SUMMARY AND CONCLUSION

I- Summary

Magnetic Resonance Imaging (MRI) is one of the most rapidly advancing diagnostic imaging tools today. Various types of acoustic noise are produced during the operation of MR systems. The problems associated with acoustic noise for patients and healthcare workers include simple annoyance, difficulties in verbal communication, heightened anxiety, temporary hearing loss, and potential permanent hearing impairment. Acoustic noise may pose a particular hazard to specific patient groups who may be at increased risk.

This study aimed to investigate the potential MRI sound adverse effects on some biophysical (dielectric properties) and biochemical (blood glucose level, malondialdehyde and superoxide dismutase in the brain) parameters of mice. Exploring there was correlation between MRI sound power and the severity of these parameters.

In this work the following materials and methods were used:

- The actual sound arise from MRI system (closed type 1.5T) were recorded using microphone attached to laptop, then saved on mp3 device which then connected to loud speaker. The noise source intensity was adjusted to be 90, 100 and 121 dB at the loud speaker using sound level meter device.
- Anechoic chamber was designed and performed to insulate the sound. Illumination and ventilation were taken into account upon design. All the exposures were performed inside it.
- The animals used were 40 mice divided to 4 groups each of ten mice, classified as the following:
    - **Control group (GpA):** remained in the anechoic chamber for two hours daily for a week without exposure to any noise.
    - **Experimental group (GpB1)**: exposed to sound intensity of 121 dB for 2 hours daily for a week.
    - **Experimental group (GpB2)**: exposed to sound intensity of its ***actual value*** 100 dB for 2 hours daily for a week.
    - **Experimental group (GpB3)**: exposed to sound intensity of 90 dB for 2 hours daily for a week.

After exposure period, mice were sacrificed and blood samples were withdrawn to determine:

- Total and differential white blood cells (WBCs) count.
- Blood glocuse level.
- Brain tissues disected, and devided into two portions, one portion for the dielectric measurements and the other portion was homogenized for determination of:
    - Brain superoxide dismutase activity to indicate the oxidative stress state.

- Brain malondialdehyde concentration to assess the lipid peroxidation state in brain cell membrane.

The results of the present work are:

1- Significant increase in blood glucose level in all experimental groups as compared with control group.

2- Significant increase in total blood WBCs and blood platelets count in all experimental groups as compared with control group.

3- Significant decrease in hematology markers (Hb, Ht, RBCs, MCV, MCH and MCHC) in all experimental groups as compared with control group

4- Significant decrease in brain superoxide dismutase activity in all experimental groups as compared with control group.

5- Significant increase in brain malondialdehyde concentration in all experimental groups as compared with control group.

6- Changes in the dielectric properties (conductivity and permittivity) in all experimental groups as compared with control group, and the degree of depressed center and the maximum values of the real conductivity and permittivity depend on the noise intensities.

II. Conclusions:

Depending on the present work results, we can conclude that acoustic noise that produced during the operation of MR systems have direct and clear effect on:

- The biochemical parameters (MDA levels, superoxide dismutase activity, and blood glucose level).
- Blood glucose level.
- Total WBCs count.
- Oxidative stress state.
- The dielectric properties of brain tissue.

Recommendation:

The simplest and least expensive means of preventing problems associated with acoustic noise during MR procedures is to encourage the routine use of disposable earplugs or headphones. Earplugs, when properly used, can abate noise by 10 to 30 dB, which is usually an adequate amount of sound attenuation for the MR environment. The use of earplugs typically provides a sufficient decrease in acoustic noise that, in turn, is capable of preventing hearing problems.

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الملخص العربى

التصوير بالرّنين المغناطيسي من الوسائل التشخيصية الهامة ولكن أثناء التصوير يتعرض المريض لضوضاء صادرة من جهاز الرنين المغناطيسي ناتجة من التغير الشديد والسريع في المجال المغناطيسي للجهاز وهذا قد يؤدي بدوره إلى أضرار صحية للمريض.

- الضوضاء: تعرف الضوضاء بأنها خليط متنافر من الأصوات ذات استمرارية غير مرغوب فيها وتشكل خطر كبير علي صحة الإنسان. يمكن قياس الضوضاء بطرق فيزيائية يُعبر عنها بالديسيبل. وقد وجد أن التعرض إلي ضوضاء بمستوي ٨٥ ديسيبل أو أكثر لفترة قد يؤدي إلي فقدان السمع الدائم. هناك الكثير من التأثيرات الصحية الناجمة عن تلك الضوضاء منها التأثيرات السمعية المباشرة ويندرج تحتها ضعف السمع أو فقدانه بشكل كامل ومنها التأثيرات الغير سمعية مثل ارتفاع ضغط الدم، امرضا الجهاز الدوري، اضطرابات النوم و الاضطرابات النفسية والعصبية.

