エナジードリンクは心機能を変化させる（Abstract: SSC02-06）

心臓MRI画像によりエナジードリンクが左室収縮能を増強させることが示された

Cardiac MRI images show that energy drinks increase systolic left-ventricular contractility

健康な成人がカフェインおよびタウリンを多く含むエナジードリンクを摂取すると1時間後の左室収縮能が有意に上昇するとのスタディ結果が、2013年Radiological Society of North America年次集会で発表された。現在進行中のこのスタディにおいて研究者らは、男性15人および女性3人（平均年齢27.5歳）の計18人において心臓磁気共鳴画像検査を用いてエナジードリンク摂取の心機能に対する影響を測定した。各々のボランティアがタウリン（400mg/100mL）およびカフェイン（32㎎/100mL）を含むエナジードリンク摂取前および1時間後に心臓磁気共鳴画像（MRI）を施行された。スタディ参加者がエナジードリンクを摂取して1時間後に施行した心臓MRIでは、ベースラインの画像と比較し、左心室のピークストレインおよびピーク収縮期ストレインレートが有意に増加することが示された。心拍数、血圧および左室駆出率はベースラインと2回目のMRI検査の時とで有意差はなかった。エナジードリンクを摂取することによる長期の心臓リスクについてはいまだ不明であるが、小児や既知の不整脈を有する人々は、心収縮の変化が不整脈のきっかけとなる可能性があるため、エナジードリンクの摂取を避けるべきである、と筆者らは結論付けている。

Full Text

Healthy adults who consumed energy drinks high in caffeine and taurine had significantly increased left-ventricular contractility one hour later, according to a study presented at the 2013 annual meeting of the Radiological Society of North America (RSNA).

"Until now, we haven't known exactly what effect these energy drinks have on the function of the heart," said radiology resident Jonas Dörner, M.D., of the cardiovascular imaging section at the University of Bonn, Germany, which is led by the study's principal investigator, Daniel K. Thomas, M.D. "There are concerns about the products' potential adverse side effects on heart function, especially in adolescents and young adults, but there is little or no regulation of energy drink sales."

Energy drinks represent a multibillion-dollar industry that is growing every day. While teenagers and young adults have traditionally been the largest consumers, in recent years more people of all demographics have begun consuming energy drinks.

A 2013 report from the Substance Abuse and Mental Health Services Administration stated that in the U.S. from 2007 to 2011, the number of emergency department visits related to energy drink consumption nearly doubled, increasing from 10,068 to 20,783. Most of the cases were identified among patients aged 18 to 25, followed by those aged 26 to 39.

"Usually energy drinks contain taurine and caffeine as their main pharmacological ingredients," Dr. Dörner said. "The amount of caffeine is up to three times higher than in other caffeinated beverages like coffee or cola. There are many side effects known to be associated with a high intake of caffeine, including rapid heart rate, palpitations, rise in blood pressure and, in the most severe cases, seizures or sudden death."

For the study, which is ongoing, Dr. Dörner and colleagues used cardiac magnetic resonance imaging (MRI) to measure the effect of energy drink consumption on heart function in 18 healthy volunteers, including 15 men and three women with a mean age of 27.5 years. Each of the volunteers underwent cardiac MRI before and one hour after consuming an energy drink containing taurine (400 mg/100 mL) and caffeine (32 mg/100 mL).

Compared to the baseline images, results of cardiac MRI performed one hour after the study participants consumed the energy drink revealed significantly increased peak strain and peak systolic strain rates (measurements for contractility) in the left ventricle of the heart.

"We don't know exactly how or if this greater contractility of the heart impacts daily activities or athletic performance," Dr. Dörner said. "We need additional studies to understand this mechanism and to determine how long the effect of the energy drink lasts."

The researchers found no significant differences in heart rate, blood pressure or the amount of blood ejected from the left ventricle of the heart between the volunteers' baseline and second MRI exams.

"We've shown that energy drink consumption has a short-term impact on cardiac contractility," Dr. Dörner said. "Further studies are needed to evaluate the impact of long-term energy drink consumption and the effect of such drinks on individuals with heart disease."

Dr. Dörner said that while long-term risks to the heart from drinking energy drinks remain unknown, he advises that children, as well as people with known cardiac arrhythmias, should avoid energy drinks, because changes in contractility could trigger arrhythmias. He also cautions that additional study is needed to address risks posed by the consumption of energy drinks in combination with alcohol.

