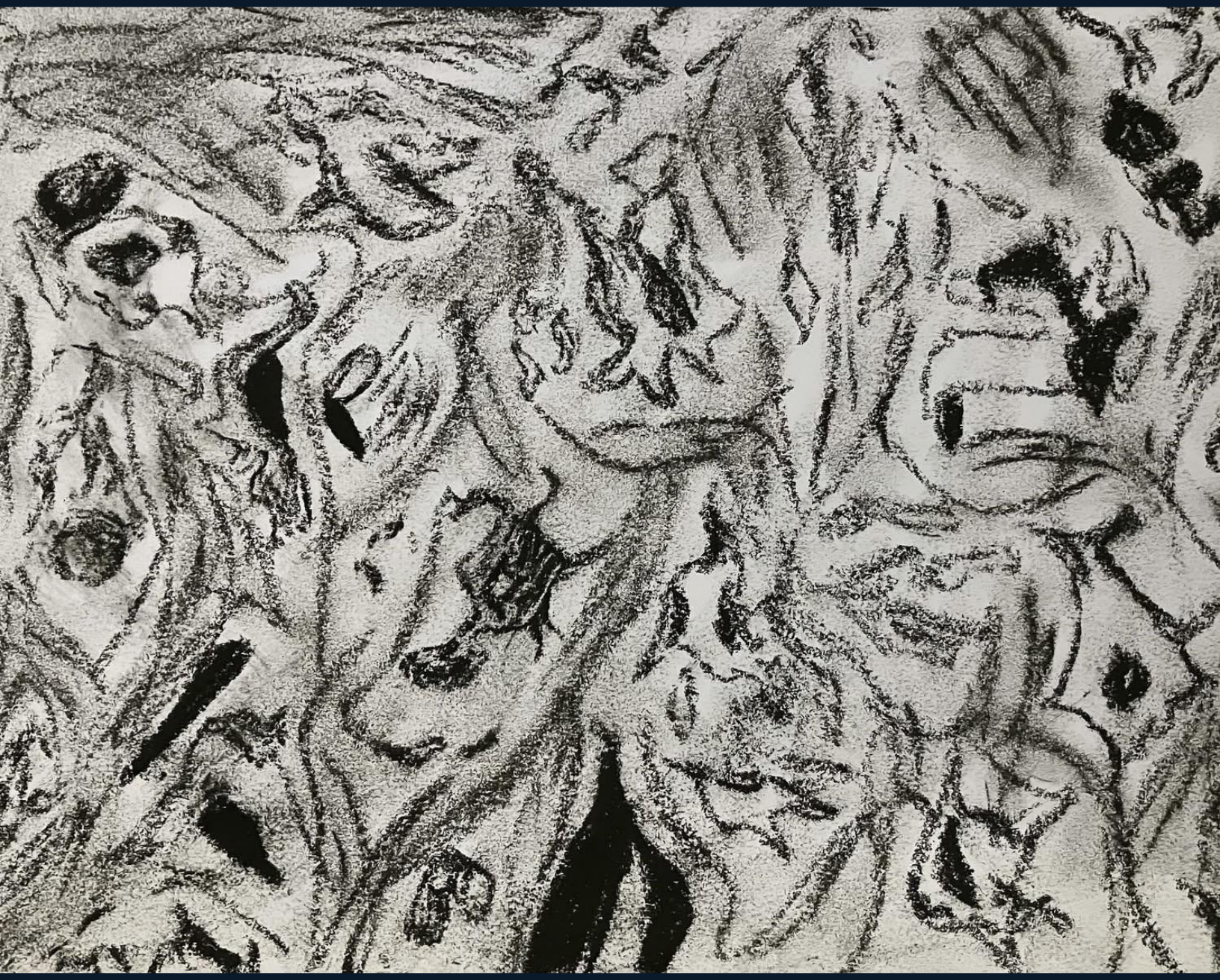

PhysiOdyssey

Exploring Human Physiology

A creative writing journal with a physiology focus

Volume 2, Issue 1, 2026

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We are delighted to share the second issue of PhysiOdyssey: Exploring Human Physiology, and we look forward to moving towards a regular six-monthly publication rhythm as our community continues to grow. Once again, we have been impressed with the range of voices and styles in the submissions we've received and are excited to bring you a selection that really showcases the scope of physiology as a discipline and its impact on our daily lives.

In this issue, you'll find historical perspectives that have shaped modern understanding and speculative pieces that imagine the future of physiology. You'll be immersed in the world of research and asked to consider what happens when healthy physiological function fails. From a light-hearted look at how our blood clots in Coagulation Chaos, to an insightful view into neonatal surgery in The Role of Adrenaline, each article highlights a different way in which our bodies work, adapt and sometimes surprise us.

While compiling this collection, we were also delighted to run our first haiku competition, organised by our student intern, Katie Lang. The competition celebrated physiology through concise and creative expression. The results are on our website, and selected entries from this competition will be featured in Issue 3.

One of the aims of PhysiOdyssey is to show that physiology is not confined to laboratories and textbooks; it affects everyone, old and young, city dwellers and countryside wanderers, office workers and astronauts. It is part of our day-to-day lives and our adventures, and can inspire stories, reflections and creative interpretations.

Contributors to this issue come from science, medicine, arts, and other backgrounds, helping to make this collection so rich and engaging. We are grateful to them all for sharing their perspectives and experiences, and to our readers for continuing on this journey with us. If this issue sparks an idea of your own, we encourage you to submit to a future edition. Surprise us and help us explore human physiology in a new way.

Shona and Katherine

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Cover artwork by Emma Reid

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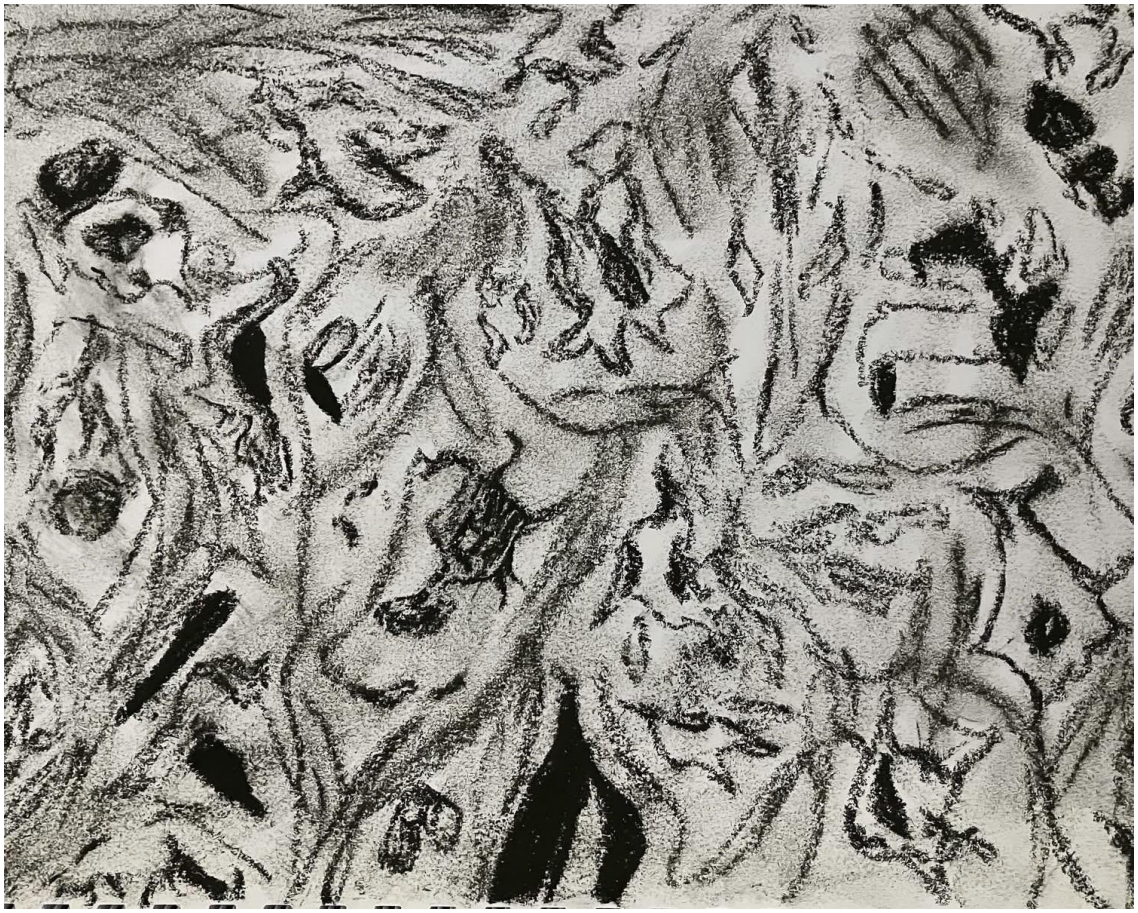
Duality

By Emma Reid



All is calm, peaceful, serene.
The microglia are at rest.
Long, lithe limbs softly sway.
Patiently sensing, searching.
They wait.

