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Efficacy of new microprocessed phototherapy system with five high intensity light emitting diodes (Super LED)

Dear Editor,

We have read with interest the article by Martins et al.[1] in which two types of phototherapy using different light sources were evaluated. We believe that this is the first published Brazilian study testing equipment in which LEDs were used that employ LEDs. We really like the detailed description of the radiation monitor, information on its wavelength range and on the spectrum of the light sources used. We consider that mention of these data and standardization of the measurements are essential for understanding and evaluating results in phototherapy. We would like to address some comments we consider pertinent to the discussion.

In the results, the authors refer to the mean irradiance expressing values in $\mu W/cm^2/nm$. We believe that they probably refer to the mean of irradiance measurements at the point of peak intensity. Spectral irradiance is quantified[2] as $\mu W/cm^2/nm$ whereas irradiance values are expressed in $Watts/m^2$. Mean irradiance may more suitably designate the weighted assessment of irradiance at the surface area exposed to light. If weighted irradiance were measured at the area illuminated, a considerable difference would be observed in the irradiance emitted by the two phototherapy devices, since the center to periphery decrease in spectral irradiance of the halogen phototherapy unit is significantly greater than that of the device equipped with LEDs.[3-5]

Another aspect regarding the results refers to the authors' report on the patients on Super LED phototherapy, who relapsed with elevated total bilirubin when withdrawn from treatment and needed to go back on phototherapy. To avoid controversy over efficacy of this type of treatment, the authors could have elaborated this in their discussion. This phototherapy system actually has a greater capacity of rapidly reduce bilirubinemia, which caused the withdrawal levels (not informed on the study) to occur before the patient had had a better glucuronidation capacity so he could have been able to suppress new increases..

Finally, we believe that the wider emission spectrum of the halogen lamp, unlike the explanation provided on the study, did not interfere in the results of the phototherapy. Of the light spectrum of 380 nm to 600 nm, only the range between 400 and 500 nm will be absorbed by bilirubin, thus determining its conversion into an isomer and a product of photooxidation. The decrease in values is actually attributed to the difference in the intensity rather than in the quality of irradiance.

We appreciate the authors' article and we do hope that we have contributed toward a better understanding of the data reported.

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Authors' reply

Dear Editor,

We want to thank Prof. Fernando Facchini for his review and comments on our article: "Efficacy of a new microprocessed phototherapy system with five high intensity light emmiting diodes (SUPER LED),"[1] which certainly contributed to a better understanding of our results.

In our study, in accordance with the comments addressed, the irradiance emitted by the two types of phototherapy was actually determined at the level of the infant´s skin, at the center of the focus of the light, as described in the methods. We, however, agree with Prof. Facchini on the heterogeneous character of the irradiance distributed across the surface illuminated, and considered this question in the discussion. We also agree that, due to the heterogeneity of irradiance, a variety of weighted measurements could have been more representative of the values of irradiance emitted by the two phototherapy devices, and a significantly greater difference than that reported in our study would be observed.

With regard to the need for some patients to go back on phototherapy, although there seemed to be a trend toward relapse in the Super LED group compared to the halogen phototherapy group, both groups analized did not show statistically significant differences in the number of patients who relapsed with elevated total serum bilirubin (26.8% vs. 18.2%, p = 0.43). The main pathway for bilirubin excretion during phototherapy consists in conversion into two isomers. Geometric isomers form rapidly, yet they can convert back to the original bilirubin molecule. Bilirubin relapse after termination of phototherapy could be partly attributed to this mechanism, as suggested by Prof. Facchini.

Nevertheless, the structural isomer (lumirubin) is not reversible, therefore it does not undergo glucuronidation, it is highly soluble in water and rapidly excreted in urine. The formation of this structural isomer is currently considered the main mechanism behind the phototherapy action on the decrease in serum bilirubin levels.[2] Unlike the geometric isomer, the formation of lumirubin is influenced by the intensity of the light (irradiance) emitted by the phototherapy, increasing proportionally to the increase in irradiance.[3] It may also be speculated that newborns treated with Super LED phototherapy produced larger quantities of structural photoisomers and consequently exhibited a greater decrease in serum bilirubin levels.

The quality of the light spectrum deserves further consideration, since bilirubin does not interact with light "only" in the range between 400 and 500 nm. Several studies have demonstrated that green light (490-565 nm) also reduces serum bilirubin levels.[4] Explanation lies on the fact that studies on absorption of light in bilirubin were carried out in vitro, in which bilirubin is bound to albumin. However, in vivo, fatty acids bind to albumin and the resulting complex binds to bilirubin. Binding of the fatty acids causes the spectrum of light that is absorbed by the bilirubin molecule to bend toward longer wavelengths, i.e., toward the green portion of the visible light spectrum.[5]

However, efficacy of the blue light (440-490 nm) is indoubtedly superior. Photoizomerization of bilirubin proves more efficient when the blue rather than the blue-green light is used.[6] Phototherapy using halogen lamps (380-600 nm) will emit considerable amount of light in the green range.

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