OPEN ACCESS
Indonesian Journal of Health Research and Development **Vol 4 No 1 (2026)** https://doi.org/10.58723/ijhrd.v4i1.592
Check for updates
Research Article

Acute Ischemic Stroke After Wasp Sting and Early Intensive Rehabilitation: A Case Report

Received: December 26, 2025	Revised: February 15, 2026	Accepted: February 26, 2026	Published: February 28, 2026

Sasirekha K[1], Priya J[1], Ganesan B[2], Arun B[3]*

Abstract

Background: Cerebrovascular accidents following Hymenoptera stings are exceptionally rare, with most reported cases involving multiple stings. This case study presents a unique case of acute ischemic stroke triggered by a single wasp sting and highlights the critical role of early intensive physiotherapy in achieving excellent functional recovery.
Aims: A 55-year-old previously healthy electricity lineman sustained a single wasp sting over the neck. After initial symptomatic treatment at a primary health center, he returned to work but collapsed within two hours, presenting with right-sided weakness, mild aphasia, and apraxia. Brain imaging showed subtle small-vessel ischemic changes without large-vessel occlusion. Extensive thrombophilia and cardioembolic workups were normal. The stroke was attributed to venom-induced vasospasm and inflammatory/thrombogenic effects. The patient was managed with intravenous corticosteroids, dual antiplatelet therapy, and low-molecular-weight heparin. Structured inpatient physiotherapy commenced for the patient who stays in the wards, and good progression was noted as the day passed.
Results: At the time of discharge, the patient was walked with minimal assistance. At one-month follow-up, he achieved modified independence in activities of daily living, with ongoing gradual recovery of hand function. Functional Independence Measure (FIM) on admission was 13, later it improved to 39 at the time of discharge, and the follow-up of the patient rose to 52. Scores improved markedly since admission to the follow-up.
Conclusion: This case demonstrates that even a single wasp sting can precipitate acute ischemic stroke via vasospasm and inflammation. Prompt medical stabilization combined with early, intensive, goal-directed physiotherapy can yield rapid and substantial functional recovery.

Keywords: Exercises, Hemiplegia, Physiotherapy, Venom, Wasp sting

1. INTRODUCTION

Wasp stings are common worldwide and typically produce localized reactions ranging from mild pain, erythema, and oedema to significant local swelling (Ewan, 1998). Sensitive individuals may trigger severe systemic allergic responses, including anaphylactic shock, hypotension, generalized oedema, respiratory distress, or multi-organ failure (Gupta 2020, Reber et al., 2017). Most symptoms are resolved within 24 hours; however, uncommon and delayed reactions continue to be reported, including myocardial infarction, acute kidney injury, rhabdomyolysis, pulmonary hemorrhage, acute pancreatitis, atrial fibrillation, seizures (Reber et al., 2017) disseminated intravascular coagulation (DIC), and cerebrovascular accidents (Temizoz, 2009).

Müller's 1990 classification of Hymenoptera venom reactions remains widely used: (a) normal local reaction, (b) significant local reaction, (c) systemic anaphylactic reaction (grades I–IV), and (d) unusual or delayed reactions (Wani et al., 2014). Neurological complications, including ischemic and hemorrhagic stroke, fall under the fourth category (Kabra et al., 2022).

Although bee and wasp venoms share enzymes such as hyaluronidase and phospholipase A2, they differ in key components (Vasconez-Gonzalez et al., 2025). Bee venom is rich in melittin, whereas wasp venom contains antigen 5, a potent allergen, along with vasoactive amines, kinins, leukotrienes, and thromboxane (Wani et al., 2014). These mediators can induce platelet aggregation,

vasoconstriction, endothelial dysfunction, systemic inflammation, and a prothrombotic state (Sookrung et al., 2014), providing plausible mechanisms for cerebrovascular events even in the absence of anaphylaxis (Jameson et al., 2020).

Cerebrovascular accidents following Hymenoptera stings are rare, with only a limited number of cases reported in the literature. Several pathophysiological mechanisms have been proposed to explain this uncommon but serious complication. These include venom-induced cerebral vasospasm leading to focal ischemia, as well as global cerebral hypoperfusion secondary to anaphylaxis. Immune-mediated vasculitis or direct endothelial injury may further contribute to vascular compromise. In addition, venom-triggered platelet aggregation and thrombosis can precipitate ischemic events. Stimulation of sympathetic ganglia may result in intense vasoconstriction, compounding cerebral ischemia. In some cases, disseminated intravascular coagulation (DIC) may develop, leading to secondary cerebral infarction or hemorrhage, as described in previous reports (Yang et al., 2022, Mahale et al., 2016).

