Final
Transcript of
Dr Anders Sode West
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Introduction and background

Anders West (00:01)

Thank you for the invitation and thank you for letting me talk about this very interesting topic. My name is Anders West. I'm a stroke doctor at the Rigshospitalet Hospital and Research Centre in Copenhagen.

This first slide is a good illustration of the importance of the light we need for our human health - this is my children receiving that natural light.

But it also illustrates the problem that we see in our stroke units and in other hospital units because the patients don't have the possibility to go outside and receive this important light.

I have been researching post-stroke complications for over 14 years. And I see that circadian disturbance is a huge problem.

First, a little background. This is a picture of the Nordic god, Balder, who unfortunately gets killed. He's also the most beautiful god.

Stroke and complications: depression, sleep, fatigue and anxiety

And a little about stroke. In summary, a stroke is a clot in the arteries. It's also bleeding inside the brain or just outside the brain. Although we often think that the most important impacts are speech impairment, mobility and so on, most patients recovering from stroke and suffering from other neurological diseases are complaining about depression, sleep quality, fatigue and anxiety. These are among the most frequent complications.

One-third of stroke patients experience depression. It's not because they are sad about the decreased mobility or so on, but it's a chemical disturbance in the brain. Fatigue is a huge problem: 40 % of our stroke patients complain that is the worst complication after a stroke.

When we look into these complications, we can see that they have a significant impact on cognitive function, recovery, quality of life, and the survival of the stroke, especially when we relate it to depression and fatigue. So it's a huge problem.

The interesting part is that these complications may be linked with the circadian rhythm.

Link between complications and circadian rhythm

These complications, of course, cost society a lot of money and a lot of manpower is used to take care of these complications both inside and outside the hospital and in the nursing home.

Shadab gave us a fantastic introduction to the circadian system. But, as a topline summary, we need blue light, while activity and food intake may influence the circadian cycle. Therefore, we need the right light at the right time.

So what about our patients? They are admitted to a hospital. They don't have the option to go outside. They only receive light through the windows. Their circadian rhythm may be severely disturbed.

Potential for circadian lighting to affect entrainment

We published a paper focusing on circadian rhythm in temperature. And we can see there are severe disturbances in the temperature regulation after a stroke. This study was a Randomised Controlled Study, looking at two naturalistic light installations inside the hospital. Please take a look at the methodology paper if you'd like to read that in more detail. We have this Ciracadian unit where we installed light in every type of room: in toilets, hallways, dining rooms, and all the patient rooms. And we were lucky to have an equivalent control unit with normal indoor lighting.

And here you can see that the blue line is the circadian light. The red dot line shows the normal indoor lighting at the control unit. And you can see here in the morning, the light is beginning to be bright, by in the middle of the day, it's very bright and white. And in the afternoon, you see this red light. And you can see the huge difference between the circadian light and the standard indoor lighting.

Need to specify spectral distribution

But when we talk about circadian light, it's important to mention the spectral distribution because our visual system cannot differentiate between the specific wavelengths in a light source. So it's not enough to just describe light in terms of the Kelvin temperature; we need to specify the right spectrum. The light blue line in the diagram at the top shows the

melanopic light spectrum. You can see what a high blue content stimulation it has for our eyes. In the picture below, you can see very low amounts of the melanopic spectrum in the normal indoor lighting.

So you can see that our circadian system receives almost no stimulation in standard lighting compared to the circadian light.

We were very surprised to see such a significant difference.

Circadian rhythm in melatonin and cortisol

In the first test, we measured the circadian rhythm in melatonin and cortisol every four hours. The stroke patients at the start of the intervention had almost no rhythmicity in melatonin levels. But for those in the circadian unit, the melatonin levels were higher and starting to show normal rhythmicity. Very interesting findings.

When we look at cortisol, we can see that there was a significant increase in the morning hours in the circadian units. And we need cortisol in the morning to wake the body up. So we need to be 'stressed' in the morning. We published a paper about that, too.

Impact of circadian rhythm on fatigue, rested feeling and depression

When we look at the sleepiness and fatigue result, we found that the circadian rhythm reduced fatigue and produced a rested feeling: rested feelings increased by 40 %, and fatigue was reduced by about 20%.

And yet, there was no significant difference regarding sleep quality between the groups.

One of the primary outcomes was the depression scores. At the time of discharge, you can see that depression was decreased by 50 %. That is the same effect we see when we give anti-depressant medication, which actually works very well in our patients. Well-being was increased by almost 50%, and anxiety was reduced by almost 30%.

At the same time, we saw no effect on cognition.

This is a topic that we need to explore: Why doesn't light impact regulate cognition to the same degree? Maybe it's because, in this study, we were looking at function more broadly. But we are running a new study about that.

