

## CT scan exposure in children with ventriculoperitoneal shunts: single-center experience and review of the literature<sup>1</sup>

### Abstract

**Purpose:** A computed tomography (CT) scan in childhood is associated with a greater incidence of brain cancer. CT scans are used in patients with ventriculo-peritoneal (VP) shunts in whom shunt dysfunction is suspected. We wanted to assess the CT scan exposure in a cohort of children with VP shunts and attempt to quantify their radiation exposure.

**Methods:** A single-centre retrospective analysis was performed recording CT head scans in children younger than 18 years with VP shunts. Hospital coding data was cross-referenced with electronic records and radiology databases both in our neurosurgery unit and in hospitals referring to it.

**Results:** One hundred and fifty-two children with VP shunts were identified. The mean time with shunt in situ was 5.4 years ( $\pm 4.61$ ). A mean of 3.33 CT scans (range 0–20) were performed on each child, amounting to 0.65 ( $\pm 0.87$ ) CTs per shunt year. Based on 2 msv of radiation per scan, this equates to an average exposure of 1.31 msv per child per shunt year.

**Conclusion:** Children who have multiple CT head scans for investigation of possible shunt dysfunction are at a greater risk of developing cancer. We discuss the implications of this increased risk and discuss strategies to limit radiation exposure in children with VP shunts.

### Highlighted Citations from Their Literature Review

**Stone et al.** Reported revision rates of **84.5%**. 4.7% of patients requiring greater than ten revision procedures (2.66 average revisions per patient).

**Lee et al.** In a single-center retrospective review, over a five-year period, **25,000 CTs were performed on 13,800 children, 34.3% of whom were under one year** at the time of the scan.

**Florin et al.** In a ten-year retrospective review of ED visits, **1,319 children with shunts were responsible for 6,636 visits. 49.4% resulted in a head CT head scan.**

**Mathews et al.** A large cohort trial following 680,000 children in Australia reported a greater incidence of cancer diagnosis in children undergoing CT scans in childhood. They observed a **24% higher incidence of cancer when exposed to a single CT** vs. those who never had a scan, with a subsequent **16% increase for each additional scan**. Children in the cohort who received a head CT had a **44% greater risk of brain tumors compared to those who had never been**

scanned. There was an increased incidence ratio of 1.61 for patients developing radiation-induced malignancy.

**Pearce et al.** In the UK, a similar study estimated the risk of developing either leukemia or brain cancer in children who had undergone CT imaging before the age of 22. Children undergoing **two to three head CTs had triple the risk of developing brain tumors**, and those who had **five to ten head CTs had triple the risk of developing leukemia.**

**Sheppard et al.** Identified that a single CT head scan in childhood carries a **2.4-fold increased risk of developing a brain tumor compared to children who have not had a CT.** The increased risk is significant, but the estimated risk of developing radiation-induced cancer corresponds to around one per 1800 pediatric head CTs.

**Koral et al.** A study focusing on head CTs reported that **children with shunts were exposed to 2.1 scans per year, with the potential for 1 in 97 developing cancer.**

<sup>1</sup> Dobson, G.M., et al. CT scan exposure in children with ventriculoperitoneal shunts: single centre experience and review of the literature. Childs Nerv Syst (2020). <https://doi.org/10.1007/s00381-019-04345-3>