

## **Pathophysiology of PEM by Dr Simon (A translation on a lecture given in German)**

Dr Simon has been examining various kinds of chronic fatigue syndromes. For example, in cancer patients, but also in typical CFS patients whose CFS started after infections. Rather recently, a big insurance company asked him and his team to investigate regarding Long Covid, because the insurance company wanted "objective" and measurable information on exercise ability and fatigue levels in Long Covid patients. He and his team use methods for objectively measuring performance and strength/ability which are typically known from professional athletes and competitive sports but had then been started to be used for cancer patients with fatigue, in order to evaluate in which bodily/physiological system those patients were having problems with performance/strength/ability/energy. And to see why these patients don't manage to perform the way they would want and expect. He says that this is exactly the problem for patients with CFS. They feel like they should be able to do X but they are just not able to.

He mentions that initially their findings corresponded with other doctors' findings: that the organs appear to be healthy. Muscles seem healthy and functioning normally. There are no structural problems with the muscles, lung, the heart etc. They get "perfect measurements". But then they found blood circulation issues in these patients. The blood either flows too quickly through a body part so that it doesn't release its oxygen to the tissues properly, or it simply doesn't release its oxygen. Which results in an oxygen deficit in the tissue of the muscle or brain. This all happens in spite of perfect blood oxygen saturation. Such reduced oxygenation of the muscle or brain tissue means that even if you are otherwise a perfectly healthy person, when you have this circulation problem, and your body doesn't manage to provide a stable and steady blood flow and oxygenation to all your muscles and areas of your brain, then you have a huge problem due to lack of oxygen and the hypoxic damage that can result.

Because, as a compensation mechanism, your breathing centre in the brain then reacts to the perceived and actual hypoxia, and it sends you into over-breathing in an attempt to fix this. With over breathing and oxygen deficit, your heartbeat also typically grows faster automatically, and some patients might end up feeling breathless. This is a maladaptive response. It's an attempt of compensating for lack of oxygen in tissues due to impaired blood flow by getting the patient to breathe more or breathe harder.

This lack of oxygen in the tissue and subsequent hyperventilation will happen every time you use a certain muscle or muscle group in an "unbalanced" way, like for example your arm muscles when doing your personal hygiene or brushing your teeth, or cutting bread or lifting something. Any focused and isolated prolonged and unbalanced movement or usage of muscles will trigger this lack of oxygen in the muscle and over-breathing reaction. For most patients it happens if they use these muscles in such way **for more than 30 seconds. These 30 seconds seem to be the cut-off point** because **below 30 seconds the body can compensate via anaerobic activity**. There won't be any harm done in exerting muscles for less than 30 seconds because of this anaerobic compensation ability of our bodies. Anything that goes beyond 30 seconds though will cause "hypoxic damage" because even anaerobic

activity can't compensate the lack of oxygen in the tissue. Such hypoxic damage then "necessarily causes symptoms - like 2 days AFTER the exertion took place". This is PEM. Such hypoxic damage from only using one muscle or group of muscles too much too long (longer than 30 seconds) has systemic effects on the whole patient. Due to the automatic hyperventilation in the face of the blood circulation issues and lack of oxygen in the tissue, more problems appear along the way.

He says it's a really very complex situation as this leads to other blood flow issues with low oxygenation in other parts of the body as well. For example, this can lead to oxidative stress that has an impact on the immune system. He summarizes these findings by saying "Small exertion, but big impact." This whole situation is for example especially bad for the muscles of the thigh in certain situation where the thigh and leg need to be raised high, like when climbing stairs. He gives a technical explanation for that and then goes to explain that therefore the thigh muscles would require a flexible blood flow adaption due to their specific structure and position in motion. Such flexible blood flow is an adaption that post-Covid patients with this blood flow problem, are not capable of anymore. This leads to massive loss of strength and performance for these muscles. Climbing stairs can become extremely difficult or impossible, and if one pushes through, harmful. So, exerting a small group of muscles (even just in the hand) can lead to huge problems for the whole body. A patient might start out their day with cutting bread or vegetables for 1 minute and exerting their arm muscles by doing so - and then afterwards be so defeated by that they afterwards will have trouble just walking.

Unfortunately, this all happens too when using the brain only and getting overstimulated by sound, light, noise, or mental exertions. You get lack of oxygen in some brain tissues and again start to automatically breathe too much, so hyperventilate, with all its consequences and more blood flow problems and whole-body exhaustion and immune system problems. So, it's not just the using of muscles, but also using the brain that can set the cascade in motion. He also emphasizes that emotional stress "works extremely against recovery."

