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The significance of Terson syndrome as a clinical marker of subarachnoid hemorrhage: A systematic literature review

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Abstract

Subarachnoid hemorrhage (SAH) is a type of hemorrhagic stroke that occurs due to the rupture of an intracranial aneurysm, with high morbidity and mortality rates. One of the most common complications is Terson's syndrome (TS). Intraocular hemorrhage can occur simultaneously in patients with SAH due to a rapid increase in intracranial pressure. Terson syndrome has significance for the clinical markers of SAH, including the mechanism, degree of severity, and implications. A systematic literature review was conducted to assess the significance of Terson syndrome for subarachnoid hemorrhage. The sources used were publications from the last five years that were relevant to the topic. The results of the study show that Terson syndrome has significance for clinical markers of SAH, such as low GCS scores, high Hunt and Hess scores, and high Fisher Scale scores, all of which are markers of severe SAH.

Keywords: Terson syndrome; Subarachnoid Hemorrhage; Glasgow Coma Scale; Hunt and Hess; Fisher Scale

1. Introduction

Subarachnoid hemorrhage (SAH) is the occurrence of intracranial bleeding into the cerebrospinal fluid in the subarachnoid space [1]. The subarachnoid space is located between the arachnoid mater on the outside and the pia mater on the inside and contains cerebrospinal fluid and the main arteries that supply the brain [2–4]. Subarachnoid hemorrhage is the third most common type of stroke. The prevalence of SAH is twice as high in women compared to men, with the peak incidence occurring between the ages of 50 and 60 [5]. The incidence rate reaches 8 cases of spontaneous SAH per 100,000 people per year across 32 countries [6].

SAH is a significant contributor to mortality and morbidity, regardless of the cause. The etiology of SAH is mostly non-traumatic (85%), and the remaining patients had no previous vascular lesions on initial digital subtraction angiography [4]. Subarachnoid hemorrhage is induced by high blood pressure, obesity, smoking, and female gender [7]. Patients with SAH typically complain of severe headache like a thunderclap, vomiting, syncope, photophobia, decreased consciousness, and seizures[8,9].

Subarachnoid hemorrhage is mostly caused by the rupture of an intracranial aneurysm or arterial blood vessels in the brain[10]. Intracranial aneurysms occur at arterial junctions, bifurcations, or sharp angles in the vasculature, causing hemodynamic stress on the vessel walls [4]. Spontaneous release of blood into the subarachnoid space during hemorrhage causes a rapid increase in intracranial pressure. The increase occurs acutely within 24 hours, subacutely

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within 7 to 10 days, or delayed [11]. In addition to SAH, patients may experience simultaneous intraocular hemorrhage, known as Terson's syndrome [4].

Terson syndrome (TS) is an oculo-cerebral syndrome characterized by retinal and vitreous hemorrhage, usually caused by high intracranial pressure associated with subarachnoid or subdural hemorrhage. Intraocular hemorrhage occurs in 20% of patients, while vitreous hemorrhage affects only 4% of patients with SAH [12]. TS occurs in up to 46% of all patients with subarachnoid hemorrhage [13]. Two ophthalmological examinations are required to identify SAH patients with Terson syndrome [14]. Acute increased intracranial pressure causes cerebrospinal fluid effusion into the optic nerve sheath. The accumulation of fluid widens the retrobulbar aspect surrounding the orbit. The resulting dilation compresses the central retinal vein and the retinocoroidal vein in the subarachnoid space. This leads to venous hypertension, causing capillary rupture [15,16].

Terson syndrome is a serious complication of SAH that includes intraocular bleeding and can result in decreased vision or even blindness [17]. Terson syndrome can be used as a prognostic indicator of morbidity and mortality in SAH. In addition to providing a poor prognosis for neurological clinical outcomes, TS also has a functional impact on the patient's vision. Therefore, early detection of Terson syndrome through ophthalmological examination is important, as TS can be used as a clinical marker of SAH with a high degree of severity. A systematic literature review of the significance of Terson syndrome as a clinical indicator of SAH was conducted with the aim of strengthening knowledge and practice in managing cases of subarachnoid hemorrhage.

