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Role of Anesthesia in Reducing Artifacts in Claustrophobic and Infant Patients undergoing MRI

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ABSTRACT

Objectives: To determine the role of anesthesia in reducing artifacts in claustrophobic and infant patients undergoing MRI.
Study Design: Cross-sectional study.
Place and Duration of Study: Armed Forces Institute of Radiology and Imaging, Rawalpindi Pakistan, from Apr 2023 to Sep 2023.
Methodology: Study included 385 claustrophobic and infant patients undergoing MRI. In collaboration with Anesthesia department, claustrophobic and infant patients were given anesthesia. For infant patients, General Anesthesia was given, induction of anesthesia was given by Propofol, and maintenance of anesthesia was through Sevoflurane. Adults 18 years or above, cooperative patients and only history of claustrophobia were administered anesthesia through sedatives e.g Dormicum (Midazolam). Artifacts if present were calculated. SPSS version 26.0 was used to record, enter, and analyze the data.
Results: out of 385 patients, 195(50.6%) were male and 190(49.4%) were female. MRI results showed that 369(95.8%) of the scan had no artifacts, while 16(4.1%) of the patients had artifacts in their MRI scan. In term of complications only 4(1.03%) had mild complications like allergic responses, vomiting, and nausea.
Conclusion: The study here concluded that anesthesia have positive role in reducing artifacts in claustrophobic and infant patients undergoing MRI.
Keywords: Anesthesia, Artifacts, Claustrophobic, Infant Patients.

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INTRODUCTION

Improvements in imaging technologies over the last few decades have made medical practice more advanced. Medical imaging technology has been vital in helping with quick clinical diagnosis and treatment, particularly during the COVID-19 epidemic. Magnetic resonance imaging (MRI) offers superior soft tissue resolution and multi-planar reconstruction over other imaging modalities. It also shields the patient from the risk of ionising radiation and improves the visualisation of lesion size, shape, and location.[1] Magnetic resonance imaging (MRI) an get multiplanar images to assess the structure and function of body organs without the use of ionising radiation and has a high soft-tissue contrast resolution, it is becoming more and more useful in a range of pediatric disorders.[2] Thus, a common issue is claustrophobia impeding MR imaging. For every patient booked for MR imaging, 1% to 15% have claustrophobia, making them impossible to image, or they need sedation to go through the scan (mean: 2.3%; 95% confidence interval: 2.0% to 2.5%).[3] Therefore, it is predicted that claustrophobia prevents over 2,000,000 MR treatments from being done globally or results in their early termination. This equates to a €1 billion loss in productivity at an average cost of €500 per MR scan, which is a significant financial loss for the healthcare system. Thus, claustrophobia is not only a prevalent issue that keeps a large number of patients from taking use of the information gleaned by MR imaging, but it also poses a significant socioeconomic challenge to the health care system. During MR imaging, patients who suffer from claustrophobic anxiety are more likely to feel scared and enclosed in some way.[4] In December 2016, the FDA warned the public about the potential hazards of poor neurodevelopment in children under three years old associated with recurrent or prolonged exposure to sedatives and general anaesthetics during surgeries or procedures. A number of studies involving human subjects and several that used animal models served as the impetus for this.[5] For example, a recent observational clinical study concluded that prospective studies are necessary to further address this potential association, even though it found that repeated exposure to anesthesia/surgery during the first two years of age was a significant independent risk factor for the development of learning disabilities and the need for individualised education programmes.[6] Furthermore,

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the effects of general anaesthesia exposure in infants between the ages of three months and four years have not received much attention in the literature overall.[7] The general anaesthesia and awake-regional anaesthesia (GAS) study, a well-known randomised controlled experiment, is the source of the strongest cooperative effort to date. Strong evidence was discovered in the study, which included up to five years of follow-up, to suggest that brief exposures (less than an hour) to general anaesthesia or sedation are not linked to notable abnormalities in neurocognition or behaviour.[8] In this analysis, which focused on the association between aspiration and nil per os (NPO, or pre-study fasting) state, it was discovered that NPO status was not a reliable indicator of aspiration or any significant difficulties in this sizable dataset.[9] The study examines the efficacy of anesthesia in mitigating motion artifacts in MRI scans for claustrophobic and infant patients. Patient movement during MRI procedures often leads to image artifacts, compromising diagnostic accuracy. Anesthesia offers a potential solution by inducing sedation or unconsciousness, ensuring patient stillness throughout the scan. This improves image quality, reducing the need for repeat scans and enhancing diagnostic reliability. By addressing the specific needs of claustrophobic and infant patients, the study aims to improve patient comfort, optimize resource utilization, and enhance safety in MRI settings. Clearer, artifact-free images facilitate more accurate diagnoses and treatment planning, ultimately improving patient outcomes. Additionally, anesthesia protocols tailored to these populations ensure safety while maximizing the effectiveness of the procedure. The study's findings hold promise for streamlining MRI processes, reducing healthcare costs, and enhancing the overall quality of care for vulnerable patient groups. The study aims to define role of anesthesia in reducing artifacts in claustrophobic and infant patients undergoing MRI.