Reported cases show wide variability in presentation and timing. Latency from sting to neurological deficit ranges from minutes to 24 hours (Wani et al., 2014), and both single and multiple stings have been implicated (Rajendiran et al., 2012, Viswanathan et al., 2012). Early recognition, prompt neuroimaging, and timely multidisciplinary management are critical to improving outcomes in this rare complication (Gök et al., 2000). This case study aim is to report a rare case of acute ischemic stroke following a single wasp sting and to evaluate the impact of early, intensive, goal-directed physiotherapy on functional recovery.

2. MATERIAL AND METHOD

Case Presentation

A 55-year-old male, working as a lineman in the Electricity Board in Erode district, sustained a wasp sting on his neck and ear while cleaning an unused shelf in the morning. He immediately visited Sivagiri Primary health center, Erode District, Tamil Nadu for emergency care, where he was treated with intravenous antihistamines and antiemetics. After an hour of treatment, he returned to work, but within an hour he fell from a chair and became unconscious. He was promptly shifted to the Government Super Specialty Hospital in Erode.

On arrival, he was hemodynamically stable (BP 140/90 mmHg, HR 85 bpm, RR 20/min, SpO_2 100% on room air), with clear lung fields and normal heart sounds. No carotid bruits were audible. He regained consciousness shortly after admission but exhibited complete right hemiplegia, mild expressive aphasia, and limb apraxia.

His past medical history was unremarkable, with no diabetes, hypertension, or relevant surgical history. CT brain revealed mass effect on the lateral ventricles with age related involutional changes in brain with small vessel ischemic changes. Four vessel colour doppler is also normal. MRA & MRV also finds normal.

3. RESULT AND DISCUSSION

3.1 Result

Investigations revealed

i. Non-contrast CT brain: mild mass effect on lateral ventricles with age-related cerebral atrophy and small-vessel ischemic changes.
ii. Four-vessel colour Doppler, MR angiography (MRA), and MR venography (MRV): normal, with no evidence of large-vessel stenosis or thrombosis.
iii. ECG and transthoracic echocardiogram: normal.
iv. Thrombophilia workup (serum homocysteine, lupus anticoagulant, anticardiolipin antibodies): within normal limits.

In view of the temporal association with the wasp sting and absence of conventional risk factors, a diagnosis of acute ischemic stroke secondary to wasp venom-induced vasospasm or inflammatory/thrombogenic response was made. He was treated with intravenous corticosteroids, H1- and H2-receptor blockers, dual antiplatelet therapy (aspirin + clopidogrel), and low-molecular-weight heparin bridged to oral anticoagulation for the initial phase

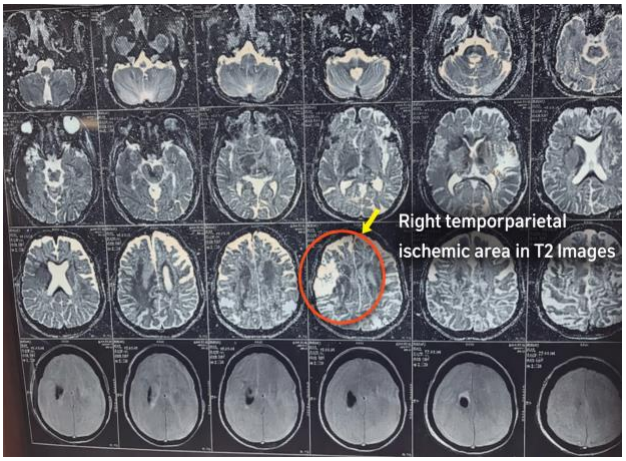


Figure 1. Right Parito temporal Ischemic area in T2 Images

OPEN ACCESS
Indonesian Journal of Health Research and Development **Vol 4 No 1 (2026)** https://doi.org/10.58723/ijhrd.v4i1.592
Check for updates
Research Article

