Pediatric Glioblastoma Model Suggests Treatments

Mutations in the ATRX gene increase the aggressiveness and genetic instability of high-grade pediatric gliomas, but also leave tumors more susceptible to DNA-damaging drugs and radiation, according to a recently published study (Sci Transl Med 2016;8:328ra28).

ATRX, a histone chaperone protein, is inactivated by mutation in 30% of pediatric glioblastoma multiforme, tumors that progress rapidly, have no effective treatment, and are universally fatal. The study links ATRX to defects in DNA repair, and suggests that some children may benefit from treatments that induce double-stranded DNA breaks, including topoisomerase inhibitors—topotecan and irinotecan—and radiation.

“This paper helps not only to elucidate the biology of this histone protein, but also to lay the platform for deciding how to potentially treat patients who have ATRX mutations,” says Maciej Lesniak, MD, a neurosurgical oncologist and chairman of neurosurgery at Northwestern University Feinberg School of Medicine in Chicago, IL, who was not involved with the study.

In the new work, Maria Castro, PhD, of the University of Michigan School of Medicine in Ann Arbor, and colleagues created a mouse model of ATRX-deficient glioblastoma by knocking down the gene in neural stem cells in the lateral ventricles of newborn pups. The mice developed aggressive tumors that displayed microsatellite instability, an indicator of genomic instability.

ATRX mutations cause genetic instability in human tumors, too, the researchers showed. An analysis of publicly available genome sequencing data from 293 pediatric high-grade gliomas revealed a higher incidence of single nucleotide variation in ATRX-mutated tumors, compared to ATRX-wild-type tumors. ATRX status did not correlate with copy-number alterations or karyotypic changes. The effect of ATRX on mutation rate was unique to childhood tumors—an analysis of 290 adult glioblastomas revealed no effect of ATRX status on mutation rate.

Researchers created a mouse model of pediatric brain cancer by causing an ATRX mutation that occurs in many human tumors. Tissue staining differentiates healthy brain tissue (red) from glioblastoma (blue/green).

In the mice, ATRX loss resulted in specific defects in DNA repair, mainly affecting nonhomologous end joining pathways responsible for mending double-stranded DNA breaks. Because of the repair defect, the mouse tumors were more sensitive to agents that induce double-stranded DNA damage, including doxorubicin, topoisomerase inhibitors, and radiation.

The results suggest that ATRX loss results in tumors that are both more aggressive and more responsive to treatment. Recent studies have shown that in adults, lower-grade gliomas with ATRX mutations respond better to treatment.

In the new study, the researchers showed that ATRX mutations give a survival advantage in treated high-grade pediatric gliomas as well.

“We found exactly the same as in the mouse tumor—the genome of the pediatric cancers with ATRX mutations was unstable, and the children responded better to therapeutics,” Castro says.

The model will be useful for testing novel chemotherapeutic agents, either as single agents or in combination with radiation therapy. The model has another benefit too: Because it uses immunocompetent mice, researchers can assess immunotherapies as well, Castro says.—Pat McCaffrey

Proposed NIH Budget Includes Mandatory Funding

President Obama recently unveiled his proposed budget for fiscal year (FY) 2017, which would increase the NIH’s total budget by $825 million to roughly $33.1 billion. To fund the increase, he suggested relying on mandatory dollars instead of discretionary funding, which is controlled by Congress. In addition, he proposed trimming the NIH’s base budget, funded through discretionary spending, by $1 billion, which would then be offset by $1 billion in mandatory funding.

The modest overall increase of $825 million would prioritize just three NIH programs: $680 million for the NCI’s recently announced cancer “moonshot” initiative; $100 million for the Precision Medicine Initiative cohort program; and $45 million for the BRAIN initiative.

Many in the medical research advocacy community have greeted the proposed budget with considerable skepticism. “It’s unrealistic, generally speaking,” says Lynn Marquis, director of the Coalition for the Life Sciences. “Thinking in terms of your household budget, you’d never add to your mandatory expenses—picking up a more expensive mortgage, for instance—without knowing you could pay for it.” The same concept applies to what the president has proposed, she says, because a funding source for a mandatory budget increase for the NIH has yet to be identified. Additionally, competition for such funding sources is fierce.

Discretionary dollars are more favorably regarded, Marquis explains, because “the appropriations process allows for flexibility to add new programs or modify existing initiatives.” On the other hand, mandatory spending—once a federal revenue stream has been established—including no such flexibility, which “could be problematic for a constantly evolving agency like the NIH.” Nonetheless, she acknowledges that this was the president’s workaround “to ensure that important programs continue to receive sufficient support,” given that spending caps agreed to last year by Congress and the administration “left things very tight, fiscally.”

Mandatory funding is “not a totally foreign concept,” says NIH Director Francis Collins, MD, PhD. Last year, the House of Representatives passed the 21st Century Cures Act, aimed at accelerating drug discovery and development, which if implemented would provide nearly $9 billion in
mandated funding over 5 years for the NIH. Representatives proposed funding the bill by selling some of the nation’s petroleum reserves. The Senate is now considering its own version of this legislation.