## Rehabilitation

He starts out by saying that patients require *intensive consultation*. That patients need to be taught how to avoid certain one-sided or unbalanced exertion of muscles and muscles groups. This also includes fine manual work that also requires brain work, like knitting (a pattern) or drawing or crafting and so on. You'd think that if it's only your fingers doing the exertion, it wouldn't be so bad, but they have found that it is. Because this type of work (when people concentrate) often typically leads to impaired oxygen saturation of the brain, which will lead to the same hyperventilation and impaired blood flow and oxygenation of tissues and all the rest of it, like exerting bigger muscle groups.

If patients can't avoid certain exertions or types of fine manual work, then they will need to find adjustments for it. They will need to bear in mind that they **can't do such work for more than 30 seconds at a time**. Ideally only do it for 10 seconds at a time. Then have a break (rest their muscles and brain) for 30 seconds. Or rest for **1 minute if the exertion was rigorous**. According to him there's no point or no benefit in resting longer than 1 minute, meaning that rests longer than 1 minute after such exertion, are not more effective than the 1-minute rest. (But only if the exertion lasted 30 seconds max.) He says that most patients

get it wrong. They're exerting themselves for 15 minutes and then they rest for 15 minutes. But that's useless. Any exertion where patients' tissues are bound to become hypoxic mustn't be kept up for longer than 30 seconds. And then muscles must be let to rest again for 30 seconds. He calls such 30 seconds or 1 minute break "an awarding break".

Anything you will do will have to be done with an awarding break after 30 seconds. In such breaks patients shall relax their muscles totally and feel how they reacted to the 30 seconds exertion before. Did it make them hyperventilate? Can they feel it was too much? There are patients who still manage to walk 15 minutes in a flat landscape and if they walk more than 15 minutes they'll crash up to 2 days after the exertion - with PEM. They found that these patients are well able to keep walking/standing for 30 (!) minutes if they do their 30 seconds breaks (where they either just stop and stand and rest their muscles while standing or keep moving their feet very lightly in place, or else just walk very slowly and comfortably for 30 seconds, slow like a slug. So, patients don't even need to be standing still for the 30 seconds break, but just slow down from their normal pace. He says that this is a very effective training to be walking (and pacing) like that with the breaks.

He says that other patients are much worse and they can't walk for 15 minutes, not even slowly. For these patients it's sufficient to do other forms of training in their everyday life. Like just sit down and get up and stand just as long until they start to feel unwell and then sit right down again, followed by 30 seconds of rest. They recommend you do this a few times if you tolerate it. Always with the 30 seconds rest in between. Stand up for a few seconds or minutes (until you feel un-wellish from for example the blood pooling in your legs or breathlessness or dizzy etc.), then sit down and relax your muscles for 30 seconds (or 1 minute) and then get up again until it's too much to keep standing and then sit down, relax again. 10 times in a row then take a longer break. Don't stand too long. Sit down immediately when you start feeling unwell and always rest and relax for at least 30 seconds up to 1 minute.

He says that everyday life can be "training" in this way. Patients who don't manage to empty the dishwasher for example. They should pull a chair and then put out a couple of dishes and put them on onto the tabletop. Make sure not to exert for more than 30 seconds at any one time. And then rest for 30 seconds. And then continue. And then rest again. And so on. Go slow. Use right arm, then switch, use left arm. And then when you feel well enough stand up and put the dishes into the cupboard proceeding the same way. Slow, with breaks of 30 seconds.

He says that anything in your day can be training like that. The walk from the kitchen to the bathroom is training. Do it with breaks if the walk would be too long without them. He, as an exercise physiologist, doesn't even recommend actual training. He advises against it. Because these everyday things are enough training. Any additional training would be detrimental at that stage. Additional training is the reason why these patients deteriorate in typical exercise rehabilitation. Because there they are forced to exercise. Which they can't do. He gives out about how doctors in these Post Covid rehabilitation centres celebrate it as a victory if the patient after 3 months of exercise therapy manages to walk "3 metres more in a 6 minute walking test", which he finds ridiculous. He says that typically, patients deteriorate in all areas after such a training rehabilitation. They can measure the

deterioration with their methods. He says that a typical problem arises for patients who just *want* to walk with their dogs or with their spouses and *not slow down* for the sake of their dogs or spouses, and not take these 30 seconds breaks. These patients are harming themselves. Patients should really, really take these 30 seconds cycles serious. Because: If a patient stops to walk and takes their 30 seconds break, they will often notice hyperventilation already during the break. This is a sign that during the walking part some of their muscles went hypoxic already. That it already was too much exertion. But if it was only for 30 seconds then no real harm was done. If they now don't listen to that and don't take their 30 seconds breaks, in order to please their spouses or dogs, then they will just walk over their capacity and will harm themselves. They'll be paying for it 2 days later. After 2 days when PEM hits you won't be able to tell anymore what it was that put you over the edge and gave you PEM. "Was it the visit with my sister that I enjoyed?", "Was it the emotional arousal at that event?", "Was it the walk with my dog?" - Patients often won't be able to tell what it was that gave them the PEM, because after 2 days it's impossible to determine it.