There's trouble ahead.
A blockage has brought all blood flow to a standstill.
No movement, no passage, no delivery.
No oxygen, no glucose, no hope?
A fire begins to burn at the blockage site and starts to spread…

It's the sign the microglia were waiting for.
They awaken, and the change begins,
Small bodies start expanding.
Limbs become short and thick.
Ready for action!

But not all microglia want to fight the flames.
Some add fuel to the fire.
Pro-inflammatory cytokines are the weapon of choice.
Yes, that'll do the job.
They look on as the brain begins to burn.

Wait… all is not yet lost!
The flames can still be overcome!
A new band of microglia have come to save the day!
They release anti-inflammatory mediators,
And fight tirelessly to restore, repair, and replenish.

But the clean-up is long, and arduous.
Engulf the dead, the dying, and the weak.
New cells, new vessels, and new hope!
The fire has finally been put out.
Until next time…

Scientific Statement

The author drew inspiration for this poem from her own scientific research in the field of ischaemic stroke. Duality explores the opposing roles of microglial cells, which become activated after a blood clot within a brain blood vessel leads to a stroke. Microglia are small cells that are found within the central nervous system and act as immune scavengers. At rest, they survey the brain's environment, and become activated when they detect any neurotoxins, or dead/dying cells. Activation leads to a change in morphology, where microglial cells become spherical in shape, and their processes thicken, and shorten. They are then able to engulf the potentially harmful substances to remove the threat and protect the brain.

However, there are elements of ‘light and shade’ in the role of microglial cells following a stroke - a concept which is examined in this piece. Microglial cells can adopt one of two different activation states — the M1 or the M2 phenotype. In the early phase of ischaemic stroke, activated M1 type microglia release cytokines, which promote neuroinflammation, and contribute to brain injury. In the hours and days following the stroke, activated M2 type microglial cells, act to promote brain repair, by releasing neuroprotective factors, which aid the recovery and repair of brain tissue and promote the formation of new blood vessels. The conflict between the two microglial activation states is explored as their opposing responses to a fire breaking out within the post — stroke brain. The accompanying image, drawn in charcoal by the author, represents the activation of microglia within the ischaemic brain after stroke, and was inspired by a photomicrograph from one of her research studies.

PhysiOdyssey · 2026 · Vol 2, No.1, pp. 4-12
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Coagulation Chaos

By Sophie Menzies

It's Garry's first day as head of Essie's haemostasis team, where he's stationed in the clotting command centre alongside Phil and Flo. Phil is Garry's seasoned mentor who keeps him on track when coordinating the coagulation cascade — sometimes with guidance, often with sarcasm — while Flo, chief of surveillance, keeps Garry up to date as the cascade rolls out.

Garry is already being put to the test when Essie takes a tumble and cuts her knee. Now, he's frantically trying to manage the team to successfully conduct the coagulation cascade. However, this involves tight regulation of everyone involved, from vitamin K and platelets to all twelve — give or take — clotting factors.

Will Garry be able to contain his inner frenzy and produce a successful clot? We join him to experience his management firsthand, as well as the rollercoaster of emotions he faces as the chaos of coagulation unfolds.

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It's happening. Stay calm. I can't believe this is really happening and on my first day! I'm screwed! No, there's no time for this flapping about in a panic, pull yourself together. First, we have to — dammit, I can't think! What comes first again?!

"Earth to Garry," says my mentor, Phil, his voice dripping with sarcasm, "Essie's bleeding out here."

"Right! Sorry! Alright, let me think, first step is to… constrict the blood vessel! We need to squeeze the blood vessel walls to slow down the bleeding. Activate vasoconstriction!"

"Vasoconstriction confirmed," Flo reports. "Blood flow is reduced'.

"Can we now confirm collagen fibres are exposed at the site?"

"Confirmed," nods Flo.

Good, that means the platelets have something to stick to — we're getting there…

"Alright, Platelets, you're up." The platelets team is keen to get going. "Get down to that vessel and stick to those collagen fibres!" And off they go.

Those platelets really were chomping at the bit.

"You might as well just send Von Willebrand down too," Phil says, "The platelets get cranky if they're left waiting around."

"Oh yes, good idea," I nod, "Von Willebrand! Quickly! Go with the platelets please. Don't keep them waiting!"

"Can't forget about Von Willebrand now, can we Garry?" Phil chuckles, "Who else would bring the collagen fibres and platelets together to form that all important plug?"

He is right, that Von Willebrand factor is quite significant!

"Platelets confirmed on site, Garry," Flo interrupts, "They've made contact with the collagen fibres."

"And Von Willebrand?'

"Not quite yet."

"But we have to meet the 30-to-60-seconds-after-injury target! Where are they?"

"Garry, it's barely been one second," Phil quips, "Just be glad Essie has Von Willebrand Factor… you know it'd be a nightmare without it. Also, I think the name for that target needs a rethink."

I can't even imagine it. No Von Willebrand?! The thought makes me shudder…without that, even minor bleeds would take ages to stop. However, I do agree — the target name needs updated.

"Von Willebrand present on site, Garry," Flo interrupts, not a moment too soon, "Platelet plug confirmed to be forming at the location of vessel damage".

"Finally! That's fantastic," I say, relieved, "We're officially over the first hurdle, folks."

Now it's time for the big task. This is going to be pure chaos; how will I manage this?! No… focus… we just have to get the fibrin fibres there so we can mesh them and form the clot. Easy… totally fine… definitely not complex at all.

"Garry, wakey wakey," Phil teases. "Are we stemming this bleed or having a crisis?" he jabs.

"Sorry! Alright! Flo, we're going to need all hands on deck — Essie's fall has damaged both the vessel and nearby tissue, so we need the intrinsic and extrinsic pathways ready to go."

"I've put an alert out," Flo replies, "All clotting factors are on standby and ready when you are, Garry."

"Great, thank you. So, we'll start with getting the extrinsic team moving. That means we need our Extrinsic Pathway Initiator — Factor 7 — to the vessel please! Oh, and Thromboplastin will meet you there for activation."

"On my way!" Factor 7 calls back.

"Now for the Intrinsic Initiator. Factor 12! Time to head down to the vessel! Let us know when you make contact to confirm your active form, please!"

"Will do, boss," Factor 12 replies as he vanishes to the coagulation site.

Both pathways have now been triggered; this is a good start. I just hope all the clotting factors are as eager as our pathway initiators…

"Factor 7 has met thromboplastin at the site, Garry," Flo reports, 'We can confirm his activation to Factor 7A".

What a relief!

"And, just in, Factor 12 has reached the site and made contact with the damaged vessel, he is confirmed to be in his active form, Factor 12A."

"We're on a roll, Garry," Phil remarks with a hint of pride.

"Don't jinx me, Phil!" I warn, "There's still much to do."

There really is a lot that can still go wrong… Before I forget, let's get the liver on the line.

"Vitamin K, are those clotting factors rolling off the production line?"

"Yes, sir! Quality control is up and running!"

"Great! We now need our intermediate factors of the intrinsic team to head down; Factor 11, you're up! Factor 9, you better get ready to go, too!"

"I'll be ready to go, Garry," Factor 9 informs. "We just need slow coach here to hurry up and get down there," she teases Factor 11 as he heads to the site.

"We should have an intermediate factor race one day," Phil ponders to himself.

"Not on my first day though, Phil," to which Phil chuckles.

"Factor 11 confirmed at the site," Flo updates, "He has made contact with Factor 12A which has activated him to his Factor 11A form."

"Oh, he was speedy today," Factor 9 giggles, "Ready for me to go, Garry?"

"Yes!" I say, "Get down there quickly and then we'll send the others for the converging of teams."

"Sir, yes, sir," she calls as she exits.

"Well, would you look at that, things are going well," Phil drawls.

"He's right," Flo chimes in before I could tell him not to jinx me again.

"Factor 8!" I call, "Time to go!" And she appears, ready to go. "Calcium, that means you're up too!"

"I know, I know," he says, trudging along behind Factor 8, "The body doesn't half work me overtime, you know."

"Stop moaning!" Phil calls out, "We get it, you're involved in everything, you're very important, and that includes now! Come on! Off you go, time to get some complexes forming."

