know that with or without cancer, human bodies will ultimately return to the earth. They will become dust and ashes just like our discarded drawings and paintings. Only a select few will be preserved — priceless children's drawings treasured by their parents; expensive masterpieces in our art galleries and museums. They speak deeply to us without articulating a single word. A few human bodies endure too. They are in our medical school museums, where cadavers continue to teach the ancient art of anatomy to today's medical students.

And for the many faceless ones, who in brokenness and silence, taught me to listen to their voice in my patients — I write this tribute.

.

References

1. Brand P and Yancey P. Fearfully and wonderfully made. Grand Rapids, Michigan: Zondervan Publishing House: 1980.

Peer Reviewed

Competing Interests: None declared.

Correspondence: Reena George, CMC Vellore, India. reena.vellore@gmail.com

Cite this article as: George RM, Mathew S. Anatomy lessons. Christian Journal for Global Health. Nov 2017; 4(3):96-101. https://doi.org/10.15566/cjgh.v4i3.198