Other co-authors are Daniel Kuetting, M.D., Claas P. Naehle, M.D., and Hans H. Schild, M.D.

新たなリハビリテーションデバイスは脳卒中後の運動技能を改善する（Abstract: SSE17-06）

思考を上肢を動かす電気インパルスに変換する新たなリハビリテーションデバイスは脳卒中患者に有益である

Stroke patients benefit from novel rehabilitation device that converts their thoughts to electrical impulses to move their upper extremities

個々人の思考を上肢を動かす電気インパルスに変換する新たな脳卒中リハビリテーションデバイスを用いることにより、脳卒中患者の運動機能および日常生活動作の施行能力が改善したと2013年Radiological Society of North America年次集会で発表された。研究者らは、脳卒中により片方の手に障害を負った8人の患者を組み入れ、彼らのリハビリテーションデバイスに関する小規模な臨床試験を行った。また患者らの異常のない方の手をコントロールとした。それぞれの患者が新たなデバイスを用いて2〜3時間のリハビリテーションセッションを3〜6週間にわたり9〜15回受けた。中等度重症度の脳卒中の患者においてリハビリテーションセッション後に運動機能が最も大きく改善した。軽症および重症の脳卒中と診断された患者らはリハビリテーション後には日常生活動作を完全に行えるほどに改善したと報告した。リハビリテーション前後のfMRI結果の比較から運動機能を司る脳領域の再構築が認められた。リハビリテーション過程中の拡張テンソル画像から線維路の整合性が徐々に強化されることが示された。

Full Text

Using a novel stroke rehabilitation device that converts an individual's thoughts to electrical impulses to move upper extremities, stroke patients reported improvements in their motor function and ability to perform activities of daily living. Results of the study were presented at the 2013 annual meeting of the Radiological Society of North America (RSNA).

"Each year, nearly 800,000 people suffer a new or recurrent stroke in the United States, and 50 percent of those have some degree of upper extremity disability," said Vivek Prabhakaran, M.D., Ph.D., director of functional neuroimaging in radiology at the University of Wisconsin-Madison. "Rehabilitation sessions with our device allow patients to achieve an additional level of recovery and a higher quality of life."

Dr. Prabhakaran, along with co-principal investigator Justin Williams, Ph.D., and a multidisciplinary team, built the new rehabilitation device by pairing a functional electrical stimulation (FES) system, which is currently used to help stroke patients recover limb function, and a brain control interface (BCI), which provides a direct communication pathway between the brain and this peripheral stimulation device.

In an FES system, electrical currents are used to activate nerves in paralyzed extremities. Using a computer and an electrode cap placed on the head, the new BCI-FES device (called the Closed-Loop Neural Activity-Triggered Stroke Rehabilitation Device) interprets electrical impulses from the brain and transmits the information to the FES.

"FES is a passive technique in that the electrical impulses move the patients' extremities for them," Dr. Prabhakaran said. "When a patient using our device is asked to imagine or attempt to move his or her hand, the BCI translates that brain activity to a signal that triggers the FES. Our system adds an active component to the rehabilitation by linking brain activity to the peripheral stimulation device, which gives the patients direct control over their movement."

The Wisconsin team conducted a small clinical trial of their rehabilitation device, enlisting eight patients with one hand affected by stroke. The patients were also able to serve as a control group by using their normal, unaffected hand. Patients in the study represented a wide range of stroke severity and amount of time elapsed since the stroke occurred. Despite having received standard rehabilitative care, the patients had varying degrees of residual motor deficits in their upper extremities. Each underwent nine to 15 rehabilitation sessions of two to three hours with the new device over a period of three to six weeks.

The patients also underwent functional magnetic resonance imaging (fMRI) and diffusion tensor imaging (DTI) before, at the mid-point of, at the end of, and one month following the rehabilitation period. fMRI is able to show which areas of the brain are activated while the patient performs a task, and DTI reveals the integrity of fibers within the white matter that connects the brain's functional areas.

Patients who suffered a stroke of moderate severity realized the greatest improvements to motor function following the rehabilitation sessions. Patients diagnosed with mild and severe strokes reported improved ability to complete activities of daily living following rehabilitation.