"I hope Garry's replaced you because you're retiring, Phil!" Vitamin K chimes in mischievously, still on the line.

Flo and Phil laugh.

"They know they'd miss me" Phil chuckles.

"You're not retiring any time soon, ok!" I warn him somewhat desperately.

Have I missed anything? Factors 12, 11 and 9 from the intrinsic team are at the site and activated, and Factor 7 on the extrinsic team is activated too. Factor 8 is heading to the site now with calcium, which means the clot is on track.

"Factor 8 is on site," Flo reports, "Calcium's there too — it's locking 7A to thromboplastin to form the extrinsic tenase complex, and after he'll link up with 8A and 9A to form intrinsic tenase."

"Amazing! Amazing!" I squawk, unable to disguise my relief, "We're getting there, folks, we're forming a clot!" I'm almost singing the words.

"Don't jinx it!" Phil teases, smugly.

"Oh, shush." Flo directs her words at Phil, then says, "You're right, Garry. You're doing well, we're about halfway to success now."

"Yes, and still half to go," I redirect, "Including the big convergence of the intrinsic and extrinsic pathways."

"Before that," Phil interrupts, "Remind me again why exactly we need Vitamin K on the line."

"Seriously? You think now is a good time for a quick quiz?"

"Of course,' Phil replies, "Easy question, no?"

I groan. "Vitamin K modifies some of the clotting factors so they can bind with calcium; that way, they anchor to the platelets, where the clotting teams assemble."

Phil grins. "Top marks, Garry. Excellent answer."

"Anyways…Flo, what's the latest?" I ask.

"Both complexes of the intrinsic and extrinsic pathways have formed — we're set to proceed, Garry."

"Phew, ok." I take a breath. "Time for convergence."

Please go smoothly.

"Better shout the big man in, Garry," Phil says, doused in sarcasm, "Time to let the top dog shine."

Both Phil and Flo groan. *It's not often factors get nicknames like this, but when they do, it's rarely a compliment….*

"Factor 10!" I call out…. "Factor 10! You are up — time to go!"

Phil scoffs. "Ill-prepared as always…."

"This cannot be happening. He's going to screw the whole thing up. Where is he?! This is his one job!"

What am I supposed to do without Factor 10?! This is a nightmare, we're screwed!

Finally, the door swings open.

"You called, boss?" Factor 10 says, nonchalantly.

"Unbearable," Phil mutters to himself.

"Yes, I did, Factor 10. I called on you multiple times."

"Relax, Gazza," he drawls, "The star of the show is here now, isn't he?"

If he weren't so necessary to this process, I would fire him right now.

"Would you please just hurry up and get down there? Everyone is waiting for you to converge the pathways," I say sternly.

"Ok, ok. Chillax Gazza, all will be fine," he says as he saunters off to the site.

"Chillax? Is he for real!?" I exclaim to Phil and Flo.

"He needs a serious talking to," Phil remarks.

Flo nods in agreement. *And who said he could call me Gazza?!*

"Right, moving on. Could we get some more calcium to the vessel site please, along with Factor 5 and Prothrombin?" I call.

"Of course, boss. We can't keep the top dog waiting for his big job, can we?" they joke, sarcastically.

"I might start calling you Gazza," Phil perks up.

"Don't start!" I snip.

"Factor 10 is at the site, Garry," Flo updates.

"Finally," I groan.

"Factor 10 is activated. Calcium and Factor 5 are confirmed on site and Prothrombin is just arriving."

"The pathways have become one, Garry," Phil announces, both smugly yet sarcastically, "Closing stages coming up."

Final phase… I've almost done it. I just have to get prothrombin converted to thrombin, which will be done by Factor 10A teaming up with Factor 5A and calcium. Then it's just converting fibrinogen to fibrin and — wow, we really are almost clotted.

"Factor 10A, Factor 5A and calcium have made contact with prothrombin, Garry," Flo updates, "I can confirm prothrombin has been converted to thrombin."

"Excellent!" I squeak, "Fibrinogen! Get down there! Oh, and don't forget to take some calcium with you, you'll need it for the stabilising phase!"

"On our way, Garry!" Fibrinogen replies, hurrying to the site.

"She'll get down there in no time, Garry," Flo adds, "And she'll make sure calcium keeps up with her."

"I remember the days when Prothrombin and Fibrinogen were called Factor 1 and Factor 2," Phil reminisces, "We said the new names would never stick. Now look at them."

"Fibrinogen has arrived at the vessel," says Flo. "Thrombin has now converted her to Fibrin."

"This is it, Garry. The final step!" Phil declares with mock drama thick in his voice.

I cannot believe I've made it to the final step. We're going to form a clot!

"Last but not least — Factor 13, our finale factor, you're up!" I call out, giddily.

"My time to shine, eh?" she teases as she leaves.

"This wait is going to feel like forever," Flo says.

I was just thinking that.

"We could do another quick quiz to kill time, if you wish?" Phil suggests, his tone deadly serious.

"Please, no!" I plead.

"Sure you don't want to discuss our clotting command centre regulators, Protein C and Protein S?"

"Oh, I'm very sure — that's a different department's concern," I say, bluntly.

"Garry," Flo interrupts, "Factor 13 arrived on site. I can confirm fibrin fibres have meshed, and the clot is cross linked."

"We have a clot!" Phil grins.

WE HAVE A CLOT!

"You have successfully clotted off Essie's bleed, Garry," Flo says with pride.

"Essie will live to see another day then," Phil jokes.

"You just always have to ruin it," Flo jabs, and they continue their friendly bickering as Garry absorbs his triumph.

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Full of pride, Garry finishes his shift that evening on a high, unable to help reminiscing about his successful clot. As he's leaving the command centre for the night, he bumps into Factor 13.

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"Oh, hi Garry! That was quite the first day you had," Factor 13 says.

"Tell me about it — definitely not what I had in mind," I chuckle.

"Shame it was all for nothing too," she laughs.

What?

"What do you mean, 'nothing', Factor 13?" I ask, trying to contain my concern.

"Oh…" Factor 13 pauses, "You don't know?"

Don't say what I think you're going to say.

"I'll take that silence as a no…" she says quietly.

Please don't say it.

"Well… um… unfortunately, Garry…"

No.

"Essie… well… She picked the scab."

You have clot to be kidding me!

Scientific Statement

Haemostasis is an essential physiological process for stopping bleeding after blood vessel damage. Platelets, clotting factors, calcium ions, and supporting proteins circulate continuously in the blood, ready to mount a rapid, coordinated response to seal an injury and

stabilise the developing clot. The concept of the control team characters is used for creative purposes only, to make the process of blood clot formation engaging and more accessible.

Following blood vessel injury, the first response is contraction of tiny muscles in the vessel wall to reduce blood flow. The vessel damage causes exposure of collagen fibres which circulating platelets bind to, aided by the protein von Willebrand factor.

Alongside this, clotting factors activate each other in a coordinated sequence, eventually producing thrombin, an enzyme which converts fibrinogen into fibrin threads. These threads weave through the platelets which have become bound to the damaged vessel, allowing for formation of a strong, stable clot to seal the injury. Calcium is essential to ensure clotting factors work effectively, and vitamin K is needed earlier in the liver to prepare several of these factors so that they can bind calcium effectively.

Clotting factors are typically described using Roman numerals; however, Arabic numbers were used in this story to improve ease of understanding. While clotting is often taught using the classic intrinsic and extrinsic pathways, we now know these function as an integrated system. The classic understanding has been used here to support the narrative structure.

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Anatomical manuscript predicts physiological truth

By Jane Flint Bridgewater

Renaissance man discovered three dimensions,
light and shade turned line to curve and form.
Verrocchio and Maria Nuova
watched in awe a human foetus drawn
from tragic destiny, maternal loss.
Words tumbled down the manuscript like red
black tears streaming from a heart set free
which had no certain bed beyond the organ
until Harvey's day. Villous debris
inspired imagined nourishment of life.
Quantum microtubules not yet foreseen,
but function indicated by this strife.
God gave the genius beauteous role,
in light of truth to trace the human soul.

Scientific Statement

An exhibition of Leonardo da Vinci's drawings at Queen's Gallery in 2012 stimulated this sonnet, admiring the accuracy of anatomical detail despite the lack of appreciation of the physiology of circulation, nutrition and neurophysiology at the time. Such perfect documentation inspired broad understanding of the former two, but a recent study has controversially suggested a quantum basis for consciousness based upon micro-tubular function.

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The Prometheus Thesis

By Steven Campbell

Isla Muir was dying. Not metaphorically, not existentially, but cell by cell, gene by gene. Dying in the most literal, finite sense of the word. The osteosarcoma had advanced beyond the spinal barrier, devouring bone like it knew her name. Chemotherapy had failed. Palliative care was a whisper wrapped in morphine. Twenty-three years old and scheduled for nothing but a quiet, lucid end.