2. Material and methods

2.1. Literature Study

A systematic review was conducted using secondary data from previous research in the form of scientific articles with studies related to SAH patients with Terson syndrome. The study method was carried out using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) 2020. Articles were searched using the Scopus, Pubmed, and ScienceDirect databases with the keywords “Subarachnoid hemorrhage” AND “Terson syndrome”.

2.2. Include and Exclude Criterias

The article search was conducted based on the following inclusion criteria: 1) the article was a quantitative study, 2) the study included SAH patients with Terson syndrome, 3) the article was relevant to the study and research subject, and 4) the abstract and full text were specifically available. Exclusion criteria for the search included: 1) articles not written in English or Indonesian, 2) published between 2021 and 2025, and 3) articles that were not fully accessible. The results were presented qualitatively in the form of a meta-synthesis in accordance with the research objectives, namely the significance of Terson syndrome as a clinical marker in patients with SAH.

3. Results

A systematic database search yielded 537 articles. These were then screened based on title, abstract, number, and journal issue. This screening process resulted in 213 duplicate articles. The articles were then screened based on inclusion and exclusion criteria, with 190 articles not written in English and 103 articles published before 2021. From the 31 articles that were selected, 5 articles were found to meet the research criteria. The entire process is shown in Figure 1.

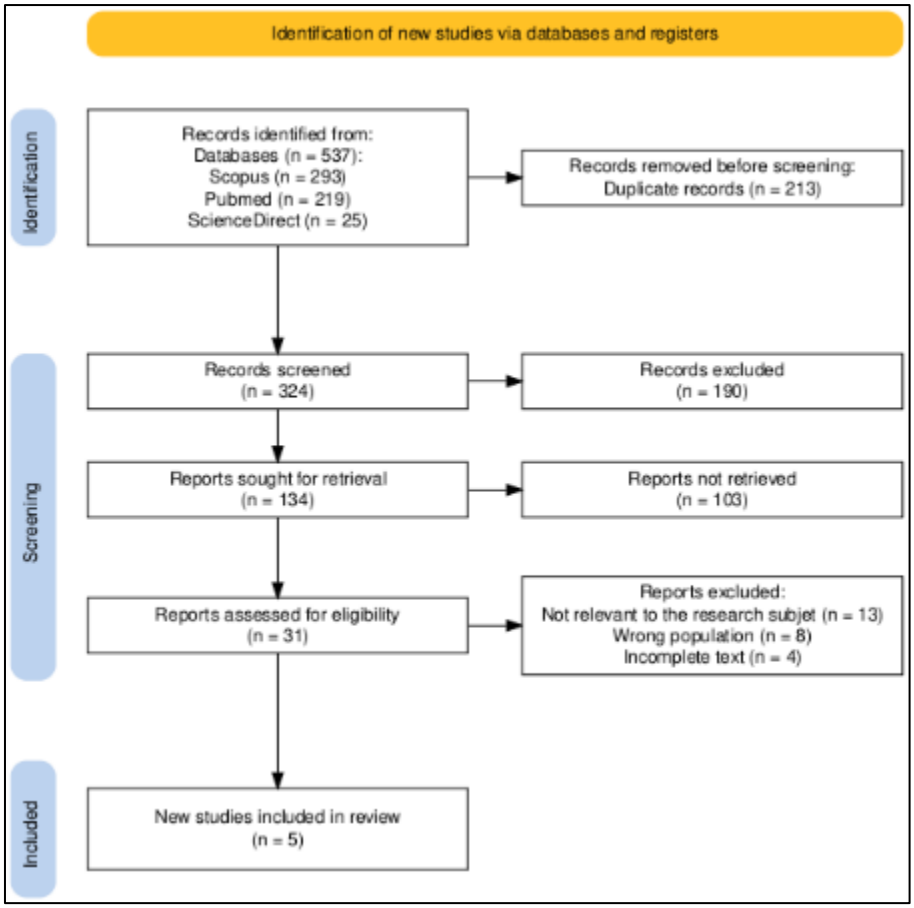

Figure 1 Literature Selection Flowchart [18]