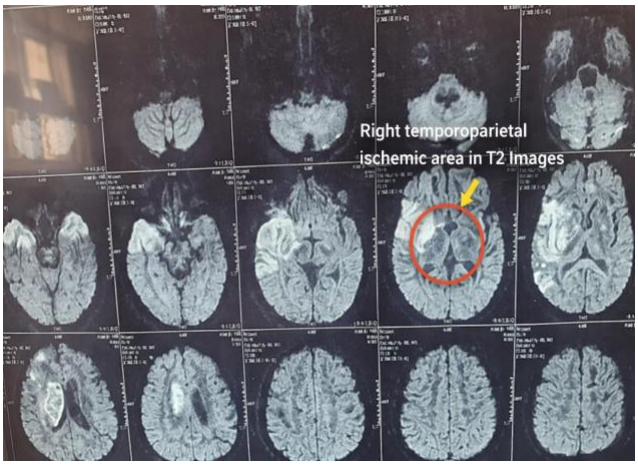


Figure 2. Right Parito temporal Ischemic area in T2 Images

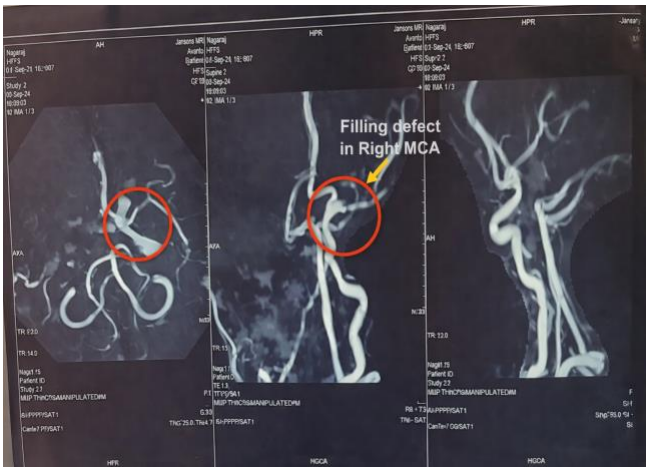


Figure 3. Filling defect in Right MCA in MR angiogram

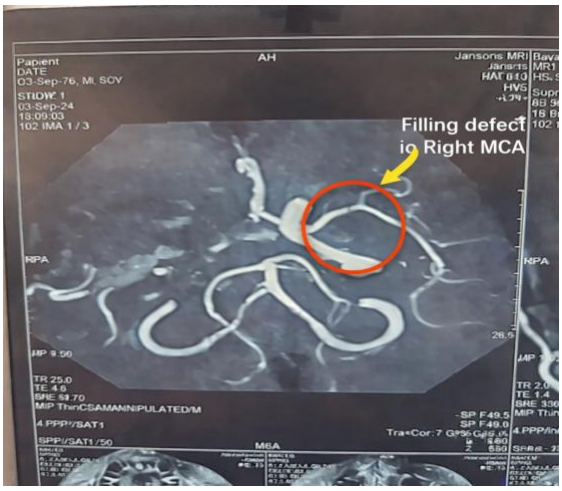


Figure 4. Filling defect in Right MCA in MR angiogram

After stabilization, the patient was shifted to the Medical Intensive Care Unit and referred for early physiotherapy. Rehabilitation commenced on the day of admission under close neurological monitoring. Progress was rapid and systematic:

i. **Days 1–3**: Emphasis on complication prevention and joint preservation. Passive range-of-motion exercises were provided for the paralysed limbs; vigorous DVT prophylaxis and ankle pumps were performed; breathing exercises and chest physiotherapy were administered; and two-hourly positioning was maintained. Active exercises were encouraged on the unaffected side.