But Isla had other plans.

Her doctoral thesis had been formally rejected by the university's ethics board before it ever reached a defence. Officially, she had claimed to be working on tissue engineering and regenerative medicine. Privately, in encrypted folders hidden from institutional servers, the real title remained: Subjective Continuity Through Embodied Rebirth: A Proof-of-Concept in Human Regenerative Substrate.

She called it the Prometheus Thesis.

The basement beneath the abandoned biomedical annex at Foresterhill was where she built it. A bioreactor stolen in pieces from three separate laboratories. A CRISPR-Cas9 gene editor modified for real-time response inside living cells. A printer that worked not in plastics but in hydrogel, seeded with pluripotent stem cells suspended in nutrient-rich media.

She began with herself. Buccal swabs. Bone marrow aspirates. Blood, hair, skin. Sequencing her genome took days. Correcting it took weeks. Mutations were identified and digitally excised. Structural weaknesses were reinforced. Cancer-linked regions were removed and replaced using comparative methylation patterns drawn from species with exceptional cellular repair: whales, deep-diving bats, salamanders.

Next came the scaffold. An anatomical replica of her body, printed layer by layer inside a nutrient vat. Not a clone, not exactly. A body grown from a corrected blueprint: her ideal, pre-morbid self. One that had never known pain. A biological blank slate.

The brain was the problem.

Isla's consciousness could not simply be copied like data from a drive. Her living brain, ravaged though it was, had to be mapped in active function. She used an optogenetic lattice: neurons genetically altered to respond to light, allowing their firing patterns to be tracked with extreme precision. Lasers pulsed through the transparent cranial array, forcing her neural circuits to reveal themselves in sequences of colour and timing.

This was the stage that nearly killed her. Days passed in seizure-like states as her cortex endured constant stimulation. Her thoughts fragmented under photonic stress while terabytes of synaptic activity were recorded, neuron by neuron, pathway by pathway.

From this emerged what she called the N-Ego Construct: a compressed schematic of identity, memory, and neural structure. Not thoughts themselves, but the architecture that produced them. The Construct was stored in a polymer-based nanomatrix, capable of interfacing with living tissue.

Finally, she initiated the transfer.

The room pulsed with electromagnetic current. The artificial body floated in its amniotic gel, twitching faintly under stimulation as neural tissue matured. The Construct was uploaded into a cortical implant embedded deep within the new brain's thalamic relay centre, the region that coordinates sensory input and conscious awareness.

Activation occurred through controlled synaptic ignition: patterned electrical signals designed to reproduce her original neural firing order. Her old body, riddled with tumours, convulsed under sedation. Her last breath came not with fear, but calculation. Isla closed her eyes. Released the trigger.

She awoke.

Not gasping. Not screaming. Her first breath was controlled, deliberate. Her first thought: I'm alive. But something felt unseated. Her limbs responded too smoothly. Her heartbeat felt distant, as if borrowed. There was no pain, no fatigue. Her memories arrived in fragments: her mother's voice before her own name. Her coursework. The ethics rejection. Her diagnosis. Her decision. Her death.

The room was silent.

Her old body lay still in the surgical chair. Hollow. Sunken. Eyes closed, lashes resting against colourless skin. She approached it. Her former self. Was this me? she wondered. Is this now mine?

The Construct had transferred. But not entirely. Something had been lost in translation. Emotional tones were blunted. Sensory meaning slipped from memory. Music no longer stirred her. Childhood recollections floated free of warmth or fear.

She understood then:

The body was perfect.
The mind was accurate.
But the soul was gone.

She buried the old body beneath the dunes at Aberdeen Beach. No ceremony. No stone. She walked the shoreline in silence, waves brushing against feet that had never walked before. Behind her, in the hidden lab, the bioreactor still hummed. The CRISPR device blinked in standby. The scaffold printer had another sequence queued.

Isla Muir had returned.

But something else might have come with her. And something had stayed behind.

Scientific Statement

This story is inspired by Mary Shelley's *Frankenstein* and reimagines its central idea using contemporary science rather than nineteenth century electricity and anatomy. While the act of resurrecting the dead remains firmly within the realm of science fiction, many of the tools and concepts referenced in the narrative are drawn from real, ongoing research in modern biology and medicine.

Several real scientific technologies form the foundation of the story. Gene editing techniques, particularly CRISPR-Cas9, allow scientists to cut and modify DNA with high precision. This technique is already being used experimentally to correct genetic diseases and study how genes function. As demonstrated by Dolly the sheep in 1996, it is possible to create a genetic copy of an organism from adult cells. Although cloning humans is illegal and ethically prohibited, it makes for a great narrative idea. 3D bioprinting is another real technology, in which living cells are layered to form simple tissues such as skin, cartilage, and blood vessels. Scientists hope this will eventually allow replacement organs to be grown for transplant patients. Optogenetics is a neuroscience technique that uses light to control the activity of genetically modified neurons, and is currently used in laboratories to study how brain circuits

work. These technologies represent genuine scientific progress and provide the realistic framework for the story.

The narrative also references more speculative ideas. Consciousness scanning, the ability to record or copy a person's mind, does not exist in real science. Although brain imaging can measure electrical activity and identify regions involved in memory or emotion, there is currently no way to capture thoughts, identity, or personality in a transferable form. Similarly, the story's central conceit (Prometheus's Thesis), creating a fully healthy version of a person in a new body and transferring their consciousness into it, moves beyond current science into science fiction. While damaged organs can sometimes be replaced and genetic defects edited, there is no method to rebuild an entire human body or restore life once biological death has occurred.

The aim of this story is to imagine what might happen if real scientific tools were pushed to their theoretical end point. By grounding the narrative in existing technologies such as gene editing, cloning, and tissue engineering, the story attempts to feel plausible, even as it crosses into speculative territory. The gothic horror element lies not in the machines themselves but in their consequences: the ethical, psychological, and social implications of using science to redesign the human body and identity.

In this way, the story mirrors the function of Shelley's original novel for a modern audience. Where *Frankenstein* reflected contemporary fears about galvanism and anatomy, this version reflects present-day anxieties surrounding genetic engineering, artificial life, and the boundaries of medical intervention. The science provides a credible framework, while the act of transferring consciousness and recreating a person remains a fictional extension used to explore themes of mortality, responsibility, and what it truly means to be human.

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Psoas: The Tenderloin

By Xinyi Jiang

What to do with this lean meat
a fancy name a prime price tag

a mignon cushion of little tendons
between kidneys and ribs

a lesser force of tear free from
contractions for locomotion

waxy fats to saturate our hearts
as cooped-up cross-bred

quadrupeds fatten on
concentrated soy and corns

that promise marbling flecks
to sizzle on pans melt on tongues

What to do with the pair of sixteen-inch
muscle of the soul from our deepest core

tapering along spines to groins pelvis femurs
joining torsos to legs

billions of cells fire up for bipedal moves
shortened hardened inflamed

by age weight junk food sedentary lifestyles
stressful jobs toxic relationships

that tie us in knots freeze us in foetal balls
compress our nerves restrict our diaphragms

keep us sore and stiff afraid and confused
forgetting who we are

Scientific Statement

Psoas tenderloin refers to the psoas major muscle, which connects the lower spine to the thigh bone (femur) and is crucial for hip movements. It is fundamentally the same muscle in animals and humans, though in cattle it performs relatively low-load locomotor work, contributing to its exceptional tenderness and leanness. Its culinary value can be further influenced by selective breeding for intramuscular fat (marbling).

In humans, the psoas is sometimes known as the muscle of the soul. It is a deep core muscle that plays a role in keeping humans upright. It has been described as embodying our survival instincts and primal urges, and contracts as part of a whole-body response to stress. Persistent muscle tension can contribute to chronic back and core muscle pain, as well as altered movement patterns. The psoas is often associated with back pain, tight hips and poor postures. Research also suggests psoas health may be associated with Alzheimer's disease.

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Mycelium

By Eilidh S M Eglinton

Dr Adlington skimmed the paper she was preparing for submission to *Medical Advances.* Merely checking for typos at this stage. She was confident that the data spoke for themselves — no statistical spin required to prove significance, this time.

Of course it had already been scrutinised, scoured, checked and counter-checked. Everyone in the department wanted in on this one and it was going to be a long list of authors. Adlington *et* quite lengthy *al*. She had both the alphabetical and authoritative advantage this time. Not that it was about her name. No, of course not. This was for her grandmother, and each patient she had seen over the years devoured from the inside, brain matter lignified, pock-marked, burrowed and punched-out by plaque or ischaemic attack. This was for the flourishing of humanity.