Dr. Prabhakaran said the results captured throughout the rehabilitation process—specifically the ratio of hemispheric involvement of motor areas—related well to the behavioral changes observed in patients. A comparison of pre-rehabilitation and post-rehabilitation fMRI results revealed reorganization in the regions of the brain responsible for motor function. DTI results over the course of the rehabilitation period revealed a gradual strengthening of the integrity of the fiber tracts.

"Our hope is that this device not only shortens rehabilitation time for stroke patients, but also that it brings a higher level of recovery than is achievable with the current standard of care," Dr. Prabhakaran said. "We believe brain imaging will be helpful in both planning and tracking a stroke patient's therapy, as well as learning more about neuroplastic changes during recovery."

Other co-authors are Dorothy Farrar-Edwards, Ph.D., Justin Sattin, M.D., Mitch Tyler, Ph.D., Veena A. Nair, Ph.D., Svyatoslav Vergun, B.S., Leo Walton, B.S., Jie Song, M.S., and Brittany Young, B.A., B.S.

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乳房トモシンセシスはがん検出率を上昇し再検査を減少させる（Abstract: SSK01-02）

デジタル乳房トモシンセシスを用いることによりがん検出目的の再検査率が有意に改善した

Ratio of callback to cancer detection rate improved significantly when using digital breast tomosynthesis

大規模乳がんスクリーニングプログラムにおいてデジタル乳房トモシンセシス（DBT）は再検査率を減少させがん検出率を上昇させた、と2013年Radiological Society of North America年次集会で発表された。デジタル乳房トモシンセシスは、若年女性およびデンスブレストの女性を含む全ての群の患者における再検査率軽減において有望であることが示された。トモシンセシスは電離放射線を用いて乳房の画像を作成する点においてマンモグラフィーと類似である。しかし、従来のマンモグラフィーとは異なり、トモシンセシスは乳房組織の3次元再構築をすることにより乳房全体を連続したスライスで観察することが可能である。スタディにおいて研究者らは、2011年以降にDBTを施行された女性15,633人の画像結果とその前年にデジタルマンモグラフィー検査を施行された患者10,753人の画像を比較した。デジタルマンモグラフィーと比較し、平均再検査率はDBTを用いることにより10.40%から8.78%まで低下し、がん検出率は4.28%から5.25%（患者1,000人当たり）に上昇した。全体の陽性的中率は4.1%からDBTを用いることにより6.0%に上昇した。トモシンセシスは進化しているプラットフォームであり、将来この技術はさらに向上するであろう、と研究者らは強調している。

Full Text

Researchers have found that digital breast tomosynthesis (DBT) led to reduced recall rates and an increase in cancer detection in a large breast cancer screening program. The results of this study were presented at the 2013 annual meeting of the Radiological Society of North America (RSNA).

Digital mammography is the gold standard for breast cancer screening, but may yield suspicious findings that turn out not to be cancer. These false-positive findings are associated with a higher recall rate.

Digital breast tomosynthesis has shown promise at reducing recall rates in all groups of patients, including younger women and women with dense breast tissue. Tomosynthesis is similar to mammography in that it relies on ionizing radiation to generate images of the breast. However, unlike conventional mammography, tomosynthesis allows for three-dimensional (3-D) reconstruction of the breast tissue, which can then be viewed as sequential slices through the breast.

Because DBT technology is relatively new, it is typically used only as a supplemental screening tool, but since October 2011, every patient screened for breast cancer at Hospital of the University of Pennsylvania (HUP) in Philadelphia has been screened using DBT, according to Emily F. Conant, M.D., chief of breast imaging at HUP and the study's lead author.

"We have used DBT on all of our breast screening patients," Dr. Conant said. "Every patient has had it—we have not selected patients because of their risk or breast density or if they were willing to pay extra. We did not charge extra and were able to provide all of our women with this new technology."

For the study, Dr. Conant and colleagues compared imaging results from 15,633 women who underwent DBT at HUP beginning in 2011 to those of 10,753 patients imaged with digital mammography the prior year. Six radiologists trained in DBT interpretation reviewed the images.

The researchers found that, compared to digital mammography, the average recall rate using DBT decreased from 10.40 percent to 8.78 percent, and the cancer detection rate increased from 4.28 to 5.25 (per 1,000 patients). The overall positive predictive value increased from 4.1 percent to 6.0 percent with DBT.

