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Zebrafish embryogenesis genes

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Abstract

A large-scale study of regulated gene expression has identified novel genes that may be involved in zebrafish embryonic development

Significance and context

A major aim in developmental biology is to correlate changes in gene expression with developmental changes at the cellular level. Over the years, studies of regulated gene expression during embryogenesis have already provided many answers to questions about developmental mechanisms. The increase in the number of organisms whose genomes have been completely sequenced now makes it possible to overview complete gene populations that might be involved in embryogenesis. Kudoh *et al*. have studied regulated gene expression during embryogenesis in the zebrafish *Danio rerio*. A high-throughput screen based on *in situ* hybridization to detect gene-expression patterns revealed a set of markers for a characteristic structure in the zebrafish embryo - the yolk syncytial layer - and for different regions in the brain.

Key results

A normalized cDNA library was constructed that contained 2 million clones with an average size of 2 kilobases (kb). Of these, 2,765 clones were randomly selected and used as probes in the high-throughput *in situ* hybridization screen. Further analysis was carried out on the 347 of these probes (13%) that identified gene-expression patterns restricted to a single organ or to different but clearly identifiable regions of the embryo. Partial sequence analysis revealed recognized motifs in 163 of these clones, which included genes encoding transcription factors, secreted proteins, signal transduction mediators, receptors, other transmembrane proteins, enzymes, nucleic-acid-binding proteins, structural proteins, cell-cycle components and chaperone proteins. The complexity of gene-expression patterns in the yolk syncytial layer and the embryonic brain was shown, revealing several new markers for these structures. The yolk syncytial layer is unique to fish embryos, and is thought to be involved in the transport of nutrients from the yolk to the blastoderm. Most of the genes expressed in the yolk syncytial layer were expressed in this layer only, throughout all stages of development - for example, a gene encoding fructose-1,6-bisphosphatase. Some genes were downregulated after gastrulation, however, or were inactive early on but induced after 24 hours - for example, a transketolase-encoding gene. Interestingly,

one clone that was downregulated throughout embryonic development was similar to a human gene encoding a protein that regulates cell fusion. As the yolk syncytial layer is formed by cell fusion, this gene may be involved in its formation.

Links

All the data obtained by the gene-expression pattern screen and more information about the authors' laboratory are available at the Zebrafish cDNA database

Conclusions

Analyses of regulated gene expression can help to decipher complex developmental processes. This study confirms that 'synexpression groups' - sets of genes that share a similar complex expression pattern - can be used to discover novel components in known pathways.

Reporter's comments

This large-scale study identifies a numerous and diverse collection of genes as attractive candidates for roles in zebrafish development. Many of these genes need further study, including the effects of their knockout, to demonstrate their function during embryogenesis. The knowledge gained from our improved understanding of zebrafish embryonic development might also be applied to embryonic development in other vertebrates.

Table of links

Genome Research

Zebrafish cDNA database

References

1. Kudoh T, Tsang M, Hukriede NA, Chen X, Dedekian M, Clarke CJ, Kiang A, Schultz S, Epstein JA, Toyama R, Dawid IB: A gene expression screen in zebrafish embryogenesis. Genome Res. 2001, 11: 1979-1987. 1088-9051