She looked again at the beautiful Kaplan–Meier chart, whose filamentous threads did not merely plateau (best hoped-for outcome) or diverge into varying gradients of decline (best expected outcome); but — astonishingly, and she had never seen this in any other trial —up-tick and climb, within mere months, even to surpass baseline IQ. It was staggering. And with only a handful of major adverse reactions (immune rejection leading to death) and fewer than five percent minor side effects in the two thousand trial subjects, few could argue against the risk-benefit balance and cost-effectiveness. That this would be the greatest medical advance of the past century was beyond doubt.

There she was again, getting ahead of herself, distracted with what could be. It was hard not to envision the prizes and plaudits that must follow. Further safety data beyond the current stage 3 trial would, of course, be a matter of time.

There. A final typo. People were always misspelling her name: Addlington.

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Mayu Matsumoto was sixty-three — the age at which her mother had started forgetting. First her PIN pass, then security number. Then where she was going. Then where she was. Then

words. Her children's names. Her own. Finally, her swallow. Then she had been returned to the earth — material reclaimed, spirit released.

Mayu was even younger when she had started forgetting. Genetic *anticipation* they called it — without irony — the earlier onset of increasing severity with each generation. She could anticipate the attrition of her own mind, even before she noticed the first symptoms: the mis-spliced sentences; familiar words sinking under the surface; imposters resurfacing in their place.

She had had confirmation of her gene carrier status a few years by the time she was invited to participate in the trial. She was aware of the myco-anthropogenetics department at the Biosphere as a leader in neuroregenerative research from when her mother had donated tissue samples to an earlier study. The invitation did not come without stark warning of the risks of first human trials — although the mouse trials had been reassuring so far — and had emphasised that due to double-blinding, she would not even know whether she would receive the new therapeutic or a placebo. But what was there to lose, that she was not already expecting to lose? She owed it to others affected by this unrelenting gene; she owed it to her son.

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The administration had been effortless — a pressurised puff to the roof of her nose through a fine white silicon tube, which she had barely felt. Afterwards, she felt so little difference she felt sure she had received the placebo, of saline or some other innocuous solution. Although prepared for that possibility, she nevertheless felt twinges of disappointment, mixed with tugs of relief, amidst a prevailing sense of resignation. She carried on as usual, to await her follow-up scans and serial cognitive testing.

At her first follow-up, she reported no change in symptoms. She could not view her cognitive results, nor see the team raise optimistic eyebrows at the two-point difference in word-finding speed and improved reaction times. She glimpsed them through the window as she came out of the scanner, clustered around the monitor, trying to maintain neutral expressions. All she was told as she was ushered out was that there had been 'no deterioration', which was a relief, at least.

The changes came gradually but more noticeably after that: she found her daily puzzles easier and achieved a new Tetris level week by week. She started organising her decades-cluttered flat with new energy. She discovered an old painting set which had waited patiently,

aspirationally, to be used. First studies, then work, then caring duties for her son, then latterly for her mother, had prevented her from ever taking up the brushes; and perhaps, if she cared to admit it, a reluctance to find that, after all, she had no talent for painting.

She unscrewed the lids, pierced the silver circle of yet-unbroken tubes, and squeezed a streak of the primary colours onto the pristine palette. The paint had separated a little into oil and sludgy pigment but mixed easily back together. The colours were so vivid they almost sang to her. She sat down at the table, picked up the cheap nylon brush, and fluidly sketched out the peonies in the vase in front of her. She was quite pleased with how she captured the dimensions and textures of the blowsy petals — effortlessly, intuitively, though yet imperfectly. Acceptable, for a first attempt — she might even frame it.

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A year later and, though the results of the trial had not been announced, she was beyond doubt that, whatever she had received, it was working. Decline was no longer inevitable. She felt good about life, which had a new vibrancy. Even food tasted better (if she ate in the right places) and she could discern subtleties of flavour that she had not appreciated before. Umami and earthy notes would ground sweet florals, weaving alongside hints of citrus, which all together danced in a scintillating kaleidoscope on her mind. Some flavours she had no name for, although new words suggested themselves to her.

November came round with a spell of unseasonable warmth. Today's weather took her back to her childhood summers — before the gulf stream had shut down with its complementary current of warmer air, and temperatures had occasionally hit as high as twenty. Perhaps it was a harbinger of yet further cycles of climate change, but today she would enjoy it. The honeyed breeze carried hints of heather and moor from the Pentlands, recalling old happinesses, and it occurred to her that a walk in the hills would give her just the right vantage point for painting the light on the city on this amber day.

She settled on Allermuir, easily accessible by public transport, and set off on the path kept freshly trampled by nature-walkers. At the foot, some blossom trees were duped into an early spring. As she walked on, although the colours were autumnally muted, the crisp light glazed them to a renewed sharpness. Some red-capped mushrooms buttoned the bright bracken. As she climbed, she noticed some winged ants emerging from peppered holes in the bank, and before long both the ground and air were seething with them, their silvery wings catching in her silvery hair.

Next she noticed some flashes of white darting among the heather, which confused her — could it be a stoat, a little early with its winter coat? But as the heather thinned, she realised it was a mouse, which, now that it was out of cover, seemed unnaturally nonchalant and unafraid. It tracked along at a few metres distance, occasionally pausing to sniff, then darting onwards.

It was not a high hill and within half an hour she had reached the trig point, where she stopped to open her flask and set up her paints. She took in the panorama, the low sun highlighting the foreshortened city. To the north-west, the Forth Bridges: the rail bridge, once lapped by perpetual paintbrushes, now lapped by perpetual waves, glowed a rusted red. The elegantly engineered rigging of the road bridge stood proudly behind, like a semi-submerged tall ship, its white bones gleaming a coral orange-pink. Against the russet-brown scrub of the hill, the colours chimed in her mind as a pure piercing harmony. She picked up her squirrelltail brushes and started to paint.

Absorbed in her painting, she could yet sense activity around her. The flying ants gathered on the warm side of the trig cairn behind her back. The white mouse that had tracked her up the hill had nestled in next to her leg. Soon, a few new white mice had scurried to join them, then quietly curled up to sleep. They had not gone unnoticed by a circling buzzard, which hovered uncertainly at a distance, perhaps deterred by her presence. She felt at one with all around her — with the light, with the mice, with the buzzard, with the ants.

She stroked the mouse's head between its ears, her little finger caressing the plush tissue of fur, and beneath it, the malleable shell-fine skull. She could almost discern each silky white fibre. Running her finger over its ear, she noticed a firmer clump, almost rubbery, villous. She looked down and saw from its ear a growth, white as its fur. A tumour, perhaps — which might explain its unusual behaviour. She continued to stroke her (she felt sure it was a *her*) in sympathy, and as she did so a fine white puff dispersed into the air. Catching the light, it shimmered faintly, barely perceptible, as it hovered in a halo above the mouse's head, which had now stilled. With barely a movement of her own head, her attention expanded to perceive the same soft glow, a talc-fine haze lingering above the other creatures around her — the mice, the ants. She observed this strange phenomenon not so much with curiosity as with an absorption of its beauty; with peace. As she did so, she felt her own consciousness drift above her, released, dispersed into the evening light.

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Dr Adlington stood on the platform, which was really the floor of her office, and scanned the crowded virtual room: journalists with DictAi at the ready; global academics eager to glean details of techniques to mimic or reproduce; jostling entrepreneurs; even that controversial billionaire, curiously un-aged, although he must have already reached his fourscore and ten when she was a child. Word had clearly got out.

She felt a little clammy, especially under the sweaty band of the headset. Despite the ultralight design, it put uncomfortable pressure on her temples. She acknowledged that pre-presentation nerves — especially to such a significant audience — may have something to do with it. It also happened to be unseasonably warm.

There was a clamorous chatter, not often heard at remote — room events, which was reminiscent of the in-person conferences that she had attended in her early career and signalled the excitement and interest of the audience. Everyone muted as she took the lectern. She opened with her well-practiced script.

"Mycelium: in the nineteenth century, it solved the greatest medical problem of the day: from the petrie dishes of Alexander Fleming were built the pharmaceutical giants of that age. Life expectancy was transformed. So too, now, it has come to solve the most intractable confounder of medical progress of our age, which, in the intervening century, advances in other fields have only served to propagate.

You are all aware of the monoclonal antibody technologies that offered some early hope, but for most merely delayed the inevitable decline by a year or two, and not without cost.