Against that backdrop, “it’s not surprising that mandatory funding appeared in the budget proposal,” says Mary Woolley, president of Research!America. “It’s still a high-risk strategy, albeit not the first time a tactic of this kind has played out between a president and Congress when they’re of different parties, over something as inherently popular as medical research.” She points out that during the Clinton administration, “budgets with very modest increases for the NIH were put forward. President Clinton knew full well that Congress would add considerably to what he proposed—which they did.”

Representative Tom Cole (R–OK) and Senator Roy Blunt (R–MO), who lead the appropriations subcommittees overseeing the NIH and other health and education programs, have already announced their intention to boost the NIH’s budget, even “at the expense of other agencies within [our] jurisdiction.”

Plus, with public enthusiasm for medical research running high, those seeking reelection in November “will pay exquisite attention to what their constituents want,” Woolley adds. “We’re of the view that where there’s a will, there’s a way,” she continues. “Congress will find a way to put money behind its priorities. I do think they’ll do much more for the NIH, specifically, than the president did in his budget proposal.” –Alissa Poh

Metastatic Sites Predict Prostate Cancer Survival

According to a new meta-analysis of clinical trial data from patients with metastatic castration-resistant prostate cancer (mCRPC), overall survival (OS) is strongly influenced by where this disease spreads (J Clin Oncol 2016 March 7 [Epub ahead of print]). Previous reports had indicated as much but involved only small numbers of patients, warranting a more comprehensive investigation.

An international team of researchers—led by Susan Halabi, PhD, a professor of biostatistics at Duke University School of Medicine in Durham, NC—gathered information from nine phase III studies, encompassing 8,736 men with mCRPC. The patients in these trials had all received docetaxel as standard therapy. The researchers classified them into one of four groups corresponding to the site of metastases: bone, liver, lungs, and lymph nodes. Most (72.8%) had bone metastases; another 8.6% and 9.1% had metastatic lesions in the liver and lungs, respectively, while those with lymph node metastases made up the smallest group (6.4%).

The researchers confirmed earlier studies identifying visceral disease—liver and lung metastases—as a negative prognostic factor of survival. Patients with liver metastases fared worst, with a median OS of just 13.5 months; those with lung metastases had a slightly longer median OS of 19.4 months. In contrast, patients with disease involving bone or lymph nodes had median survival times of 21.3 and 31.6 months, respectively.

Anthony D’Amico, MD, PhD, chief of genitourinary radiation oncology at Dana-Farber/Harvard Cancer Center in Boston, MA, suggests that particular variants of mCRPC could explain the poorer survival of patients with visceral disease. “Classic prostate adenocarcinomas have a penchant for bone-only metastases,” he explains. “Certain other prostate tumors, though, have a mixed histology that includes a neuroendocrine or small-cell component. These readily spread to internal organs like the liver and lungs and are associated with a worse prognosis.” Recent research has shown that even classic prostate adenocarcinomas can acquire neuroendocrine expression over time, he adds.

Distinguishing neuroendocrine and small-cell prostate cancer from adenocarcinoma is important, D’Amico says, because approved hormone therapies like abiraterone acetate (Zytiga; Janssen) and enzalutamide (Xtandi; Astellas) are not effective against these variants. Rather, “you want to consider chemotherapy that’s used in such histologies—platinum drugs, for instance, or etoposide.”

The study researchers think the significantly different outcomes seen with these four subgroups highlight the importance of reporting end points, including OS, by metastatic site—although this has yet to be widely implemented in phase III studies of mCRPC. D’Amico agrees, adding that “future trials should be directed based on the biopsy of a patient’s metastatic lesion, so we know exactly what we’re dealing with and can figure out the best treatment.” –Alissa Poh

Inflammation May Activate Antitumor Mechanism

Inflammation promotes colorectal cancer, but it may also trip a molecular switch that hinders tumor growth by stimulating stem cells to divide asymmetrically, a recent study reported (Cell Stem Cell 2016;18:189–202).

Many types of normal stem cells divide asymmetrically, typically producing another stem cell and a cell that goes on to differentiate; normal intestinal and colon stem cells divide symmetrically. Cancer stem cells can divide symmetrically or asymmetrically, and “the consensus is that asymmetric division limits or suppresses cancer,” says Xiling Shen, PhD, of Duke University in Durham, NC, because it caps the number of cancer stem cells.

Shen and his colleagues investigated what controls intestinal stem cells’ mode of division, focusing on the developmental genes Numb and Notch and the tumor suppressor miR-34a. Notch stimulates cell division and promotes colon cancer, whereas Numb and miR-34a cause cells to differentiate and develop normally.

To the team’s surprise, they found that in addition to directly inhibiting Notch, miR-34a inhibits Numb—which is also an inhibitor of Notch. This counterintuitive result made sense, however, because the researchers determined that Numb, Notch, and miR-34a interact to form an incoherent feed-forward loop, a control circuit that behaves like a switch, directing cells to one of two fates. Flipping the switch in one direction produces high levels of Notch and causes symmetric
CANCER DISCOVERY

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