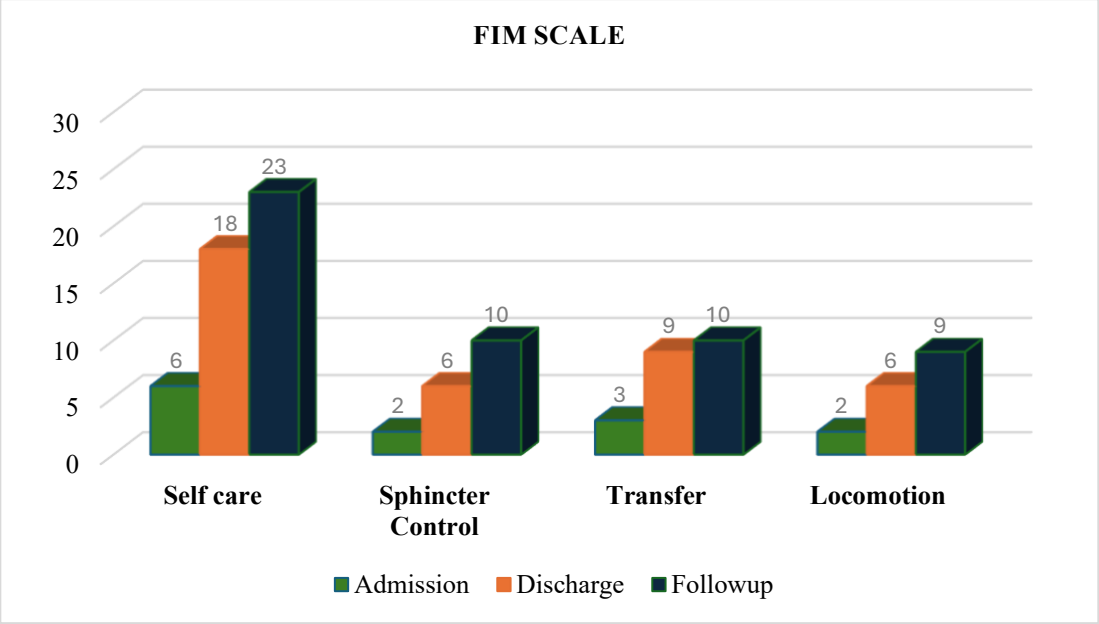
ii. **Days 4–6**: Proprioceptive neuromuscular facilitation (PNF) patterns were introduced for upper and lower limbs. Supported sitting was initiated on Day 4 and progressed to minimal assistance by Day 6. Upper-limb weight-bearing in sitting was added to enhance trunk control and proximal stability.

iii. **Days 7–9**: Standing training began with manual support and a tilt table as needed. Gait training with facilitation of the affected lower limb was started on Day 7. By Day 9, the patient could stand independently for short periods and place the affected foot flat with good weight-bearing.

iv. **Days 10–12**: Focus shifted to functional ambulation. The patient progressed to walking with minimal support, with specific correction of mild circumduction gait. Standing strengthening, static and dynamic balance activities were intensified. By Day 12, he achieved a safe, supervised functional gait.

On Day 12, the patient was discharged in stable condition with significant neurological recovery. He was counselled to continue intensive outpatient physiotherapy at a center closer to his hometown, as daily travel to Erode was impractical. A detailed home exercise programme was provided.

Functional progress was documented using the Functional Independence Measure (FIM). The admission FIM score on selfcare, sphincter control, Transfer and locomotion was 13, later it improved to 39 at the time of discharge, and the follow-up of the patient rose to 52.



Graph 1. Functional Independence Measure (FIM) Score from day of admission to discharge and follow-up

Post-Discharge Follow-Up

The patient was reviewed every 15 days at the local rehabilitation facility.

i. **15-day follow-up (≈27 days post-stroke)**: Gait was improved with reduced circumduction and longer walking distances. Gross upper-limb function improved markedly, though fine motor dexterity remained limited.
ii. **1-month follow-up (≈42 days post-stroke)**: Further improvements were noted in lower-limb symmetry and notable improvement in gait. Hand function showed gradual improvement, but tasks requiring precision (buttoning, writing, picking up small objects) remained challenging. An expected pattern given the greater cortical representation of fine motor skills. The patient achieved modified independence in most activities of daily living.

Subsequent follow-up was scheduled fortnightly to monthly, with continued emphasis on hand therapy, advanced balance training, and community reintegration to maximize long-term functional recovery.