Many of you will know that over the last decade we have been pioneering myco-anthropogenetic therapies, with encouraging results in laboratory and animal studies. Today, I present to you the exciting outcome of the first human trial, which promises to revolutionise healthcare, to enhance humanity…"

She paused to take in the murmur that she could see, rather than hear, ripple around the room, as the strands on the animated Kaplan-Meier graph spread across her screen, infiltrated their minds.

Scientific Statement

Mushrooms have long been known to have medicinal and psychoactive properties. There is growing research into new applications in medicine, from psilocybins for the treatment of depression in patients with terminal cancer diagnoses (Griffiths et al., 2016), to the cognitive enhancing properties of Hericium erinaceous, commonly known as Lion's Mane, as a treatment for dementia (Mori et al., 2009). In vitro studies have explored the ability of bioactive compounds from Lion's Mane to stimulate the growth of damaged peripheral nerves via nerve growth factor (Ma et al., 2010). Simultaneously, electronic technologies such as Neuralink are being developed as potential therapies for neurological disorders (Musk, 2019).

This speculative fiction weaves together these strands and asks, what if there were an organic solution that could achieve what is being attempted by brain-machine interface technology, yet more elegantly? Mycelium is the often-subterranean fungal hyphal system that allows communication between plants and trees across distances and species. What if these cell-fine, invisible, infiltrative networks could be made compatible with human tissue through chimeric gene-editing technologies, to symbiotically repair damaged neurons?

The story borrows ideas of mutualism and symbiosis, where species coexist to benefit one another to the point of co-dependence — for example ants benefiting from farming fungi — and of parasitism, for example Ophiocordyceps invading ant bodies to control behaviour and promote spore dispersal (Trinh et al., 2021).

The end of the story is left open to the imagination of the reader: Has Mayu's mind become entwined with a coordinated, fungal consciousness, along with the mice, ants, and other study participants? Or has she died, having enjoyed a few good years of life, rather than suffering decline? Or has she simply had a psychedelic experience? And will this new technology be seized on by those eager for self-enhancement, without yet having awareness of the long-term consequences?

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Critical Care

By Max Mulgrew

An impossible place to wake –
sulphurous light, a devil in my throat,
a boiling sea of beds.
I was someone drifting, afloat

on steaming oil, past hawsers and bollards,
sepulchral docks, cranes and ships,
monitors, chest drains, arterial lines,
pacemaker wires, catheters, intravenous drips.

I heard a nurse shout 'oh God, no'
and the team flooded round
a drowning mermaid I would never see.

Scientific Statement

I awoke from an induced coma in a critical care unit following lengthy open-heart surgery to replace my faulty aortic heart valve. The ventilator tube was still in my throat, and I had multiple lines and tubes inserted into my body. My heart had been stopped during surgery, so I had been chilled and attached to a heart by-pass machine to protect my vital organs.

Patients who undergo open-heart surgery, particularly for valve replacement, frequently suffer post-operative delirium (POD). While POD is most prevalent on the first day after surgery, it may start later and may last several days. It can affect the patient's recovery, may lead to longer-term problems, and is associated with a higher rate of mortality.

While suffering delirium, I was in a huge gymnasium that seemed to go on forever, then at endless Liverpool docks (to which I have no connection), with doctors looking down at me under industrial lighting. There were no windows, and I became obsessed about time so a big clock was hung by my bed to appease me, but I still did not know whether it was nine o'clock in the morning or nine o'clock at night. The risks of suffering POD are increased by prolonged heart-lung by-pass during surgery, blood transfusion, induced hypothermia during surgery,

and the conditions in the critical care unit, which can make it difficult for the patient to know whether it is day or night.

As I lay there, I heard a shocked nurse's words as she realised the woman in the next bed had pulled vital tubes out of her body. It was an understandable reaction from a dedicated medic who was caring for critically ill patients. I learned later that the patient I never saw had died.

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Doomed Sisters

By Sofia Blueman

She sat in a small room. It was dark and damp, but warm. The air smelled of blood. The girl had grown used to it — the darkness and the metallic tang. A lot of time had passed, probably a couple of days. The shaman would come soon.

Or maybe he won't come. The test wasn't over yet. Perhaps she could still be reborn. The girl hugged her knees. Time slowed down and sped up, but nothing happened. In the complete darkness, all her senses were heightened. But here it was useless. No matter how hard she tried to hear something, there were no sounds around. Only the smell of blood. And fear. It thickened around the girl, took shapes in the darkness, smelled of sweat. Sour, repulsive, sharp. All that was left was to wait. And pray that the Goddess would hear.

"Hear me. Please. I hope for your favour. Choose me, please, choose me. I am strong and healthy. Choose me."

The girl addressed the Goddess again and again. What else could she do in a tiny room with nothing but walls? Only pray, think, and remember. She remembered the first time she saw the shaman. She had been a little girl. He stood there — heavy, powerful. He smelled the same as this room — blood. The shaman talked about the Goddess and the test, his voice vibrating low under the ceiling of their house.

"Do not be afraid, you all will go through this. The test is an honour. This is the only way you can make a sacrifice to the Goddess. We all live to serve her. Accept your destiny."

She heard these words many times after, but that first time stuck in her memory. It felt like everyone knew some big adult secret but had been afraid to say it out loud. Until then.

All destinies are predetermined from birth. The villagers, the sisters, and the shaman — they all know this. The Goddess gives them life and purpose. They laboured for her: feeding, protecting, serving. She was the limit of everything and the meaning of life. Or death.

Some resisted. From time to time, someone argued with the shaman, refused their destiny, or tried to escape. All of them were cruelly punished. Even those who simply stopped working. They were caught, brought to the shaman, and sacrificed to the Goddess. No one could argue with destiny.

The girl also accepted her fate. She was not the first one who entered the testing room. And probably not the last. Other sisters had gone there, too. But no one had ever returned. Everyone knew that this was the end. Unless the Goddess decided otherwise. They said she chose those who are capable of being reborn as a new Goddess. And each sister secretly hoped to pass the test. And those whom the Goddess didn't choose were sacrificed.

"You have to be strong. You have to be brave. Only the strongest will survive."

So the girl still had a chance. Others were less lucky. Half of the sisters died at an early age, never even reaching the room.

"Hear me. I hope for your favour." The girl began to sway back and forth.

She remembered the first time a sister was taken. It was a long time ago. She and her sisters had been playing in the shared house. Some were jumping on the beds, some were running after each other. There were shouts and laughter all around. The noise suddenly stopped when the shaman entered. He silently looked at all the sisters. Their reddish crowns froze in front of him like a rabbit frozen by the musky scent of a predator. A heavy gaze stretched from one to the other, slowly studying, looking right through them, reaching to their very souls.

Then the gaze stopped. The heavy figure silently approached one of the sisters and took her hand, not painfully, but the girl jerked in surprise as if she had been struck.

"Let's go, child," he said slowly. And he led her away.

And although everyone knew that this would happen, that they would have to go through a test and sacrifice themselves, no one truly believed it. The moment the girl realized they could take her away, too, hit like a falling stone. After that, the house was noisy with voices for days. Someone cried, someone screamed, and someone fell into silent hysteria.

The shaman came many more times. And gradually, the sisters came to terms with it. Sometimes, rarely, he would take two at once, and sometimes he would not appear for a long time. Someone said that there was a second house, and the shaman would take sisters from there, too. But the girl didn't believe it. Anyway, what difference did it make where they took you from, until it was your turn?

"I am strong, I am healthy. Choose me." The girl concentrated on her words. If you believe, then the Goddess will hear. She will hear.

A creaking sound came from the wall. Someone entered the room.

"It's her, the Goddess. She heard me, she came for me," the girl thought.

Excitement ran through her body, she couldn't get enough air, she wanted to inhale as deeply as possible, like before jumping into deep water. Could it be that she had passed the test and now she could be reborn? The sisters were right. If you prayed hard enough, if you asked, the Goddess would hear.

The girl felt warmth. The Goddess was standing very close. Now she would come and take the girl with her. The Goddess would make her reborn. A new Goddess. It was time. She passed the test. The idea warmed the girl like a spring heated by the sun. The darkness no longer frightened her. But the smell of blood had grown stronger.

"Choose me, I'm ready," the girl whispered, blissfully.

She moved towards the warmth, stretched out her hands. Her fingers were noticeably shaking, but it was invisible in the darkness. The girl's whole body tensed and leaned forward. She smiled, feeling the presence of the Goddess.

"It's time to go, child," the shaman's quiet voice called her.

The girl jerked. Her insides instantly contracted.

"It can't be! No, not him," she thought.

The girl pressed her hands to her chest. She stepped back, her legs buckling. The darkness around began to spin.

