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RESEARCH ARTICLE

INVOLVEMENT OF THE LOCATION OF INTRAPARENCHYMAL EDEMA AFTER A CEREBROVASCULAR EVENT IN THE APPROACH OF A DECOMPRESSIVE CRANIECTOMY

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Abstract

Introduction: Decompressive craniectomy, introduced by Kocher in 1901, reduces intracranial pressure by removing part of the skull. It is used in severe neurological conditions such as brain injury and stroke, allowing the swollen brain to expand, thereby reducing mortality and improving function.

Objective: To evaluate the effect of the location of intraparenchymal edema on the efficacy of decompressive craniectomy and postoperative clinical outcomes.

Methods: A systematic search was performed in PubMed, Cochrane Library and Scopus. This search was focused on studies related to intracranial hypertension and its neurosurgical approach.

Results: In this study, the following risk factors for mortality after decompressive craniotomy were identified: male sex, age over 50 years and late surgery. Operating between 12-24 hours improves results, especially in the non-dominant hemisphere. Correct surgical technique minimizes complications and improves the healing process of patients.

Discussions: This study demonstrates that the location of intra-abdominal edema affects the results of craniectomy, with better results in the non-dominant hemisphere. A better understanding of brain anatomy and individualization of surgical techniques are essential to reduce complications and improve surgical outcomes after stroke.

Conclusions: In conclusion, patient survival and functionality can be improved as seen from a modified Rankin scale by precise knowledge of the location of intraparenchymal edema and an approach with reduced damage to collateral structures.

Introduction:-

Decompressive craniectomy (DC) is a surgical procedure used since the beginning of the last century. It was first performed in 1901 by Kocher1 as a treatment for elevated intracranial pressure (ICP). It is performed by removing a portion of the skull to relieve elevated ICP, measured in millimeters of mercury (5 to 15 mmHg in adults). This procedure is used in severe neurological emergencies, such as traumatic brain injuries, ischemic strokes, subarachnoid hemorrhages, and severe intracranial infections. By allowing the swollen brain to expand outside the

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skull, compression of unaffected brain structures is avoided, which can save the patient's life. Its importance lies in the fact that it can reduce mortality to less than 20% and therefore enhance functional aftermath in patients with (20% and improve functional outcome in patients with) brain injuries caused by malignant ischemic stroke[2].

The surgical approach varies according to the affected hemisphere in which the parenchymal condition is located or the neuroanatomical location, since it can be infra or supratentorial[3]. With this, the most common locations that can cause an increase in ICP include the parietal, temporal, frontal and occipital lobes, as well as the extrapyramidal nuclei and the cerebellum.

The clinical picture associated with the increase in ICP can be classified in the context of the location of the intraparenchymal lesion, and can also be classified into a classic triad:

Headache, vomiting and papilledema.

Headache is the main associated symptom, it is constantly present with morning predominance, with this patients feel pain relief in the supine position and tend to present an improvement with orthostatic position.Vomiting is a frequent accompanying symptom without a trigger, being projective, and also occurring more frequently in the morning. As the condition progresses, a decrease in the level of consciousness may occur, which may be a consequence of a reduction j in cerebral perfusion pressure and decreased cerebral blood flow, or due to damage to the reticular formation of the brain stem[4].

In the context of a cerebrovascular event, an increase in ICP also occurs, which may be due to different reasons. This leads to severe and acute neurological deterioration in the first few days after a stroke due to an expansion of the infarcted area. This expansion is related to the lack of collateral flow.

Much of what we know about intracranial pressure (ICP) in patients with stroke comes from studies of patients with malignant cerebral ischemia. In this group of patients, increased ICP is typically associated with large infarcts, more severe intracranial edema, and a mass effect, peaking between the third and fifth day after the stroke[5]. In these cases, there may be an extremely high elevation of ICP that will precede death; However, it is important to note that clinical signs suggesting mass effect herniation usually appear before the marked preterminal increase in ICP. This indicates that the increased ICP is due to the herniation and not the primary cause. Similarly, although pain is present in all of these patients and is one of the reasons for monitoring ICP, very few have elevated ICP before pain symptoms occur.

Methods:-

Comprehensive searches were conducted in different databases, including PubMed, Cochrane Library, and Scopus, with all related information up to August 13, 2024, using the terms "edema", "middle cerebral artery", "surgery", "ischemic stroke", "decompressive craniectomy" and "cerebral infarction", the search focused on obtaining studies that aimed to describe the characteristics of increased intracranial pressure.

Results:-

In the present study, a comprehensive analysis was carried out which involved searching for articles in which the clinical improvement of patients after a decompressive craniectomy was seen. The information consulted, according to Márcio Costa Nobre et al., showed that the risk factors associated with higher mortality are: being male, being over 50 years old, having been admitted 24 hours after the stroke.

Supporting this, the author Luiz SeveroBem Junior et al. tells us that “57.9% of patients had modified Rankin scores (mRS) of 4 or 5 (reduced functionality or death), while 42.1% had scores of 2 or 3 (some functionality). 64.8% had mRS scores of 2 or 3, and 35.2% had scores of 4 or 5, in an evaluation 6 months after surgery.