3.2 Discussion

This case highlights the rare but potentially devastating capacity of wasp venom to trigger acute ischemic stroke, even following a single sting and in the absence of conventional cardiovascular risk factors (Reber et al., 2017). The temporal association between the sting and the onset of right hemiplegia with aphasia strongly suggests a venom-mediated mechanism (Gök et al., 2000). Although the precise pathophysiology remains incompletely understood, current evidence points to a multifactorial process involving vasoactive and pro-inflammatory components of wasp venom—such as histamine, serotonin, leukotrienes, thromboxane, and mast-cell degranulating peptides—that can induce intense cerebral vasospasm, endothelial dysfunction, platelet aggregation, and a prothrombotic state (Kulhari et al., 2016).

Additional proposed mechanisms include retrograde stimulation of the superior cervical sympathetic ganglion (Min et al., 2022), and hypersensitivity reactions leading to global or focal hypoperfusion (Tao et al., 2017). While multiple stings and larger venom load increase risk (Sundaramoorthy et al., 2011). Our case reinforces that a single sting can produce severe neurovascular complications in susceptible individuals (Moein & Zand, 2017).

No evidence-based guidelines exist for wasp sting-induced stroke owing to its rarity (Thavara et al., 2025). Initial management must prioritize ABC stabilization, aggressive control of anaphylactic or inflammatory responses with antihistamines, corticosteroids, and, if indicated, epinephrine, and close hemodynamic monitoring. Some reports describe successful use of intravenous thrombolysis when presentation is within the therapeutic window (Karri et al., 2021). In vasospasm-

predominant cases, maintaining euvolemia, augmenting blood pressure, and avoiding hypotension are critical to preserving cerebral perfusion (Sundaramoorthy et al., 2011).

Early, structured physiotherapy is the cornerstone of functional recovery after stroke, regardless of etiology. Initiation of rehabilitation within the first 24–48 hours—once medically stable—has been shown to prevent complications of immobility, enhance neuroplasticity, and improve long-term outcomes (Bernhardt, et al., 2017). Intensive, repetitive, task-specific training drives cortical reorganization and motor relearning (Gordon et al., 2018). In the present case, systematic progression from passive movements and positioning through PNF techniques, sitting, standing, and gait training resulted in rapid gains in mobility and independence within 12 days (Kim et al., 2019). Regular post-discharge follow-up further consolidated these improvements (Malik et al., 2022).

The relatively slow recovery of fine hand function observed in this patient is typical of middle cerebral artery territory strokes, reflecting the extensive cortical representation and complex neural networks required for dexterous movement. Sustained, specific hand therapy remains essential for optimal long-term outcomes.

This case underscores the importance of maintaining a high index of suspicion for neurological complications in any patient presenting after Hymenoptera stings, even when initial symptoms appear mild. Prompt medical stabilization combined with early, intensive, multidisciplinary rehabilitation, including structured physiotherapy and patient/caregiver education, can dramatically improve prognosis and quality of life in this uncommon but serious condition. Increased awareness among primary-care physicians, emergency staff, and rehabilitation teams is crucial for timely recognition and management of such atypical stroke etiologies.

Implications

This case reminds clinicians to remain alert to the possibility of neurological complications after Hymenoptera stings, even when only a single sting is involved, and the patient has no conventional vascular risk factors. New-onset neurological deficits following envenomation should never be overlooked. Early neuroimaging, close monitoring, and timely referral for multidisciplinary care especially for the rehabilitation can aid faster recovery and reduce long term complications.

Research Contribution

This case study adds meaningful evidence to the existing literature on wasp sting–associated ischemic stroke. It supports the proposed mechanisms of venom-induced vasospasm and inflammatory or prothrombotic effects. Importantly, it also highlights the measurable benefits of early, structured physiotherapy, demonstrated by consistent improvement in functional independence from admission to follow-up.

Limitations

This study is a single case report, the findings cannot be generalized to all patients. The exact underlying mechanism could not be conclusively proven, as advanced vascular imaging or specific biomarkers to confirm vasospasm or endothelial injury were not available. In addition, long-term follow-up was limited, and extended outcome data would provide further insight into sustained recovery.

Suggestions

Further research, including multicenter case collections or registries, is needed to better understand the risk factors, mechanisms, and optimal management strategies for venom-related cerebrovascular events. Developing clearer clinical pathways for early diagnosis and treatment may improve outcomes. Future prospective studies exploring rehabilitation strategies in toxin-induced strokes could also help refine recovery protocols and enhance long-term functional gains.

