ISSN 0006-2979, Biochemistry (Moscow), 2014, Vol. 79, No. 9, pp. 847-848. © Pleiades Publishing, Ltd., 2014.
Published in Russian in Biokhimiya, 2014, Vol. 79, No. 9, pp. 1059-1060.

# Logistics in the Cell: Cargoes and Transportation

**E. S. Nadezhdina**[1,2]

[1]*Institute of Protein Research, 119334 Moscow, Russia; fax: +7 (499) 135-2147*
[2]*Belozersky Institute of Physico-Chemical Biology, Lomonosov Moscow State University, 119992 Moscow, Russia; fax: +7 (495) 939-3181; E-mail: elena.nadezhdina@gmail.com*

Received June 19, 2014

**Abstract**—Eukaryotic cells are large and thus require a vesicular transport system. The system involves the formation of membrane transport containers, their short- and long-distance movements, recognition of destination points, and fusion with other membranes. Understanding the molecular mechanisms of these processes is of theoretical and practical significance. This special issue of *Biochemistry (Moscow)* collects surveys and experimental articles describing various aspects of vesicular transport.

**DOI**: 10.1134/S0006297914090016

*Key words*: vesicular transport, cytoskeleton, cell motility

In the life of eukaryotic cells having relatively large size, logistics plays an important role. In cells there are loads to be delivered to certain destinations, for example, secreted proteins. Cells have to select the type of cargo shipping containers, e.g. membrane vesicles, to provide their movement, e.g. with the help of motor proteins along cytoskeletal structures, to designate delivery address, etc. (see reviews of A. I. Fokin et al. and M. S. Vildanova et al. in this issue). Intracellular cargoes are very disparate; they include not only secreted components, but also members of signal transduction pathways intended to meet each other in the cellular space (see reviews of F. K. Gyoeva and E. S. Kornilova in this issue) and functional protein complexes that must be delivered to specific areas of the cell for biochemical processes, etc. The latter refers to the processes taking place at the leading edge of moving cells (see the review of A. Y. Alexandrova in this issue) or in cell-to-cell contacts (see review of I. B. Alieva in this issue). Pathogens can capture and exploit the cellular transport pathways, which is destructive to cells, but it is useful for researchers (see review of S. Yu. Khaitlina in this issue).

The variety of cargoes and shipping addresses determines the diversity of motor proteins [1] and diversity of transport containers (see article of E. V. Korobko et al. in this issue). Currently, "vesicular transport" is understood both as membrane vesicle fission and fusion, and as the process of movement in the cell space. Mechanisms of selection of transport containers with motor proteins and the mechanisms of regulation of the activity of these proteins are very complex and not well understood [2]. If, e.g. in nerve cells transport occurs directly from the cell body to process termini and in the reverse direction, the transport in fibroblast cytoplasm may resemble a random walk, which, however, leads to the delivery of a cargo at a determined address. In addition to motor proteins, movements in the cytoplasm may be driven by polymerization of actin filaments (see review of S. Yu. Khaitlina in this issue) and oscillations of membrane organelles (see article of T. V. Vyshenskaya et al. in this issue).

Decoding of the molecular mechanisms of logistics processes in cell is an important and challenging task for researchers. Advances in the description of the formation and recognition of transport containers yielded a Nobel Prize in 2013 [3]. Perhaps the major prize in the coming years can be expected advances in the study of motor proteins. However, many aspects of cellular logistics are still unclear [3]. Early works established mechanisms of vesicular transport and identification of motor proteins based on yeast genetics, cell-free systems of transport, and observation of the movement of viral particles and individual viral proteins in cells. In recent papers the main emphasis is on knockout mice, i.e. on the knockdown of individual proteins in cells to identify novel protein–protein interactions.

From a practical point of view, detailed knowledge of intracellular transport and cell motility is important for understanding the mechanisms of destruction of these processes in various pathologies that need to be adjusted.

* To whom correspondence should be addressed.

It was found that mutations in proteins participating in early vesicular transport lead to anemia and hemophilia [4]. A variety of transport disturbances in nerve cells cause neurodegenerative diseases [5]. Knowledge concerning what is happening with molecules participating in transport under certain pathological conditions gives the possibility for finding novel and effective ways of treatment [6]. Deviations of cell movements occur on oncogenic transformation and contribute to invasion and metastasis of cancer cells, which is the main cause of death in cancer patients (see review of A. Y. Alexandrova in this issue). Molecules that regulate movements are promising targets for anticancer drugs.

Understanding of transport routes in cells is important to establish the correct path for targeted delivery of drugs to specific cells and to specific cell compartments, including the nucleus. The problem of designing targeted delivery and specific carrier proteins is discussed in detail in the review of A. A. Rosenkranz et al. in this issue. Finally, understanding of the secretory pathway (cell logistics) should in future help to obtain eukaryotic superproducers of therapeutic proteins.

## REFERENCES

1. Vale, R. D. (2003) The molecular motor toolbox for intracellular transport, *Cell*, **112**, 467-480.
2. Bryantseva, S. A., and Zhapparova, O. N. (2012) Bidirectional transport of organelles: unity and struggle of opposing motors, *Cell Biol. Int.*, **36**, 1-6.
3. Ray, K. (2014) From fission to fusion: a perspective on the research that won the Nobel Prize in Physiology or Medicine, *J. Biosci.*, **39**, 3-12.
4. Khoriaty, R., Vasievich, M. P., and Ginsburg, D. (2012) The COPII pathway and hematologic disease, *Blood*, **120**, 31-38.
5. Franker, M. A., and Hoogenraad, C. C. (2013) Microtubule-based transport-basic mechanisms, traffic rules and role in neurological pathogenesis, *J. Cell Sci.*, **126**, 2319-2329.
6. Hinckelmann, M.V., Zala, D., and Saudou, F. (2013) Releasing the brake: restoring fast axonal transport in neurodegenerative disorders, *Trends Cell Biol.*, **23**, 634-643.