"Our study showed that we reduced our callback rate and increased our cancer detection rate," Dr. Conant said. "The degree to which these rates were affected varied by radiologist. But importantly, the ratio of callback to cancer detection rate improved significantly for our radiologists."

Dr. Conant notes that tomosynthesis is an evolving platform, and researchers are already seeing a significant improvement in important screening outcomes.

"It's the most exciting improvement to mammography that I have seen in my career, even more important than the conversion from film-screen mammography to digital mammography," she said. "The coming years will be very exciting, as we see further improvements in this technology."

Co-authors are Nandita Mitra, Ph.D., Anne Marie McCarthy, Ph.D., Despina Konto, Ph.D., Susan G. Roth, M.D., Susan P. Weinstein, M.D., Marie Synnestvedt, Ph.D., Mathew Thomas, B.S., and Fei Wan, Ph.D.

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乳がんリスクは加齢に伴う乳房密度の変化と関連する（Abstract: SSJ01-03）

一部の女性における加齢に伴う乳房密度の変化率が乳がんリスクに影響する可能性がある

The rate at which breast density changes in some women as they age may affect their breast cancer risk

若年女性において自動乳房密度測定は乳がんリスクの予測因子であり、一部の女性においてリスクは加齢に伴う乳房密度の変化率に関連するとの研究結果が2013年Radiological Society of North America年次集会で発表された。研究者らは若年女性と高齢女性の乳房密度とがんリスクを比較し、リスクが経時的な乳房密度変化にどのように関連するかを解析した。スタディ対象は乳がん282症例および健康なコントロール317人であり、フルフィールドデジタルマンモグラフィーを施行され、乳房密度は自動ボルメトリックシステムを用いて別に測定された。したがって、再現性のある客観的な定量的密度計測を行うことができた。乳がん患者は最高50歳の健康な参加者よりもマンモグラフィー上の密度が高かった。健康なコントロールは乳房密度が年齢とともに直線的に有意に低下したが、乳がん患者では乳房密度の減少にかなりばらつきがあった。マンモグラフィー上乳房組織密度が高い女性に関してはより短い間隔で追跡し、MRIや超音波などの他の画像も用いてがんの早期発見および治療を行うことが望ましい、と筆者らは述べている。

Full Text

Automated breast density measurement is predictive of breast cancer risk in younger women, and that risk may be related to the rate at which breast density changes in some women as they age, according to research presented at the 2013 annual meeting of the Radiological Society of North America (RSNA).

Breast density, as determined by mammography, is already known to be a strong and independent risk factor for breast cancer. The American Cancer Society (ACS) considers women with extremely dense breasts to be at moderately increased risk of cancer and recommends they talk with their doctors about adding magnetic resonance imaging (MRI) screening to their yearly mammograms.

"Women under age 50 are most at risk from density-associated breast cancer, and breast cancer in younger women is frequently of a more aggressive type, with larger tumors and a higher risk of recurrence," said the study's senior author, Nicholas Perry, M.B.B.S., FRCS, FRCR, director at the London Breast Institute in London, U.K.

For the new study, Dr. Perry and colleagues compared breast density and cancer risk between younger and older women and analyzed how the risk relates to changes in breast density over time. The study group included 282 breast cancer cases and 317 healthy control participants who underwent full-field digital mammography, with breast density measured separately using an automated volumetric system.

"In general, we refer to breast density as being determined by mammographic appearance, and that has, by and large, in the past been done by visual estimation by the radiologist—in other words, subjective and qualitative," Dr. Perry said. "The automated system we used in the study is an algorithm that can be automatically and easily applied to a digital mammogram, which allows an objective and, therefore, quantitative density measurement that is reproducible."

Breast cancer patients showed higher mammographic density than healthy participants up to the age of 50. The healthy controls demonstrated a significant decline in density with age following a linear pattern, while there was considerably more variability in density regression among the breast cancer patients.

"The results are interesting, because there would appear to be some form of different biological density mechanism for normal breasts compared to breasts with cancer, and this appears to be most obvious for younger women," Dr. Perry said. "This is not likely to diminish the current ACS guidelines in any way, but it might add a new facet regarding the possibility of an early mammogram to establish an obvious risk factor, which may then lead to enhanced screening for those women with the densest breasts."