Circadian regulation of metabolic processes, including coagulation with implications for prevention

A very interesting topic regarding circadian regulation is the metabolic processes in stroke patients.

When we think about stroke patients, as I mentioned before, we tend to focus on speech and movement. And yet, stroke affects the whole body, not just the brain. We have carried out research to show dysregulation in all the organs, including circadian disturbances across a

wide range of metabolic processes. And we found a circadian disturbance in the coagulation system.

This system may be important both for getting clots and preventing clots from happening in the first place. We notice disturbances in bone metabolism and thyroid hormone disturbances, and probably also other biochemical processes that may be affected after stroke.

Circadian regulation of parathyroid function with link to bone loss

When we looked at these metabolic processes in our cohort, we saw that, in the light group, the parathyroid hormone was decreasing at the time of discharge. And that is what we see in other published data that has investigated parathyroid hormone in people who work outside in daylight. So maybe this finding could prevent bone loss during hospitalisation because the parathyroid hormone is actually destroying the bones.

This data has not yet been published, but we are also looking at the coagulation system because we know that this system is very disturbed after stroke and may be one of the reasons that stroke happens in the morning hours. We see a normalization of this coagulation system at the time of discharge in the circadian groups. Another very interesting finding. And maybe this can prevent some of the strokes we're seeing.

Critical parameters for beneficial effects: duration +5 days and spectrum

So, what do we know about light in patients? We did a review and we only found 29 papers out of 10,000 papers in PubMed and other databases.

If we look at the studies that have found positive effects of light, we can see that it concerns patients who were admitted for more than five days. That coincides very well with what we know about the circadian regulation of light: that it takes time to be regulated, as we know of jet lag. So, this was another very interesting finding.

One of the other things we noticed was that, if the right spectrum was deployed, there seemed to be a positive outcome for circadian processes.

Range of effects of circadian light: brain or beyond?

The question is whether these metabolic processes are regulated by the stimulation of light - or perhaps just some of them. Light seems to be a very important factor for things that happen inside the brain, such as depression, anxiety, etc. Our data shows that light may not have such a big influence when we look at processes from the neck down, such as the metabolic processes that are regulated inside the organs.

Here, it seems that activity, food intake and sleep are the main regulators. But more research is needed in that area,

Thanks

Finally, I would like to thank all the patients who, during the hardest time of their lives, were able to be in this study and allowed us to take bloods from them every four hours during the night.

Also, to Associate Professor Helle Iversen, who was in charge of the study.

A final note about differences in domestic settings

And the last slide is what I see when I'm driving home from work.

You can see here that people are living in quite different kinds of light.

My neighbour has a very blue light, so I don't think he has such a great circadian rhythm. And my daughter's doll's house is installed with circadian light too, because it's so important!

Questions

Q: Is the implementation of circadian-aware lighting expanding?

Age Of Light Innovations (12:36)

Focusing on metabolic processes and bone health and linking with what Shadab was saying about falls, there seems to be a virtuous circle because people are falling less, but also their bones are stronger when they do fall.

So you've installed this in your hospital. Are you seeing this expanding elsewhere?

A: Early days, but expanding - especially in settings where people don’t have the option to go outside

Anders West (12:57)

It's interesting to see how fast it's going now, but I still think there is a lot more research to do.

I was one of the first to carry out research in the field. The first study is 10 years old. But over the last decade, I have seen that interest in the area is increasing and it's only going to get more important to look into this. Shadab's findings are similar to ours, which shows how important this field is becoming.

I think in the future, all homes will feature light that is circadian-regulating to some extent. Several healthcare facilities in Denmark now have circadian lighting installed. This is especially important for dementia patients who lack this circadian regulation.

Because we have healthy brains, we can regulate our circadian rhythm, just from our commute on a bicycle home to work.

But I think, in future, we will be looking at circadian lighting in buildings where people don't have the possibility to go outside as much as they need to.

Q: Benefits to health simply from circadian entrainment or other cognitive effects?

Age Of Light Innovations (14:15)

I realise that you're doing more tests, but I think we've always assumed that one of the major benefits of getting the circadian lighting right is that you get an improvement in cognition almost as a byproduct of having a healthy body.

A: Potential to have large impact on cognition but not where there is brain damage

Anders West (14:38)

Yes, but I think in our patients, the stroke affects the neurons and networks so much that the light cannot heal the brain. But now we're looking at the executive function in a brain area that is not affected by the stroke. The cognition test we did in the study looked at all domains, probably too broad, which reduced the power of the statistics. But in healthy individuals, I think that light is likely to have a huge impact on our cognition, but not where there is brain damage.