The Breast 52 (2020) 151–152

Contents lists available at ScienceDirect

The Breast

journal homepage: www.elsevier.com/brst

Correspondence

Reply to: "When to assess the flap perfusion by intraoperative indocyanine green angiography (ICGA): On the donor site or the recipient site?"

Dear Editor,

Thank you for the opportunity to respond the letter by Xiaomu Ma et al. in reply to our article "When to assess the DIEP flap perfusion by intraoperative indocyanine green angiography (ICGA) in breast reconstruction?" [1]. We have read it with great interest, and we appreciate and agree with several of their valuable statements. We would like to add some comments and try to clarify the uncertainties.

First of all, we agree that comparing the non-perfuses areas of the DIEP flap according to the ICGA in the donor and recipient sites with the postoperative flap necrosis would had been a study with high-level evidence. However, the aim of our study was not to assess the sensitivity or the specificity of the ICGA to identify the postoperative necrosis, which has already been evaluated in previous studies and has demonstrated its usefulness [2,3]. In addition, it would be difficult to compare those areas due to using the entire DIEP flap for breast reconstruction is extremely rare in our clinical practice. In fact, it is not uncommon not to include the entire well-perfused area according to the ICGA, as happened in most of the included cases of the study, and therefore, ischemic areas could not have been compared with postoperative necrosis. Moreover, ethical considerations would have limited that research. Due to the main aim of our study was to assess when is more useful to perform the ICGA for intraoperative decision making in the clinical practice, the perfused areas in the donor and recipient sites were compared between them. Furthermore, in this way, confounding factors that change the perfusion of the flap during the postoperative period were avoided.

We design the final flap taking into account the results of the ICGA, the body contour, the breast symmetry and the preferences of each patient. The areas of the flap with no fluorescence are always trimmed; the areas with fluorescence are carefully evaluated for designing the final flap, and in most cases part of them are not included either. The areas with the lowest relative signal intensity in each patient are usually discarded first, but always taking into account the other previously mentioned criteria. However, in the study we compared the perfused areas (with fluorescence) and the ischemic areas (without fluorescence) in both sites, so it was not necessary to establish a value to differentiate between the high or low intensity of the signal of the ICGA for the statistical analysis. Further studies applying absolute objective criteria with a grey scale or a software aided evaluation of ICG fluorescence would be interesting.

There are several applications of ICGA in reconstructive surgery. Some of them, such as assessing the venous congestion and the need for a second venous anastomosis, as the authors have pointed out in the reply, or assessing the patency of the anastomosis, can also be useful when the test is performed in the recipient site. However, we have focused the study just on the assessment of the flap perfusion, and according to the results obtained, we considered that it is more useful and effective to perform the ICGA on the donor site for this purpose. Due to there is no need to use all the well perfused area of the DIEP flap for breast reconstruction in most cases, it is more beneficial to perform the ICGA on the donor site, where the well perfused area is the same or smaller, and therefore, the flap can be designed based on the best perfused areas more accurately. We found no additional benefit in repeating the ICGA in the recipient site to assess the well perfused area of the flap.

The flap survival is also related to the vascular patency after the anastomosis and the ischemia perfusion injury, as the authors have mentioned in the reply, and both of them were taken into consideration in the study. Due to the perfused areas of the flap had to be assessed on the donor and recipient sites and compared between them, all the anastomoses were permeable in the included cases. In addition, the ischemia time of the flap was measured (mean 56.4 min, range 48–72 min). It has been described in the literature that the time of ischemia is a risk factor for perfusion-related complications in the DIEP flap when it is greater than 90min [4,5]. Therefore, in our study, the ischemia perfusion injury was considered minimal, homogeneous and not enough to cause an immediate relevant clinical change in the perfusion area. This consideration was supported by the fact that in no case the well perfused area was smaller in the recipient site after the anastomosis. Further studies assessing the ischemia perfusion injury with longer ischemia time would be interesting.

Finally, the most challenging aspect of the study was trying to answer the question "why the perfused area is the same or larger after the anastomosis?". The hypothesis of Xiaomu Ma et al. about the delay phenomenon and the vasodilatation caused by hypoxia-inducible factors and by cutting the sympathetic innervation of the vasculature is very interesting. Although we consider that there was not enough time for intraoperative clinical changes because of the delay phenomenon in the study and the pedicle was completely dissected when the ICGA was performed, we agree than the choke

DOIs of original article: https://doi.org/10.1016/j.breast.2019.07.009, https://doi.org/10.1016/j.breast.2020.01.002.

https://doi.org/10.1016/j.breast.2020.04.007

vessels have a main role here. Furthermore, we believe that the blood flow is also an important factor. The blood flow in the internal mammary artery (IMA) is considerably higher than in the deep inferior epigastric artery (DIEA) after their dissection. However, Lorenzetti et al. had shown that the intake of blood in a free flap does not depend on the recipient artery flow but on the tissue components of the flap [6,7]. After the anastomosis, the blood flow of the IMA decreases until a similar level of the original blood flow of the DIEA in the donor site, but it is slightly higher [6]. We obtained similar results in our blood flow measurements, and we believe that it would explain why the perfusion of the DIEP flap could improve in the recipient site in some cases.

Disclosure

The authors have no financial interest to declare in relation to the content of this response.

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14 April 2020
Available online 18 April 2020