For instance, some women might undergo a modified exposure exam at age 35 to establish breast density levels, Dr. Perry noted. Those with denser breast tissue could then be followed more closely with mammography and additional imaging like MRI or ultrasound for earlier cancer detection and treatment.

"It has been estimated that about 40 percent of life years lost to breast cancer are from women under 50 diagnosed outside of screening programs," Dr. Perry said. "In my practice, which is largely composed of urban professional women, 40 percent of cancers year to year are diagnosed in women under 50, and 10 percent in women younger than 40."

Co-authors are Katja Pinker-Domenig, M.D., Kefah Mokbel, M.B.B.S., FRCS, Sue E. Milner, B.Sc., and Stephen W. Duffy, M.Sc.

RSNA2013特集

MRガイド下超音波により乳がんの非侵襲的治療が施行できる（Abstract: SSK02-08）

MRガイド下高度集束超音波により非侵襲的乳がん焼灼が確実に施行できる

MR-guided high intensity focused ultrasound offers reliable ablation of invasive breast cancer

磁器共鳴（MR）ガイド下で集束超音波機器を用いた技術により腫瘍を熱し破壊することにより乳がんが安全かつ有効に治療できるとの研究結果が、Radiological Society of North America（RSNA）年次集会で発表された。MRガイド下集束超音波機器（MRgFUS）アブレーションは高度集束超音波の音響エネルギーを用いて病的組織を焼灼する非侵襲技術である。病変部位の特定およびアブレーション中の温度変化のモニターのためにMRIを継続的に使用する。研究者らは、浸潤性乳管がん患者12人において、がんの外科的切除およびリンパ節生検の前にMRgFUSを施行し、安全性および有効性を評価した。彼らは3T MRIを用いて、がん病変部位が存在し治療可能であることを確認した。その後患者らに単回のMRgFUS治療を施行した。研究者らは術後病理所見により治療の有効性を評価した。施術中または施術直後に有意な合併症を来した患者はいなかった。患者12人中10人においては、施術後に治療領域にMRI上強調される部位は認められなかった。これらの10人の患者においては、術後の組織評価により治療領域に残存病変はないことが確認された。

Full Text

A technique that uses focused ultrasound under magnetic resonance (MR) guidance to heat and destroy tumors may offer a safe and effective treatment for breast cancer, according to research being presented at the annual meeting of the Radiological Society of North America (RSNA).

MR-guided focused ultrasound (MRgFUS) ablation is a noninvasive technique that requires no incision or puncture to perform. Instead, it uses the acoustic energy from high-intensity focused ultrasound to remove, or ablate, diseased tissue. Continuous MRI is used to locate the lesions and monitor the temperature change during the ablation process.

Primary advantages of MRgFUS over other breast cancer treatments are that it is a noninvasive, outpatient procedure offering a quick recovery time, and that it provides precise measurement of temperature changes during the procedure.

"In the treatment stage, we are able to precisely visualize where the energy is having an effect and to measure exactly the rise in temperature," said Alessandro Napoli, M.D., Ph.D., assistant professor of radiology at Sapienza University in Rome. "Temperature monitoring is particularly important, since too low a temperature is ineffective and too high a temperature may be dangerous."

Dr. Napoli and colleagues assessed the safety and efficacy of MRgFUS in 12 patients with invasive ductal breast cancer before surgical removal of the cancer and biopsy of the lymph nodes. They used 3T MRI to confirm the presence and treatable location of cancerous lesions. The patients then underwent single-session MRgFUS treatment. Researchers evaluated treatment efficacy through post-surgery pathology.

None of the patients experienced significant complications during or immediately after the procedure. In 10 of the 12 patients, MRI showed no enhancement in the treatment area after the procedure. Post-surgery histological evaluation confirmed the absence of residual disease in the treatment area in those 10 patients.

"This procedure allows for safe ablation of breast cancer," Dr. Napoli said. "At pathology, no significant viable tumor was found in the specimens from these 10 patients."

In the other two cases, treatment failed due to transducer malfunction, and the pathologist observed residual tumor in the samples.

According to Dr. Napoli, MRI guidance is crucial for correct identification of lesions, treatment planning and real-time control during the procedure. Specifically, monitoring with MRI allows for efficient deposit of energy into the region of treatment at the correct range of between 60 degrees and 70 degrees Celsius (approximately 140 to 158 degrees Fahrenheit).

