Editorial

Embryogenesis: How to get the Picture?

Corentin Spriet[1], Dave Trinel[1] and Jean-François Bodart[2]*

[1]*TISBio, Univ.Lille, CNRS, UMR 8576, UGSF, Unité de Glycobiologie Structurale et Fonctionnelle, FRAbio FR 3688 CNRS, F 59 000 Lille, France*

[2]*Regulation of Signal Division Team, Univ.Lille, CNRS, UMR 8576, UGSF, Unité de Glycobiologie Structurale et Fonctionnelle, F 59 000 Lille, France*

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Complex and specifically orchestrated process, embryogenesis can be at hand through different methodologies, where microscopy took the main role. At first, photonic microscopy enabled to describe the different morphological events of embryogenesis and provided normal tables of development for many organisms, from marine invertebrates to lower vertebrates such as amphibian. Noticeably, Differential Interference Contrast (DIC) microscopy, also called Nomarksi Interference Contrast, brought deeper insights in spatiotemporal descriptions like for fertilization in sea urchin [1] and gastrulation in Drosophila [2]. To go further, process for image analysis were developed to gain the understanding of embryogenesis events in 4D. One can mention the development of methodology and algorithms to automatically analyze the segmentation of ascidians notochord cells, in order to get an improvement of cell segmentation's analysis derived from DIC, and to provide comprehensive local mobility map [3]. Nevertheless, DIC is infeoded in that case to animal models exhibiting transparency during their early development or organogenesis.

However, DIC inherently suffers from a lack of specificity that can be counterbalanced by using fluorescent dyes. Both can be used simultaneously and provide complementary observations : morphological phenotypes gathered by DIC, combined with specific fluorescent reporters, brought embryogenesis descriptions from global morphology towards individual cellular behaviors. Such strategy was quite successful in model like *Caenorhabditis elegans*. For example, apoptotic and necrotic cells can be identified in a developing larva and cell lineage can be achieved [4,5]. Whereas DIC microscopy did not evolved *per se*, its use was favored by the growth of computing power and the increasing ability to extract information from time-lapse imaging. Thus, quantitative data can be provided during segmentation at high spatial and temporal resolution and can be applied to numerous substructures like centrosome, a mitotic spindle element [6]. One can also note that though automatic analysis from time-lapse imaging of DIC pictures might be quite demanding, it does not suffer from tedious genetic experimentations nor artifact potentially promoted by fluorescent dyes engineering.

To go beyond the structural or cellular description of embryogenesis, molecular tools came to enlarge the toolbox in microscopy. The so-called FRET-based biosensors allow to dissect cellular decision like cell cycle progression, differentiation or even migration. Indeed, these molecules report for enzymatic activities of key players, i.e. Erk and PKA [7,8]. From their initial structures, these biosensors can be optimized [9] and provide dynamic maps at the subcellular level, enlightening hot spots of kinase activity in the case of Kinase Activity Reporters (KAR) [8]. Though it can be achieved in living cells, the further step that has to be performed, is to bring the biosensors in animal models where embryos are not transparent: herculean tasks have been undertaken and transition is on its way [9].

References

1. Schatten G, Hülser D (1983) Timing the early events during sea urchin fertilization. Dev Biol 100: 244-248.

2. Foe VE, Alberts BM (1983) Studies of nuclear and cytoplasmic behaviour during the five mitotic cycles that precede gastrulation in Drosophila embryogenesis. J Cell Sci 61: 31-70.

3. Obara B, Veeman M, Choi JH, Smith W, Manjunath BS (2011) Segmentation of ascidian notochord cells in DIC timelapse images. Microsc Res Tech 74: 727-34.

4. Li Z, Lu N, He X, Zhou Z (2013) Monitoring the clearance of apoptotic and necrotic cells in the nematode Caenorhabditis elegans. Methods Mol Biol 1004: 183-202.

5. Giurumescu CA, Chisholm AD (2011) Cell identification and cell lineage analysis. Methods Cell Biol. 106: 325-341.

6. Farhadifar R, Needleman D (2014) Automated segmentation of the first mitotic spindle in differential interference contrast microcopy images of C. elegans embryos. Methods Mol Biol 1136: 41-45.

7. Vandame P, Spriet C, Ritquet F, Trinel D, Cailliau-Maggio K, et al. (2014) Optimization of ERK activity biosensors for both ratiometric and lifetime FRET measurements. Sensors (Basel) 14: 1140-1154.

8. Vandame P, Spriet C, Trinel D, Gelaude A, Caillau K, et al. (2014) The spatio-temporal dynamics of PKA activity profile during mitosis and its correlation to chromosome segregation. Cell Cycle 13: 3232-3240.

9. Pantazis P, Supatto W (2014) Advances in whole-embryo imaging: a quantitative transition is underway. Nat Rev Mol Cell Biol 15: 327-39.

*Corresponding author: Jean-François Bodart, Regulation of Signal Division Team, Univ.Lille, CNRS, UMR 8576, UGSF, Unité de Glycobiologie Structurale et Fonctionnelle, F 59 000 Lille, France, Tel: +33 03 20 43 68 67; E-mail: Jean-francois.bodart@univ-lille1.fr