METHODOLOGY

This cross sectional study was carried out on 385 claustrophobic and infant patients including undergoing MRI from Apr 2023 to Sep 2023. Clasutrophobia was determined clinically by a radiologist interpreting. All the patients who underwent this procedure during study duration were included in the study. The Armed Forces Institute of Radiology and Imaging in Rawalpindi, Pakistan, conducted a review of the work and gave it their approval (IREB-Reference number: AFIRI-RWP-ERB-APRVL-016).

Before the study began, all participants were given comprehensive study material, including goals, objectives, and explanations, and they were all requested to sign an informed consent form.

Inclusion Criteria: Claustrophobic and Infant patients were included.

Exclusion Criteria: All respondents who did not give informed consent, Respondents with allergy to MRI contrast material, Patients with any metallic implants, and pacemakers were excluded.

In collaboration with Anesthesia department, claustrophobic and infant patients were given anesthesia. For infant patients, General Anesthesia was given, induction of anesthesia was given by Propofol, and maintenance of anesthesia was through Sevoflurane. Adults 18 years or above, cooperative patients and only history of claustrophobia were administered anesthesia through sedatives Midazolam. However, for uncooperative adults, general anesthesia same as infants was given. MRI was performed. Artifacts if present were calculated as it is an effect on image: Artifacts usually appear as generalized blurring, ghosting, signal loss or undesired signals in the fired of view especially in phase encoding direction. Complications like allergic responses, vomiting, and nausea. Data was analyzed by using Statistical Package for Social Sciences (SPSS) 22.00. Qualitative data was represented by using percentage and frequency.

RESULTS

Of 385 patients, 195(50.60%) were male and 190(49.40%) were female while 201(52.20%) were claustrophobic and 184(47.80%) were infants. Anesthesia was administered to all the patients (100.00%) before procedure. Out of 385 patients who underwent MRI, only 16(4.10%) had artifacts on MRI images while rest were not having any kind of artifacts (Table). In terms of complications, only 4(1.03%) patients had mild complications like allergic responses, vomiting, and nausea.

Table: Percentages of Patients having artifacts on Magnetic Resonance Imaging (MRI) Images (n=385)

Variables	Values
MRI images without artifacts	369(95.80%)
MRI images with artifacts	16(4.10%)
Gender	
Male	7(43.75%)
Female	9(56.25%)
Distribution with Artifacts	
Infants	10(62.50%)
Claustrophic	6(37.50%)

**Magnetic Resonance Imaging: MRI*

DISCUSSION

This prospective study was carried out on 385 patients, out of which 369(95.8%) of the patients had no artifacts scene on their MRI scan. The present study used sevoflurane for maintenance of anesthesia in MRI. The results were in accordance to a study carried out by Azmat Riaz Tiwana *et al*. The use of sevoflurane anaesthesia combined is a safe method for producing artifact-free paediatric MRI images. But they were unable to measure artifacts found in scan.[10] Compared to other powerful inhaled anaesthetics, sevoflurane is less odorous, has a lower solubility, and has a stronger hemodynamic stability. These factors have contributed to its increased use as an anaesthetic material. In our investigation, sevoflurane was the only anaesthetic agent utilised because the rate of adverse events increased dramatically when three or more sedative medicines are used.[11,12] Present study found that only 1.03% of the patients had complications in case of anesthesia, the results were in accordance to a study carried out by Thakkar *et al.,* where 1.2% of complications were linked to procedures carried out under GA.[13] Present study found that their was change in body temperature pre and post sedation is in favor of a study carried out by Oznur Uludag *et al*. Paediatric children receiving sedation during an MRI treatment showed a notable drop in body temperature.[14] Present study found that anesthesisa can reduce artifacts is in favors of study carried out by Micheal A. Pritchet *et al*. In order to minimise motion artefact, reduce atelectasis, stabilise dependent lung regions, and improve localization accuracy during guided bronchoscopy, anaesthesia strategies are presented in this work.[15] Present study is not in favor of study carried out by Nathelie P Kool *et al.,* where they found 12 artifacts in 80 patients, the difference might be due to difference in sample size, type of population used.[16] Present study found that anesthetic machine don't enhance the artifacts in MRI scan is in favor of a study carried out by Barbara Testa et al. Monitoring and anaesthetic equipment don't seem to have an impact on the quality of MRI.[17] The small area and condensed appointment times on the mobile MRI units, according to Hudson, Haley & Vine, may be the cause of the high rate of claustrophobia. And may cause artiafcts, hence use of anesthesia can lesser these artifacts.[18]

LIMITATION OF STUDY

Lack of a control group, observational design, small sample size, exclusion of individuals with normal results, and lack of an association with risk variables were all limitations in the study.

CONCLUSION

The study here concluded that anesthesia has positive role in reducing artifacts in claustrophobic and infant patients undergoing MRI

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

HKJ & RB: Data acquisition, data analysis, critical review, approval of the final version to be published.

KMBH & HA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

ZS & JK: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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