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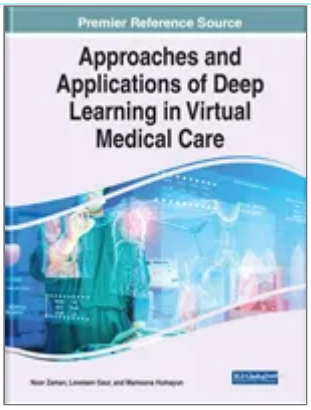

A Systematic Mapping Study of Low-Grade Tumor of Brain Cancer and CSF Fluid Detecting in MRI Images Through Multi-Algorithm Techniques

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Abstract

Low-grade tumor or CSF fluid, the symptoms of brain tumour and CSF liquid, usually requires image segmentation to evaluate tumour detection in brain images. This research uses systematic literature review (SLR) process for analysis of the different segmentation approach for detecting the low-grade tumor and CSF fluid presence in the brain. This research work investigated how to evaluate and detect the tumor and CSF fluid, supervised machine learning algorithm and segmentation method (3D and 4D segmentation process, supervised segmentation process, Fourier transformation, and Laplace transformation), and mentioned the details of publication selection with the publishing digital libraries bodies. Furthermore, this research discusses selected segmentation techniques to detect the low-grade tumor and CSF fluid in systematic mapping through systematic literature review (SLR) process.

Chapter Preview

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Introduction

The motive of this chapter is to evaluate and use a proper scientific method to spot the research problems in a systematic and organized body of knowledge. This chapter examines various related researches to explain the background of brain cancer, CSF and multiple approach algorithm details to use in segmentation method of MRI and research questions that are mentioned in details.

R1: What is the common symptom of CSF Fluid leak in the brain and Brain Tumor?

The ventricles that surround the brain and the spinal cord are filled with a clear, colourless, and ultra-filtrate of plasma that is known as cerebrospinal fluid. The brain and spinal cord form the central nervous system, which controls, and coordinates the working of all the body parts such as complex thinking and planning, muscle movement, and all organs functions. It acts as a shield and pillow to protect the brain and spinal cord from unexpected injuries. It also helps in waste removal from the brain so that the nervous system will function normally. It performs main functions as if it protects and nourishes the brain and removes the wastage as well (Spector, R. *et al*., 2015). It gives hydro-mechanical protection of the neuraxis through two mechanisms. In the first mechanism, it acts as a shock absorber that shields the brain against the skull (Telano, L. N., and Baker, S., 2020). CSF is ultra-filtrate of plasma that lies within the brain ventricles and the subarachnoid spaces of the cranium and spine (Sakka, L. *et al*., 2011). The second mechanism reduces the effective brain weight that makes the brain and the spinal cord buoyant. The volume of CSF in adults is 150 ml; around 25 ml is distributed within the ventricles and 125 ml within the subarachnoid spaces. Choroid plexus secretes CSF, in adults this secretin ranges from 400 ml to 600 ml daily. In an average young person, this constant secretion helps in the detailed renewal of CSF four to five times daily. Aging and various neurodegenerative diseases result due to the addition of metabolites because of a decrease in CSF turnover. Strict management of the CSF composition is essential and any difference can support in diagnosis (Sakka, L. *et al.*, 2011).

Cerebrospinal Fluid Circulation and Leak

Brinker, T. *et al*., (2014) studied CSF physiology and revealed that CSF is secreted by epithelial cells of the choroid plexus and it flows via the ventricles, then flows in the middle of the subarachnoid space. This literature reviews major developments that lead to the previous theories. Observations using cellular and molecular biology as well as neuroimaging show that CSF physiology is more complicated than it is traditionally assumed. Its circulation does not constitute a directed flow only, but it is a flow with periodic variations that is filled all over the brain and exchanges the local fluid among blood, intestinal fluid, and CSF. Speedy carrier of brain water and CSF homeostasis occurs through astrocytes, aquaporin, and other membranes. The steady exchange of bidirectional fluid yields a flow rate that boosts the choroidal CSF production rate. The CSF circulation enters from the subarachnoid space into the Virchow Robin space. It delivers a site for the interaction between the brain and the immune system and a drainage way so that the water molecules from the brain are cleared. Various physiological functions depend on CSF transportation like regeneration of the brain during sleep, etc. (Brinker, T. *et al*., 2014).

Among various neurological difficulties, CSF leak is a challenging one because it occurs without any reason also. CSF moves through the ventricles of the brain and the surface of the spine. The condition, when this fluid leaks through a nose or ear due to a tear or a hole in the skull or dura, is called CSF leakage. This tear or hole affects the system of the brain and the sinus badly. CSF openings are generated after the lower back section, also known as a spinal block or spinal anesthesia (S. Saeed *et al*.,2021).

Due to the spinal surgery complications, usually, tear in the dura (brain covering) takes place that causes CSF to leak (Fang, Z. *et al*., 2017). To stop this leakage, there are various studies for repairing the dural tear but the following new treatments have given promising results:

1. Substitute material may be used to create watertight dural closure.
2. Changing pressure difference along with increasing the epidural space pressure and decreasing the subarachnoid liquid pressure and may slow down the CSF leak.

Sometimes a combination of both methods is used to stop the CSF leakage. (Fang, Z. *et al*., 2017).

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