Table 1 Literature Data Results

Authors and Years	Title	Result
Göttsche et al., 2023	Terson Syndrome in Patients with Aneurysmal Subarachnoid Hemorrhage: A 10-Year Single-Center Experience	A total of 367 patients (59.5%) with SAH underwent ophthalmological examination, 78 of whom had Terson's syndrome. Patients with TS had significantly higher Fisher and World Federation of Neurosurgical Societies (WFNS) scores ($p < 0.0001$). Regression analysis showed WFNS grade ($p = 0.003$) and seizure occurrence ($p = 0.002$) as independent predictors of TS [13].
Maslias et al., 2023	Terson Syndrome: Not to Be Missed in Patients with Disorders of Consciousness	Terson syndrome occurs in 8-19.3% of patients with SAH. Two cases of TS were found after SAH occurred in patients due to rupture of the anterior communicating artery aneurysm [19].
Mesa Galán et al., 2023	Ultrasound Diagnosis of Terson Syndrome as an Indicator of Extreme Severity in Neurocritical Care Patients	Terson syndrome was identified by ocular ultrasound in 24 patients (24.37%) and indirect ophthalmoscopy in 8 patients (8.79%) with SAH [20].
Vaslow, 2022	Chronic Subdural Hemorrhage Predisposes to Development of Cerebral Venous Thrombosis and Associated Retinal Hemorrhages and Subdural Rebleeds in Infants	Subarachnoid hemorrhage due to rupture of a thrombosed cortical vein contributes to retinal hemorrhage in Terson's syndrome [21].

Sharma et al., 2021	Ocular Fundus Abnormalities in Acute Subarachnoid Hemorrhage: The FOTO-ICU Study	Fundus abnormalities were found in 29 patients (35.4%) with SAH, and 20 patients had intraocular hemorrhage, including Terson's syndrome. The severity of SAH was associated with the occurrence of ocular fundus abnormalities with aneurysmal etiology [22].

A total of five studies were included in the systematic review, with a total sample size of 1,001 patients. The search was conducted from 2021 to 2025 to ensure that the study inclusion criteria were relevant to the latest studies.

Table 2 The Relationship Between Subarachnoid Hemorrhage and Terson Syndrome

Authors and Years	Total Sampling	Population Characteristics	Type of Bleeding	Clinical Assessment of SAH
Göttsche et al., 2023	617	Patients with confirmed SAH aneurysms with cCT	SAH	High Hunt and Hess and WFNS scores, low GCS scores, high Fisher Scale scores
Maslias et al., 2023	2	Female patients aged 63 and 47 years old	SAH	High Fisher Scale scores, grade 4
Mesa Galán et al., 2023	91	Neurocritical care patients with Terson's syndrome based on ophthalmoscopy examination with an average age of 57 years old	SAH and Intracerebral Hemorrhage	GCS score <9, high Hunt and Hess scale, and intracranial hypertension
Vaslow, 2022	11	Infants with chronic venous sinus thrombosis	SAH and Subdural Hemorrhage	Increased intracranial pressure and decreased neurological status
Sharma et al., 2021	29	SAH patients with fundus abnormalities and hospitalized in the intensive care unit (ICU)	SAH	Low GCS score

Neurologically, Terson syndrome is associated with a worse clinical presentation in patients. Higher Hunt and Hess and World Federation of Neurosurgical Societies (WFNS) scores, with low Glasgow Coma Scale (GCS) scores.