تأثيرات الضوضاء السمعية التي تتولد من جهاز الرنين المغناطيسي خلال فترة التصوير الغير مرغوبة لها تأثيرات جانبية هي تأثيرات صحية مضادة تصنف دائما طبقا لنوع الضوضاء. يعمل على سهولة التأثر بهذه الزيادة من مستوى الضوضاء إلى الأمراض وعوامل مضاعفة يعمل مشاكل في القلب وأمراض أخرى. وبيان بان هناك مؤشرات معقولة بارتباط عادي بين التعرّض للضوضاء وتأثيرها على الصحة كما موجود في دراستنا.

الإعتبارات الأساسية:

تم عرض الأسس الفيزيائية للصوت وكيفية قياس الضوضاء ومدى تأثيره على الأذن البشرية وعرض أيضا الأسس الفيزيائية لجهاز الرنين المغناطيسي ومصدر الضوضاء لهذا الجهاز. كما تم توضيح خاصية العزل الكهربي للأنسجة ومدى تأثرها بالضوضاء.

هدف الرسالة:

تهدّفْ هذه الدراسة إلى بيان التأثيرات الغير سمعية للصوت الصادر أثناء التصوير بالرنين المغناطيسي على بعض الخواص الفيزيائية (العزل الكهربي) لنسيج مخ الفأر وبعض التغيرات الكيميائية الحيوية مثل نسبة السكر في الدم، ومستوى بعض الأنزيمات المضادة للأكسدة مثل malondialdehyde، superoxide dismutase في مخ الفئران. وكشف الارتباط بين شدة الصوتِ الصادر أثناء التصوير بالرّنين المغناطيسي وهذه المتغيرات في دم ومخ الفئران.

مادة البحث والطرق المستخدمة في البحث:

تم تسجيل الصوت الفعليَ الصادر من جهاز الرنين المغناطيسي (من النوع المغَلقَ 1.5T) الثناء التصوير لمدة 27 دقيقة بواسطة مسجل متصل بجهاز كمبيوتر محمول ثم نقل مصدر الصوت على ناقل ذاكرة وتوصيلها بمكبر للصوت متصل بسماعات عالية القدرة. تم ضبط مصدر الصوت على مسافة عشرة سنتيمترات من مركز السماعة لتكون قوة الضوضاء ٩٠ أو ١٠٠ أو ١٢١ ديسيبيل باستعمال جهاز قياس مستوى الصوت (Sound level Meter). تم استخدام مجموعة من برامج الكمبيوتر لتحليل مصادر الضوضاء والتعرف على التردد الرئيسى

تم تصميم وتصنيع غرف معزولة صوتيا من الخشب مبطنة بعوازل للصوت والمراعى فيها توصيل مصادر للإضاءة والتهوية مع مراعاة منع تسريب الصوت منها أو إليها وتم إجراء التعريض لكل المجموعات داخل هذه الغرف.

في هذه الرسالة تم استخدام ٤٠ فأر تم تقسيمها إلي أربع مجموعات كالأتي

- المجموعة الأولى: المجموعة الضابطة. تم وضعهم في حجرة التعرض لمدة ساعتان يوميا لمدة أسبوع دون ضوضاء.
- المجموعة الثانية: يتم وضعهم في حجرة التعرض حيث يتعرض الفئران في هذه المجموعة إلى ضوضاء شدتها ١٢١ ديسيبل لمدة ساعتان يوميا لمدة أسبوع.

- المجموعة الثالثة: يتم وضعهم في حجرة التعرض حيث يتعرض الفئران في هذه المجموعة إلى ضوضاء شدتها ١٠٠ ديسيبل لمدة ساعتان يوميا لمدة أسبوع.
- المجموعة الرابعة: يتم وضعهم في حجرة التعرض حيث يتعرض الفئران في هذه المجموعة إلى ضوضاء شدتها ٩٠ ديسيبل لمدة ساعتان يوميا لمدة أسبوع.