"No! The Goddess would hear me! Choose me, choose me!" Only one thought was racing through her mind, "Hear me. I'm healthy, I'm ready. Choose me!"

The girl began to pray again. She spoke louder and faster. There wasn't enough air, she swallowed it with the words. Beads of sweat slid down her sides and back. Like flies crawling on a piece of meat.

"It's time. Let's go. The Goddess will mourn you," the shaman's voice sounded closer. He was moving towards her.

"No! No, she will still choose me. I still have time. Come on, listen to me! Hear me! Choose me! Choose! I am healthy and strong, I'm everything you want, just choose me. Me!"

The girl screamed and cried until all the words merged into an indistinct "mmmmm-aaaa."

The shaman waited a little, stepped forward, and gently took her by the shoulder. He grabbed her firmly, but not painfully, and led her out of the room.

"Don't worry, child, it will all be over soon."

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A girl lay curled on the bed, her legs drawn up. She had been sick all day, she didn't want to eat or drink. Her belly twisted, like someone had wrapped her insides around a fist and was squeezing — then loosening, then squeezing again. Like waves, the pain came and went with a short respite, only to overwhelm her again. Her legs twitched with cramps. She felt nauseous. And sad. She even wanted to cry. Every month is the same thing.

But it's okay, a few more days and it will get better. It will all be over soon.

Scientific Statement

This story uses metaphor to explore menstruation and the physiological processes of the menstrual cycle, personifying endometrial cells as villagers undergoing ritual sacrifice. The girl, the egg (oocyte), is placed in the "testing room," which symbolizes the fallopian tube (oviduct) environment where the egg waits. Her prayers to the Goddess reflect the biological drive for survival, hope for selection, and the possibility of becoming fertilized.

Each month, multiple follicles begin to grow, but usually only one becomes dominant and capable of ovulation. This selection is orchestrated by the body's internal regulators: hormones such as follicle stimulating hormone (FSH), luteinising hormone (LH), oestrogen, and progesterone, along with local growth factors and immune signals. These act like the "shaman" in the story, continually influencing reproductive cells and tissues. Just as the shaman chooses which sisters may live and which must be sacrificed, the hormonal and immune systems determine which follicle survives, and eliminate damaged or nonviable cells to maintain balance.

The ceremony or test in the allegory corresponds to the menstrual cycle itself. If the egg is not fertilized, hormone levels fall, triggering menstruation: the shedding of the uterine lining along with the unfertilized egg. The body then resets for the next cycle.

The blood-scented room, the darkness, and the cycles of fear and prayer all reference the physical and emotional experiences of menstruation. The closing parallel scene (where a girl experiences menstrual pain) grounds the allegory back into lived female experience, linking the mythic imagery with everyday physiology.

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Things I'm Missing Out On (A Few Words About Myalgic Encephalomyelitis and Loss)

By KM Dunn

12 singing Santa Baby with my mother:
two socialists and a tangle of lights,
our voices glinting like baubles

11 chilly morning air, crisp as an apple
in my lungs and the crunch of
autumn underneath my feet

10 singed scent of candleflame
in turnip lanterns and laughter
of the children I can't have

9 a rainy afternoon on the sofa,
library books and a mug of tea,
fingers turning page after page

8 sheen of sunscreen all summer
long – skin cancer's less of a
risk if you can't go outdoors

7 my granny's birthday lunch;
she's gone now and I was too
ill to visit her in the hospital

6 marching, a proud bisexual
in the glittering critical mass
clamouring for trans rights

5 cherry blossom in the city –
even the drains filled
to spilling with candy pink

4 the quick pizzicato gambol-
scramble of lambs, racing
at dusk in the fields

3 Tracy Chapman on the radio,
sizzle of leeks in the saucepan
and a pot of soup on the way

2 snowdrops and crocuses
and winter branches waiting
to burst into life

1 fireworks, the clink of glasses,
a slick of red lipstick and
the chance of a midnight kiss

Scientific Statement

Myalgic Encephalomyelitis (ME) 'is a complex, debilitating, multisystem disease that is characterized by profound fatigue and an inability to withstand certain forms of physiological insult (e.g., physical and cognitive exertion) without symptom exacerbation' (Nunes et al., 2023). ME involves 'neuroinflammation, severe fatigue, excessive post-exertional exhaustion, disturbed sleep, flu-like episodes, cognitive problems, sensory hypersensitivity, muscle and joint pain, headache, bowel symptoms, and severe impairment of daily functioning' (Proal & Marshall, 2018).

Nunes et al. (2023) highlight 'platelet hyperactivation, anomalous clotting, a procoagulant phenotype, and endothelial dysfunction' in ME, while van Campen et al. (2020) connect the prevalence of orthostatic intolerance in the disease to 'a clinically significant reduction in cerebral blood flow'. It is estimated that 25% of ME patients are disabled to such a degree that they are housebound or bedbound (Chang et al., 2021) and 'unable to perform basic tasks of work or daily living' (Proal & Marshall, 2018).

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The Role of Adrenaline

By Colin Begg

Squeezed as I am between her cot and the wall, I can still see Rayah's small heart beating as it keeks beneath the wound in her sternum, its edges the colour of stale corned beef. Beating is too forceful a word for its mothy flicker. It tap-taps irregularly, making tiny undulations in the slow tide of bloody fluid that will rise around it over the course of the next twenty seconds, until Stephanie notices and gently siphons it away.

Now she is poking the heart again, gently with her gloved finger and thumb, like a vet reanimating a stillborn kitten — if a kitten were the size of a large walnut. At her touch, the heart's irregularity regularises. I look down at the numbers on the piece of paper just handed to me, Rayah's most recent results. My feet clench slightly in my shoes. I have been standing here for almost two hours. It was a slow start. I stretch over the machine nearest me and make some adjustments to another machine beyond it. I could tell you exactly what those adjustments were, but I fear there is scant poetry in this patient's physiology. Maybe I am wrong in that. But there is certainly a better tale in hope.

There are twelve people gathered around this heart in a loose circle of masks and hats: Stephanie, her assistant Bashir, their scrub nurse Kirsty, two circulating nurses Ross and Erica, whose names I learnt for the first time this morning, Jen the perfusionist, nurse specialists Angela and Katja, a puffy-eyed-and-obviously-hungover medical student observer (whose name we also just learnt but are too embarrassed to ask for again), me, my bored trainee Stuart — who is drinking a coffee while pretending to edit some notes on the computer — and a blood bank courier newly arrived with a fresh pack of the good stuff. Twenty-four eyes, and considerably more machines.

First and foremost, there is the ECLS Pump at Rayah's feet: which is really more an assemblage of pumps, drivers, sensors, and gas and heat exchangers. These have been keeping Rayah with us for the past 72 hours since her Big Operation. Today we hope to get rid of The Pump. Out of the corner of my eye, a temporary pacemaker blinks in time to those tidal undulations and the bigger waves of the monitor above me. Beside me is the ventilator, a Life Support Machine to you, which Stu and I hope will be sufficient to keep her still-soggy lungs in business once The Pump is away. On the opposite side, a rack of syringe drivers the height of a small Christmas tree blink and whir about nine important drugs into a big tube in Rayah's tiny jugular vein. These are what I twiddle with next, balancing the uppers and the

downers like a slow-motion physiological rally driver, my foot on both accelerator and brake. All eyes stare at the heart and wait. My mind flicks to Rayah's Mum and Dad, who must content themselves with staring at the tastefully-decorated walls of the family room along the corridor.

Stephanie stretches and twists her neck, the miner's lamp on her head temporarily blinding Katja and me. She puts down her tools and stands back a little, still watching the flickering heart before her. I watch too. Slowly, inexorably, that flicker is becoming less tentative. It's the good stuff I just gave her: red cells, each new gram of their haemoglobin lugging an extra 1.39 millilitres of oxygen per minute around her bloodstream. That, and the adrenaline infusion I have just tweaked to make her heart's myocytes twitch a little stronger and faster.

My toes relax a bit. I rock back on my heels against the wall and sip the coffee Stu brought us earlier. It's cold now, but I convince myself I can feel the caffeine creeping into my veins. This place runs on goodwill and caffeine. Caffeine, like adrenaline, is sympathomimetic, an upper. It enhances the second messenger of my adrenaline receptors and, like adrenaline, increases calcium flow in my heart cells, allowing actin to bind to myosin, making the muscle fibres pull faster, stronger.

Stephanie clamped Rayah's tubes from The Pump about three minutes ago. Jen watches over The Pump as its fluid circulates via a small bypass tube called The Bridge. Stu has lumbered from his screen to turn up the ventilator, and I can now see the velvet purple edges of Rayah's lungs swing up and down inside her ribcage. We will sit like this for another ten minutes or so, run a couple of tests and then make The Call — whether or not we remove the big tubes from her atrium and aorta, the umbilical that was keeping her three-week-old circulatory system going, allowing it to rest and recover from The Big Operation.