Table 3 Examination of Terson Syndrome and Clinical Outcomes of Patients

Authors and Years	Examinations Performed	Patient Clinical Outcomes
Göttsche et al., 2023	Direct examination with ophthalmoscopy and pharmacologically induced examination.	Patients with TS experience increased mortality and decreased survival in visual function.
Maslias et al., 2023	Funduscopic examination from the side of the bed performed 44 days after extubation.	SAH patients with TS have a 4.8 times higher risk of death compared to patients who do not experience vitreous hemorrhage.
Mesa Galán et al., 2023	Examination using an ultrasonography eyepiece and indirect ophthalmoscopy.	Terson syndrome detected in SAH patients is an independent risk factor for in-hospital mortality.
Vaslow, 2022	In infants, MRI and CT scans as well as neuroradiography protocols are used.	A rapid increase in intracranial pressure causes neurological deterioration and life-threatening acute events (ALTE).
Sharma et al., 2021	Bedside fundus photography.	Fundus abnormalities and intraocular hemorrhage are associated with poor prognosis in SAH patients.

3.1 Terson Syndrome Examination

Based on six studies included in the research, the diagnosis of Terson syndrome was made according to the resources available at the hospital and the clinical condition of SAH patients. Terson syndrome examination can be performed using funduscopy, ocular ultrasound, or OCT. In patients with unfavorable conditions, such as in the studies by Sharma et al. and Maslias et al., TS examination can be performed using ocular fundus photographs taken from the bedside. Additionally, in infant SAH patients, it can be performed using a customized neuroradiography protocol and MRI and CT scan equipment.

3.2 Clinical and Neurogical Outcomes

Subarachnoid hemorrhage patients who experience clinical deterioration with several degrees of neurological impairment based on these parameters commonly have Terson syndrome with a poorer predicted clinical outcome. SAH patients with TS who present with low GCS scores and high Hunt and Hess scales show more severe neurological impairment when TS is diagnosed. In addition, SAH patients with TS show a higher mortality rate than those without TS.

4. Discussion

Terson syndrome is a complication of subarachnoid hemorrhage with a high mortality rate, characterized by increased intracranial pressure due to rupture of an aneurysm in the anterior circulation [23]. The anterior communicating artery is prone to aneurysms, increasing the risk of neurological and clinical deterioration and retinal hemorrhage [24]. Aneurysms in the anterior communicating artery are anatomically close to the optic chiasm, making patients susceptible to visual impairment due to direct compression. Additionally, aneurysms in the posterior communicating artery, which is close to the optic nerve, can cause nerve compression or vascular impairment, which can affect venous drainage from the retina [25].

Terson syndrome can be used as a prognostic indicator of morbidity and mortality in SAH [15]. Based on previous studies, a low Glasgow Coma Scale ($p = 0.002$), high Hunt and Hess grades ($p < 0.001$), and high Fisher grades ($p = 0.002$) were found to be associated with a higher incidence of Terson syndrome. Neurological outcomes in patients with subarachnoid hemorrhage who had Terson syndrome were worse than in patients with subarachnoid hemorrhage without Terson syndrome ($p = 0.005$), and vitrectomy was performed in seven eyes of six patients due to poor visual acuity [14].

Overall, Terson syndrome serves as a clinical marker in identifying SAH with a high level of severity and provides a prediction of poor clinical outcomes for patients. In addition, ophthalmological examination and appropriate neurological intervention are necessary to improve outcomes for patients with subarachnoid hemorrhage and Terson syndrome.

4 Conclusion

Terson syndrome is an intraocular complication that is not only associated with subarachnoid hemorrhage, but also has important clinical significance as a clinical indicator of disease severity. Based on the results of a systematic literature review, Terson syndrome has important significance as a clinical marker of subarachnoid hemorrhage because it indicates increased intracranial pressure and severe SAH. Terson syndrome can be a prognosis for clinical outcomes, both neurologically and in terms of long-term visual function. In addition, the management of subarachnoid hemorrhage with Terson's syndrome is important to note because it results in higher patient mortality compared to SAH patients without TS.

From this systematic review of the literature, it is recommended that Terson's syndrome be used as an initial clinical assessment to identify subarachnoid hemorrhage patients with a higher risk of complications, so that intensive treatment can be provided immediately. Further research is needed to evaluate the sensitivity and specificity of Terson syndrome as a prognostic tool, to ensure that subarachnoid hemorrhage is not missed, especially in patients with high severity.

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