And at the time of surgery, most patients (68.3%) underwent decompressive craniectomy between 24 and 48 hours after the onset of symptoms.” Patients operated after more than 24 hours had a worse prognosis, with statistically significant data. According to the author Luiz Bem et al. It was identified that the optimal time to implement a surgery was 12 and 24 hours (The best surgical time identified was between 12 and 24 hours.) In addition, it is important to note that in this cited study, the majority of people where men whose age was around 59 years in

average. (were men with an average age of 59 years), which constitutes a higher risk for having a favorable outcome after surgery.

Patients operated on the non-dominant side had a better outcome, with statistical significance. The analysis revealed that the amount of patients discharged with GOS scores of 1 or 2 was significantly higher (the percentage of patients with GOS scores of 1 or 2 at discharge was higher) in those operated on the left side (75.9%) compared to the right side (47.3%).

Regarding the surgical technique, author Nicolas Desse et al. says that it is important to take certain anatomical points into account before making the incision.

To avoid complications, it is important to avoid the torculus, the lateral sinuses and the superior sagittal sinus, as well as to know the bone boundaries, namely: the frontal sinus, the orbital area and the petrous bone.

Based on this, the parietal bone is the one that has the most significant participation when forming the flap in the intracranial decompression process, since it is the most sectioned at the time of the surgical approach.

It is important to consider that the bone flap should measure approximately 12 cm to avoid complications such as hydrocephalus and subcutaneous flap syndrome.

Discussion:-

The present study provides evidence of the importance of the location of intraparenchymal edema, since this will influence the performance of a decompressive craniectomy in patients who have suffered a cerebrovascular event, since when analyzing the data currently available, it can be seen that the non-dominant hemisphere presents a better postoperative evolution compared to those in which the approach is performed in a dominant hemisphere, this may be due to the number of tracts associated with cerebral dominance and areas that are approached in these intraparenchymal locations. This is reflected in the scores obtained using the Glasgow scale, where a higher percentage of patients operated on the left side (75.9%) achieved higher functionality scores (GOS of 1 or 2) at hospital discharge, compared to those operated on the right side (47.3%).

Therefore, it is important to emphasize the full understanding of brain anatomy and not only that, but also of the specialized physiological functions of each area when performing a surgical procedure such as decompressive craniectomies, especially when talking about post-stroke edema. Our surgical approach should focus on the adaptation and individualization of each patient to minimize possible damage to critical functional structures, therefore the surgical technique should be included in these considerations in order to reduce possible postoperative complications that may be found in patients.

Conclusion:-

In conclusion, it can be observed that a complete knowledge of the specific location of intraparenchymal edema in the patient is necessary, since this not only plays a crucial role in the performance of a procedure such as decompressive craniectomy, also contributes to the survival and, above all, to the future functionality of the patients, thus improving the future Rankin scale that the patients will have. These findings should not only be considered as a guide to surgical decompressions, but also encourage the adoption of personalized strategies based on the neuroanatomy and physiology of each individual.

It is important to highlight that the advances that are being made in neuroimaging and continuous brain monitoring allow for greater precision in the early detection of significant changes that may occur at the level of the brain parenchyma, such as an increase in intracranial pressure, thereby further optimizing the surgical intervention. The development of new minimally invasive techniques and the implementation of adjuvant therapies, such as therapeutic hypothermia or the use of neuroprotective agents, could further improve clinical outcomes in these patients. Future studies should therefore focus on the integration of these innovative approaches to improve survival rate and quality of life.

Reference:-

1. Gummadavelli A, Englot DJ, Schwalb JM, Wu C, Gonzalez-Martinez J, Niemat J, et al. ASSFN Position

Statement on Deep Brain Stimulation for Medication-Refractory Epilepsy. Neurosurgery [Internet]. 2022 Mar 10;90(5):636–41. Available from: https://doi.org/10.1227/neu.0000000000001923
2. Pallesen LP, Barlinn K, Puetz V. Role of decompressive craniectomy in ischemic stroke. Frontiers in Neurology [Internet]. 2019 Jan 9;9. Available from: https://doi.org/10.3389/fneur.2018.01119
3. Beck J, Fung C, Strbian D, Bütikofer L, Z'Graggen WJ, Lang MF, et al. Decompressive craniectomy plus best medical treatment versus best medical treatment alone for spontaneous severe deep supratentorial intracerebral haemorrhage: a randomised controlled clinical trial. The Lancet [Internet]. 2024 May 15;403(10442):2395–404. Available from: https://doi.org/10.1016/s0140-6736(24)00702-5
4. Desse N, Beucler N, Dagain A. How I do it: supra-tentorial unilateral decompressive craniectomy. Acta Neurochirurgica [Internet]. 2019 Apr 5;161(5):895–8. Available from: https://doi.org/10.1007/s00701-019-03880-x
5. Fontes LP, Fontes MP, Jiménez PQ, Pérez JM, Iriarte MM. Comparative case-control study of homocysteine, vitamin B 12 , and folic acid levels in patients with epilepsy. Neurología (English Edition) [Internet]. 2017 Aug 1;32(7):440–5. Available from: https://doi.org/10.1016/j.nrleng.2016.02.004.