"This is carried out by a special sequence that is called MR thermometry," Dr. Napoli said. "Only MRI presently has the ability to determine, in real time, fine temperature quantification."

While the initial results are promising, Dr. Napoli said more research will be needed before the approach can be adopted as a stand-alone treatment for breast cancer.
Co-authors are Luisa Di Mare, M.D., Federica Pediconi, M.D., Michele Anzidei, M.D., Vincenzo Noce, M.D., and Carlo Catalano, M.D.

マンモグラフィーのスクリーニング間隔は乳がんの予後に影響を与える可能性がある（Abstract: SST01-01）

スクリーニングのマンモグラフィーを頻回に受けていた患者ほどリンパ節転移陽性率が有意に低かった

Patients who had screening mammograms more often had a significantly lower rate of lymph node positivity

スクリーニングマンモグラフィーにより検出された乳がん患者を対象としたスタディにおいて、スクリーニングマンモグラフィーをより頻回に受けていた患者はスクリーニング検査間隔が長期であった患者よりもリンパ節転移陽性率が有意に低かったとの結果であった、と2013年Radiological Society of North America年次集会で発表された。この後ろ向きスタディは、スクリーニングマンモグラフィーで乳がんを発見された女性332人を対象とし、スクリーニングマンモグラフィーの間隔に基づき3群（1.5年未満、1.5～3年、3年以上）のうちの1つに割り付けられた。女性の数はそれぞれ207、73および52人であった。年齢、乳房密度、高リスク状況および乳がん家族歴などで補正した結果、スクリーニングの間隔が1.5年未満の女性はリンパ節転移陽性率が8.7%と最低であった。リンパ節転移陽性率は1.5～3年および3年以上の群でそれぞれ20.5%および15.4%で有意に高かった。これらの結果に基づき筆者らは、女性らは40歳時にスクリーニングマンモグラフィーを開始し、2年に1度ではなく毎年受けるべきであると述べている。

Full Text

In a study of screening mammography-detected breast cancers, patients who had more frequent screening mammography had a significantly lower rate of lymph node positivity as compared to women who went longer intervals between screening mammography exams. Results of the study were presented at the 2013 annual meeting of the Radiological Society of North America (RSNA).

"On its pathway to other places in the body, the first place breast cancer typically drains into before metastasizing is the lymph nodes," said Lilian Wang, M.D., assistant professor of radiology at Northwestern University/Feinberg School of Medicine in Chicago, Ill. "When breast cancer has spread into the lymph nodes, the patient is often treated both locally and systemically, with either hormone therapy, chemotherapy, trastuzumab or some combination of these therapies."

Historically, healthcare organizations, such as RSNA and the American Cancer Society (ACS), have recommended annual screening with mammography for women beginning at age 40. However, in 2009, the United States Preventive Services Task Force (USPSTF) announced a controversial new recommendation for biennial screening for women between the ages of 50 and 74.

"Our study looks at what would happen if the revised guidelines issued by USPSTF were followed by women," Dr. Wang said.

The retrospective study, conducted at Northwestern Memorial Hospital, included 332 women with breast cancer identified by screening mammography between 2007 and 2010. The women were divided into one of three groups, based on the length of time between their screening mammography exams: less than 1.5 years, 1.5 to three years and more than three years. There were 207, 73 and 52 patients in each category, respectively.

Controlling for age, breast density, high-risk status and a family history of breast cancer, the researchers determined that women in the less than 1.5-year interval group had the lowest lymph node positivity rate at 8.7 percent. The rate of lymph node involvement was significantly higher in the 1.5- to three-year and over three-year interval groups at 20.5 percent and 15.4 percent, respectively.

"Our study shows that screening mammography performed at an interval of less than 1.5 years reduces the rate of lymph node positivity, thereby improving patient prognosis," Dr. Wang said. "We should be following the guidelines of the American Cancer Society and other organizations, recommending that women undergo annual screening mammography beginning at age 40."

Co-authors are Ellen B. Mendelson, M.D., Paula M. Grabler, M.D., Riti Mahadevia, B.A., and Laura Billadello, M.D.