There is a glitch. For the past two and a bit hours we have been so accustomed to the beep-beep of the heart monitor that we have tuned it out. Now the tone changes, its note lowering to a boop-boop: Rayah's oxygen saturation levels are sliding. Stu and I run our standard check of the ventilator and its connections but find nothing. We turn up the oxygen concentration and ventilator pressure. The boop-boop deepens. Looking inside her ribcage, we notice Rayah's lungs are moving less. There is probably only one cause. I dip my head and duck beneath the blue surgical drapes, into the rats' nest of tubes, lines and wires that surround Rayah's tiny head. The breathing tube to her lungs was kinked a little by Bashir's forearm as he moved a clamp. I straighten it and the boops swiftly turn back to beeps. Lungs move well. No harm. Easy done when two pairs of surgeons' hands are operating in a field the size a laptop trackpad.

Five minutes pass to ten. Sal the Cardiologist and Euan the Cardiac Physiologist arrive. Two more brains. Four more eyes. Euan scrubs hands, gowns up and places an ultrasound probe gently on the beating surface of Rayah's heart. They look at its function and the result of the Big Operation. Encouraging, says Sal. Stephanie nods.

We have to make a call soon or else there is a chance that Rayah's blood will thicken, risking a clot or worse, a stroke. Angela has pulled a blood sample from a cannula in Rayah's radial artery, a half-millimetre tube in a wrist barely wider than my thumb. She takes another from her jugular vein and carries them to the side room lab at the end of the intensive care unit. Time slows again. Lungs rise and fall, hearts move blood, those usually invisible lungs and hearts: organs you might never give second thought to until they falter.

Stephanie is getting impatient in that way that surgeons do. Her hands move back to Rayah's sternum, she leans into the wound, gently poking its edges with the suction catheter, looking for small escapes of blood, zapping errant capillaries with her diathermy probe. She glances at Rayah's monitor, then at me, her headlight beam on my forehead like a sniper's dot. Well? I pause for a second, look down at the flicking heart. Looks encouraging, I say. Wait on the gases.

Angela returns from the lab, passes me the blood gas results with a flourish. They are printed on the same thin thermal paper used for till receipts. I scan the numbers. I have read this data so many times, it is pattern recognition. It looks adequate. Not great but adequate. Clinical medicine is an imperfect science, a risk assessment. I look again at the monitor. Little has changed in the numbers and waveforms since my last mental snapshot ten minutes ago. Stephanie turns to me, I read her the numbers aloud. I think we should go for it, I say. She taps her finger gently on Rayah's skin. I agree. Okay everyone, heads up, we are coming off.

Stu runs a checklist with Katja, Jen and Angela. I won't bore you with the details. It is to make sure we don't forget anything. Based on past omissions we don't wish to repeat. Everything is ready. Stephanie reaches forward into Rayah's chest. Bashir controls a running suture as Stephanie gently delivers a tube from the wall of the right atrium. There is a small dribble of blood. Bashir makes good the hole and they leave some small orange slings in place in case they need to go back. Then they turn to the root of the aorta and repeat the process. She hands the tubes to Jen, who wraps them up and wheels away The Pump. Bashir and Stephanie wash out the chest cavity a final time with warm saline, place some new drains through the front of the rib cage, and construct a cat's cradle of thick sutures to pull the raw edges of Rayah's sternum to opposition.

A final hitch. As Stephanie draws the sutures up, the two halves of the divided sternum close down like tiny double doors. But Rayah's lungs are too stiff to go back in their bony cage: the ventilator protests with a high pressure alarm. The surgeons refashion their sutures and settle for closing the skin with a little white patch of Goretex. This will keep moisture in and bugs out until they try again on Thursday. Kirsty and her colleagues count their swabs and kit. Nothing left inside. The surgeons step back. Stuart tweaks our pumps and ventilators, more blood samples are sent. Katja calls for a chest X-ray. Instruments rattle in their trays. There is much tidying and removing of drapes and gowns and gloves. We have filled two orange bin bags with surgical rubbish.

The Pump sits silently at the edge of the room, its screens dark. Jen and Angela remove its parts and place the used bloody tubes in a huge yellow box. I stretch and step out from my corner. I check my pulse, drain the last of my cold coffee from its cup. I look at the monitor, then the adrenaline infusion. I turn it down a fraction. After this I will hover here a while, wait for more blood gases, and we'll call her parents in. I can no longer see inside Rayah's chest, but I hope her heart ticks on.

Scientific Statement

This story is a fictionalised exploration of NHS professionals' lived experience of a technique that we use to support some cardiac patients: a technology called Extra-Corporeal (outside of the body) Life Support, or ECLS for short. It uses a modified heart-lung bypass machine to support a patient's own heart and lungs — in this case until they recover from major heart surgery. The machine is often connected by tubes that pass directly through the opened front of the patient's chest. This means that the patient's beating heart can be seen directly under the surgical dressings, as described in the story. Patients can remain on ECLS in the ICU for periods ranging from several days to a few weeks until they recover or need further treatment such as re-operation, a longer-term temporary device or a heart transplant. While using ECLS is "routine" for us, to our patients, their families and lay people it is most certainly not.

The ECLS machine consists of a magnetic impeller pump (assisting the heart) and a hollow-fibre polymer gas exchanger (assisting the lungs). The story I have written describes the end of the ECLS support period, where we "decannulate" the patient, i.e. surgeons remove the large bore tubes connecting the patient's main artery and veins to the machine. This is a big step, and while we always strive to judge it right, success is not guaranteed. The process involves a large team of professionals from several disciplines, with the patient at the centre. This spirit of collaboration is at the heart of the story.

After the ELCS machine is taken away, the patient is not yet “on their own” as we must continue to support them using conventional organ support methods like mechanical lung ventilators and targeted medicines to aid the function of the heart until they have further recovered.

The adrenaline referred to in the story title is both a natural hormone of the catecholamine family, and a drug that we give to some ICU patients as a continuous infusion to provide additional inotropy (strength of contraction) to the heart muscle cells (myocytes.) In the human body, adrenaline is part of the sympathetic nervous system, which in lay terms can be thought of as the “accelerator” of the autonomic (involuntary) nervous system. Among other things, it controls our “fight or flight” stress response, a response which is also experienced by me and my colleagues as we carry out this difficult work... So the story title is a double allusion. Many other drugs act on this system, including common substances like caffeine — and coffee is a beverage which oils the wheels of the NHS. Scientifically, substances which upregulate the sympathetic nervous system are termed sympathomimetics.

Finally, some physiological concepts for readers who want to know more about the basic science. My care of the type of patient described in this story is underpinned by these three physiological formulae:

$$CO = HR \times SV$$

$$CaO2 = (1.39 \times [Hb] \times SaO_2) + (0.003 \times P_aO_2)$$

$$DO_2 = CO \times CaO_2 \times 10$$

CO (cardiac output in Litres per minute) is the amount of blood pumped by the heart in a minute. It is the product of HR (heart rate in beats per minute) multiplied by SV (stroke volume; the amount of blood pumped by each heartbeat in mL ÷ 1000). We use the same concept when talking about the amount of blood pumped by an ECLS pump, except we substitute the RPM of the pump for Heart Rate.

CaO_2 describes the arterial blood oxygen content in mL of oxygen per 100mL of blood, including both the oxygen that is bound to haemoglobin (Hb) in red blood cells (most of it) and the oxygen dissolved in the plasma (a less significant amount), where:

[Hb] is the blood haemoglobin concentration in grams per decilitre (g/dL).

SaO_2 is the arterial blood oxygen saturation, expressed as a percentage (of the potential oxygen binding sites on haemoglobin that can be saturated with oxygen. Because haemoglobin is a pigment which becomes redder with oxygenation, its

saturation can be measured using colorimetric techniques. This is how the pulse oximeter light you may have seen in hospitals or on your smartwatch works.

PaO_2 is the partial pressure of oxygen in arterial blood, in kilopascals.

The constant 1.39 represents the oxygen-carrying capacity of human Haemoglobin A (in millilitres of O_2 per gram of haemoglobin).

The value 0.003 is the solubility coefficient for oxygen in human plasma.

DO_2 (oxygen delivery in mL per minute) is the product of cardiac (or ECLS pump) output (CO) and arterial oxygen content (CaO_2) in mL per dL. This is how much oxygen the circulatory system delivers to the body's organs and tissues each minute.

Bibliography

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