New fluorescence endoscope for visualization of the placental vascular network, a feasibility study.

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Purpose: One of the technical challenges in laser surgery for twin-to-twin transfusion syndrome (TTTS) is to accurately define chorionic plate angioarchitecture without missing any interfetal anastomotic vessels responsible for TTTS. In this report, we present our new small fluorescence endoscope developed to visualize chorionic vascular configuration including superficial as well as underlying apparently-hidden anastomoses which are likely to escape our notice when a standard fetoscope is employed for intrauterine placental survey. Along with this new technological concept, the results of a feasibility study using monkey placentas are to be shown.

Methods: Indocyanine green (ICG) which has been clinically used for liver functional test was employed as a test fluorochrome for in vitro placental vascular study. This agent can characteristically emit near-infrared fluorescence (840 nm in wavelength) when excited by a 765 nm visible ray. For this reason, the built-in filter of a conventional xenon light source (Sinko Optical, Japan) was replaced by a new one that can transmit the 765 nm visible ray. Then, a near-infrared camera (Hamamatsu Photonics, Japan) was mounted on a rigid endoscope (Sinko Optical, Japan). The endoscope could convert from visible ray mode to infrared ray mode by switching a newly equipped on/off filter that specifically transmits infrared ray alone. This fluorescence-activated imaging endoscope (fluorescence endoscope) was tested for its feasibility using monkey placentas (Macaca fascicularis) obtained by cesarian section. The ICG solution was injected into the umbilical artery after an intravascular saline irrigation of the residual placental blood with subsequent recordings of the placental vascular configuration based on vascular fluorescence activities.

Results: The use of a fluorescence endoscope enabled us a dynamic monitoring of the placental angioarchitecture especially of the superficial chorionic vessels and their branches underlying the chorionic plate. On comparison of the images of a given placental area, the infrared ray mode was much superior to the visible ray mode in terms of defining the apparently hidden vascular branches immediately beneath the chorionic plate. Importantly, the fluorescent activity of these vessels was clearly detected even when the placenta was examined within remarkably turbid amniotic fluid. Furthermore, the cotyledons were easily distinguished each other with the use of the fluorescent images hopefully making an in situ pathological study of the placenta much easier than the conventional dye injection method.

Conclusions: The fluorescence endoscope could visualize the detailed placental vascular networks. This device might be potentially useful for future TTTS laser surgery and the in situ study of the placental vascular pathology. The risk of fetomaternal use of the ICG must be carefully examined. In addition, the endoscope is expected to work for other common surgery for malignant lesions including GI or breast cancer as the ICG fluorescence is well known to depict intraperitoneal or axillary lymph flow with the sentinel regional nodes.