MRI技術によりADHDにおいて脳内鉄が少ないことが示された（Abstract: SSK01-02）

磁場相関と呼ばれるMRI技術がADHDの診断改善および最良の治療を導くのに役立つ可能性がある

MRI technique called magnetic field correlation may help improve ADHD diagnosis and guide optimal treatment

磁気共鳴画像（MRI）により注意欠陥多動性障害（ADHD）患者の脳内鉄レベルを非侵襲的に測定できるとのスタディ結果が2013年Radiological Society of North America年次集会で発表された。過去のスタディにおいて、精神刺激薬はドーパミンレベルを上昇させドーパミンレベル低下が疑われる小児に役立つことが示された。脳内鉄はドーパミン合成に必要であるため、筆者らはMRIによる鉄レベル評価によりドーパミンを非侵襲的で間接的に測定できると確信した。彼らはADHDの小児と成人22人および健康なコントロールの小児と青少年27人の脳内鉄を磁場相関（MFC）と呼ばれるMRI技術を用いて測定した。薬物療法を一度も受けたことのない12人のADHD患者は精神刺激薬による治療を受けた10人のADHD患者や標準的に成育したコントロール27人よりもMFCが有意に低かった。一方、緩和速度または血清測定を用いた場合には群間で有意差は認められなかった。薬物療法未施行群における脳内鉄レベル低値は、精神刺激薬により正常化するようであった。MFC画像の非侵襲的脳内鉄レベル検出能力は、ADHDの診断改善および最良の治療を導くのに役立つ可能性があると研究者らは述べている。

Full Text

Magnetic resonance imaging (MRI) provides a noninvasive way to measure iron levels in the brains of people with attention deficit hyperactivity disorder (ADHD), according to a study presented at the 2013 annual meeting of the Radiological Society of North America (RSNA). Researchers said the method could help physicians and parents make better-informed decisions about medication.

ADHD is a common disorder in children and adolescents that can continue into adulthood. The American Psychiatric Association reports that ADHD affects 3 to 7 percent of school-age children.

Psychostimulant medications such as Ritalin are among the drugs commonly used to reduce ADHD symptoms. Psychostimulants affect levels of dopamine, a neurotransmitter in the brain associated with addiction.

"Studies show that psychostimulant drugs increase dopamine levels and help the kids that we suspect have lower dopamine levels," said Vitria Adisetiyo, Ph.D., postdoctoral research fellow at the Medical University of South Carolina in Charleston, S.C. "As brain iron is required for dopamine synthesis, assessment of iron levels with MRI may provide a noninvasive, indirect measure of dopamine."

Dr. Adisetiyo and colleagues explored this possibility by measuring brain iron in 22 children and adolescents with ADHD and 27 healthy control children and adolescents using an MRI technique called magnetic field correlation (MFC) imaging. The technique is relatively new, having been introduced in 2006 by study co-authors and faculty members Joseph A. Helpern, Ph.D., and Jens H. Jensen, Ph.D.

"MRI relaxation rates are the more conventional way to measure brain iron, but they are not very specific," Dr. Adisetiyo said. "We added MFC because it offers more refined specificity."

The results showed that the 12 ADHD patients who had never been on medication had significantly lower MFC than the 10 ADHD patients who had been on psychostimulant medication or the 27 typically developing children and adolescents in the control group. In contrast, no significant group differences were detected using relaxation rates or serum measures. The lower brain iron levels in the non-medicated group appeared to normalize with psychostimulant medication.

MFC imaging's ability to noninvasively detect the low iron levels may help improve ADHD diagnosis and guide optimal treatment. Noninvasive methods are particularly important in a pediatric population, Dr. Adisetiyo noted.

"This method enables us to exploit inherent biomarkers in the body and indirectly measure dopamine levels without needing any contrast agent," she said.

If the results can be replicated in larger studies, then MFC might have a future role in determining which patients would benefit from psychostimulants—an important consideration because the drugs can become addictive in some patients and lead to abuse of other psychostimulant drugs like cocaine.

"It would be beneficial, when the psychiatrist is less confident of a diagnosis, if you could put a patient in a scanner for 15 minutes and confirm that brain iron is low," she said. "And we could possibly identify kids with normal iron levels who could potentially become addicts."

Along with replicating the results in a larger population of patients, the researchers hope to expand their studies to look at the relationship between cocaine addiction and brain iron.

Other co-authors are F. Xavier Castellanos, M.D., Adriana Di Martino, M.D., Kevin M. Gray, M.D., Els Fieremans, Ph.D., Ali Tabesh, Ph.D., and Rachael L. Deardorff, M.S.