وبعد انتهاء فترة التعريض تم إجراء الخطوات الآتية:

- تجميع عينات من دم الفئران لدراسة كل من :
  ١- نسبه الجلوكوز بالدم كيميائيا.
  ٢- العد الكلي لكرات الدم البيضاء والحمراء وكذلك الصفائح الدموية بصورة رقمية.
- ذبح الفئران وأخذ عينات من المخ لعمل الآتى:
  ١- استخدام جزء من مخ الفئران وتم تحضيرها لقياس:
  أ. إنزيم السوبر أكسيد ديسميوتيز (Superoxide dismutase) وذلك لمعرفة مدى تكوين الأصول الحرة فى جسم الفئران المعرضة.
  ب. ماده المالوندايالداهيد (Malondialdhde) والتى تعطى انطباعا مباشرة عن مدى أكسدة الدهون المكونة لخلايا المخ.
  ٢- الجزء الآخر من المخ لدراسة العزل الكهربائي.

النتائج:

- حدوث ارتفاع ملحوظ لنسبة الجلوكوز في دم الفئران المعرضة عن تلك التي لم تتعرض نهائيا للضوضاء.
- حدوث ارتفاع ملحوظ للعد الكلي لكرات الدم البيضاء و الصفائح الدموية، وانخفاض ملحوظ في عدد كرات الدم الحمراء لجميع الفئران المعرضة للضوضاء.
- ارتفاع ملحوظ لمستوى تركيز المالوندهايد للفئران المعرضة عن تلك التي لم تتعرض نهائيا للضوضاء.
- حدوث انخفاض ملحوظ لنسبة إنزيم السوبر أكسيد ديسميوتيز للمجموعات التي تعرضت للضوضاء عن تلك التي لم تتعرض نهائيا للضوضاء.
- تغير في خواص العزل الكهربي لنسيج المخ للمجموعات التي تعرضت للضوضاء عن تلك التي لم تتعرض نهائيا للضوضاء.

مناقشة النتائج:

تفسيرا لهذه النتائج تمت مقارنة النتائج التي حصلنا عليها مع دراسات وأبحاث علمية سابقة تتعلق بنفس الموضوع، كما تم ذكر بعض الأبحاث التى أظهرت نتائج مشابهة. وقد عرضت المناقشة بأسلوب علمي سليم و تعد مناقشة وافية لجميع أوجه البحث ونتائجه.

الاستنتاجات:

نستنتج من النتائج السابقة ان الضوضاء الصادرة من جهاز الرنين المغناطيسي أثناء التشخيص لها تأثير ضار ومباشرفي المدى الصوتي تمت الدراسة علي:

١- نسبه الجلوكوز بالدم مما قد يعرض الكائن الحى للإصابة بمرض السكرى.
٢- العد الكلي لكرات الدم البيضاء يتاثر مما يؤدى إلى اضطرابات فى خط الدفاع الداخلى للجسم وهو المناعة.
٣- نسبه تواجد المواد المؤكسدة بالجسم.
٤- أثبتت الدراسة أن هناك تغيرات فى خاصية العزل الكهربي لأنسجة المخ مما يدل على مدى تأثير الضوضاء الناتجة من جهاز الرنين المغناطيسي المستخدم على الكثير من العمليات الحيوية بالجسم.

دراسة بعض التأثيرات البيوفيزيائية والبيوكيميائية للصوت الناتج من جهاز الرنين المغناطيسى للتصوير: باستخدام الفئران كنموذج تجريبى

رسالة

مقدمة إلى معهد البحوث الطبية– جامعة الإسكندرية
ايفاءا جزئيا لشروط الحصول على درجة

الماجستير

فى

الفيزياء الحيوية الطبية

مقدمة من

رمزية مصطفى شاهين

بكالوريوس تكنولوجيا طبية فى تقنيات الأشعة
جامعة بغداد، ٢٠٠٢

معهد البحوث الطبية
جامعة الإسكندرية
٢٠١٤

دراسة بعض التأثيرات البيوفيزيائية والبيوكيميائية للصوت الناتج من جهاز الرنين المغناطيسى للتصوير: باستخدام الفئران كنموذج تجريبى

مقدمة من

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جامعة بغداد
٢٠٠٢

للحصول على درجة

الماجستير

فى

الفيزياء الحيوية الطبية

لجنة المناقشة والحكم على الرسالة	**موافقون**
ا.د. طارق عثمان النمر أستاذ متفرغ قسم الفيزياء الحيوية كلية العلوم جامعة طنطا	.....
أ.د. يوسف سليم يوسف أستاذ متفرغ قسم الفيزياء الحيوية معهد البحوث الطبية جامعة الإسكندرية	.....
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السادة المشرفون

أ.د/ يوسف سليم يوسف .....

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