If you do these 30 seconds breaks you will know right away and immediately what exertion was too much. Because you'll get the feeling for it in your 30 seconds break already. "You'll pay there already, instead of 2 days later". Some patients will be able to check their pulse which would get faster in case of too much exertion, but there are other patients where this doesn't happen. So, pulse is not an accurate measure to observe this for everyone. He recommends to just learn to see how you feel in the 30 seconds breaks. You'll get an accurate feeling of knowing when something has been too much.

Professional athletes understand this whole concept immediately. They recover much more easily because they know the concept from their training pre-illness already and it intuitively makes sense to them. They know from their professional training as athletes that if an exertion leads to pain or other symptoms, their whole performance will go down and things will get worse. Typically, they are used to train to the max of their ability. But they know from experience that if they go over the top and do too much (if they feel unwell after training) that their performance will get worse and worse and worse.

He talks about a professional athlete personal friend of his who had severe Post Covid symptoms. Like tachycardia even lying down and who couldn't even get up. Whenever he tried he needed to lie back down immediately. And he had recovered completely after 6 months. But this guy did 100% everything right. He kept lying in bed and started with only raising one arm. That was his initial training. When he found that to work with no worsening, he did it with 2 arms the next day. He understood that he was only allowed do what didn't cause symptoms and problems for him in his 30 seconds rest. And he was back to perfect health in 6 months. That's faster and smoother than a typical patient.

These symptoms (after Covid) affect both professional athletes and inactive people the same way. It makes no difference whether someone was extremely fit or not fit at all. There are people who 2 years ago ran a marathon in under 3 hours and now they can't do anything anymore just like other patients who were never that fit.

If patients manage to get their blood flow back to normal, their normal strength resumes. Meaning that these patients don't need to start training from zero after they have recovered. So, symptoms are not due to deconditioning. But you have to go slow about restoring normal circulation while not making yourself hypoxic. You do this by adhering to the 30 seconds rule. When patients are stable on their 30 seconds exertion - 30 seconds break regimen then at some stage they can try to do 1 minute exertion. But this should only be tried after patients experience no symptoms anymore in their 30 seconds break after their 30 seconds exertion. And if 1 minute exertion works, then you can do 2 minutes and then 4 minutes and so on. But you have to be very careful with it, because you have to bear in mind that with any exertion longer than 30 seconds, theoretically, it can always happen the muscles get hypoxic and PEM happens again. You need to be very diligent with keeping a written protocol to see if any exertion makes you feel bad 2 days later. And in case it happens you'll need to dial back again.

Many patients are fine walking in a relaxed and slow manner (arms and shoulders relaxed) on flat landscape without getting PEM. If those patients try to walk "normally" (like they used to) though it will give them PEM. And lots of these patients keep trying to walk normally and end up not feeling so well. These patients will never succeed in getting better and will remain at their limited ability, if they keep trying to walk their usual (normal) pace.

For walking stairs, he recommends to only walk 3 steps and then take a break/rest, because the thigh muscles are especially difficult/critical in this respect. But if patients don't exert themselves for more than **10 (!) seconds** on the stairs, these thigh muscles then will recover quickly, when normal blood flow is resumed during the little breaks every 3 steps. It helps if you regulate your breath in these little breaks to slow it down. In the end you will be quicker up 4 flights of stairs if you walk it with the breaks every 3 steps, than just walking it in one go and then find yourself totally wrecked at the end of it.

On the question of what to expect in terms of remission of symptoms, he says that as regards cognitive function it gets better within a matter of *weeks*, on the physical level we're talking in *months*. Most Post Covid patients notice much, much better cognitive ability after 2 weeks of adhering to the 30 seconds protocol. His word of warning: Don't exert yourself on the so-called "good days". Don't do it. It doesn't work. He doesn't know anyone for whom it has worked to overcome their issues that way. He ends it with some German humor by saying that on good days all you are allowed do is to "*go slow* a tiny, tiny bit faster than usual."

### **YouTube links to the original German lectures**

<https://youtu.be/9NoOtxNyEPQ>

<https://youtu.be/FwAlG6zg0jQ>