RSNA2013特集

MRスペクトロスコピーにより早産児の脳の違いが示される（Abstract: CL-PDS-SU5A）

早産児に対するMRスペクトロスコピーにより白質の発達は灰白質の成長と"ずれている"ことが示された

Magnetic resonance spectroscopy on premature infants reveals white matter development is 'out of sync' with gray matter development

早産は、子供を先々衝動性や注意力散漫などの問題から自閉症や注意欠陥多動性障害などのさらに重症な状態のリスクを上昇させ得る白質の成長過程の引き金となるようである。構造的磁気共鳴画像検査（MRI）において何らかの白質の傷害は一目で明らかであったが、研究グループはMRスペクトロスコピー（MRS）を用いて光顕レベルでの違いを観察した。今回のスタディにおいて研究者らは満期産児51人および早産児30人において、成熟した白質および灰白質に関連するある化学物質の濃度を比較した。スタディ対象者群の構造的MRI所見は正常であったが、MRSの結果から白質の生物化学的成熟度は満期産児と早産児とで有意に異なることが示され、白質と灰白質の成熟のタイミングおよび同期の乖離が示唆された。新生児の脳は著明な可塑性を有しており、したがって、特に異常が早期に同定されれば治療的介入がより有効であり得る。このスタディ結果は2013年Radiological Society of North America年次集会で発表された。

Full Text

Premature birth appears to trigger developmental processes in the white matter of the brain that could put children at higher risk of problems later in life, according to a study presented at the 2013 annual meeting of the Radiological Society of North America (RSNA).

Preterm infants—generally those born 23 to 36 weeks after conception, as opposed to the normal 37- to 42-week gestation—face an increased risk of behavioral problems, ranging from impulsiveness and distractibility to more serious conditions like autism and attention deficit hyperactivity disorder (ADHD).

"In the United States, we have approximately 500,000 preterm births a year," said Stefan Blüml, Ph.D., director of the New Imaging Technology Lab at Children's Hospital Los Angeles and associate professor of research radiology at the University of Southern California in Los Angeles. "About 60,000 of these babies are at high risk for significant long-term problems, which means that this is a significant problem with enormous costs."

Dr. Blüml and colleagues have been studying preterm infants to learn more about how premature birth might cause changes in brain structure that may be associated with clinical problems observed later in life. Much of the focus has been on the brain's white matter, which transmits signals and enables communication between different parts of the brain. While some white matter damage is readily apparent on structural magnetic resonance imaging (MRI), Dr. Blüml's group has been using magnetic resonance spectroscopy (MRS) to look at differences on a microscopic level.

In this study, the researchers compared the concentrations of certain chemicals associated with mature white matter and gray matter in 51 full-term and 30 preterm infants. The study group had normal structural MRI findings, but MRS results showed significant differences in the biochemical maturation of white matter between the term and preterm infants, suggesting a disruption in the timing and synchronization of white and gray matter maturation.

"The road map of brain development is disturbed in these premature kids," Dr. Blüml said. "White matter development had an early start and was 'out of sync' with gray matter development."

This false start in white matter development is triggered by events after birth, according to Dr. Blüml.

"This timeline of events might be disturbed in premature kids because there are significant physiological switches at birth, as well as stimulatory events, that happen irrespective of gestational maturity of the newborn," he said. "The most apparent change is the amount of oxygen that is carried by the blood."

Dr. Blüml said that the amount of oxygen delivered to the fetus's developing brain in utero is quite low, and our brains have evolved to optimize development in that low oxygen environment. However, when infants are born, they are quickly exposed to a much more oxygen-rich environment.

"This change may be something premature brains are not ready for," he said.
While this change may cause irregularities in white matter development, Dr. Blüml noted that the newborn brain has a remarkable capacity to adapt or even "re-wire" itself—a concept known as plasticity. Plasticity not only allows the brain to govern new skills over the course of development, like learning to walk and read, but could also make the brains of preterm infants and young children more responsive to therapeutic interventions, particularly if any abnormalities are identified early.

"Our research points to the need to better understand the impact of prematurity on the timing of critical maturational processes and to develop therapies aimed at regulating brain development," Dr. Blüml said.

Co-authors are Ashok Panigrahy, M.D., Marvin D. Nelson, M.D., Lisa Paquette, M.D., and Jessica L. Wisnowski, Ph.D.

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