4. CONCLUSION

Wasp sting–induced stroke is extremely rare but can occur even after a single sting. Early recognition, prompt medical management, and timely initiation of structured physiotherapy are crucial for favorable outcomes. This case study shows that intensive rehabilitation and regular follow-up can result in significant functional recovery, including improvement in fine motor function.

5. ACKNOWLEDGEMENTS

The authors express gratitude to the patient for permitting publication of this educational case and to the multidisciplinary team (neurology, critical care, and physiotherapy departments) at Erode Government Super Specialty Hospital for their dedicated care.

Ethical Approval and Consent

This case report was prepared in accordance with the institutional ethical guidelines of Erode Government Super Specialty Hospital. Written informed consent was obtained from the patient for publication of this case report and accompanying clinical details. The patient was fully informed of the purpose of publication and provided voluntary consent. Patient confidentiality has been strictly maintained.

Funding

This work received no specific grant or financial support from any funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interest

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS STATEMENT

Dr Sasirekha: Conception, patient management, manuscript drafting and revision, corresponding author. Dr Priya and Dr Ganesan: Neurological diagnosis, neuroimaging interpretation, critical revision. Mr. Arun: Physiotherapy assessment and treatment, FIM documentation, follow-up evaluation, drafting of rehabilitation sections. All authors reviewed and approved the final manuscript.

AUTHORS INFORMATION

Corresponding Authors

B. Arun, Thanthai Periyar Government Headquarters Hospital, India.
ORCiD: https://orcid.org/0000-0002-1173-8209
Email: **barunmpt@gmail.com**

Authors

Sasirekha. K, Thanthai Periyar Government Headquarters Hospital, India.
Email: sasiya89@gmail.com

Dr. Priya. J MBBS, MD, Thanthai Periyar Government Headquarters Hospital, India.
Email: drjkpriyamd.erode@gmail.com

Dr. Ganesan. B, MBBS, MD, Thanthai Periyar Government Headquarters Hospital, India.
ORCiD: https://orcid.org/0009-0004-0717-3577
Email: ganz256@gmail.com

REFERENCES

Ewan, P. W. (1998). ABC of allergies. *BMJ, 316*(7142), 1442–1445. https://doi.org/10.1136/bmj.316.7142.1442

Gupta, A. (2020). Acute fatal stroke associated with honeybee sting. *Journal of Neurology & Neuromedicine, 5*(1), 1–4. https://scholar.google.com/scholar?q=Acute+fatal+stroke+associated+with+honeybee+sting+Gupta+2020

Reber, L. L., Hernandez, J. D., & Galli, S. J. (2017). The pathophysiology of anaphylaxis. *Journal of Allergy and Clinical Immunology, 140*(2), 335–348. https://doi.org/10.1016/j.jaci.2017.06.003 PMCID: PMC5657389. https://pubmed.ncbi.nlm.nih.gov/28780941/

Temizoz, O., Celik, Y., Asil, T., Balci, K., Unlu, E., & Yilmaz, A. (2009). Stroke due to bee sting. *The Neurologist, 15*(1), 42–43. PMID: 19131858. DOI: 10.1097/NRL.0b013e31818c7251. https://pubmed.ncbi.nlm.nih.gov/19131858/

Wani, M., Saleem, S., Verma, S., Yousuf, I., Wani, M., Asimi, R., et al. (2014). Multiple cerebral infarctions with severe multi-organ dysfunction following multiple wasp stings. *Annals of Indian Academy of Neurology, 17*(1), 125–127. PMID: 24753680. https://pmc.ncbi.nlm.nih.gov/articles/PMC3992753/

Kabra, R., Andhale, A., Acharya, S., Kumar, S., & Sawant, R. (2022). Acute ischemic stroke post honeybee sting: A rare case report. *Cureus, 14*(11), e31452. PMID: 36579284. https://pmc.ncbi.nlm.nih.gov/articles/PMC9792332/

Vasconez-Gonzalez, J., Izquierdo-Condoy, J. S., Delgado-Moreira, K., Noboa Lasso, M. D., Gamez-Rivera, E., Salazar, C., et al. (2025). Stroke risk following bee and wasp stings: A systematic review of ischemic and hemorrhagic events. *Frontiers in Toxicology, 7*, 1632308. PMCID: PMC12415000. DOI: 10.3389/ftox.2025.1632308

Sookrung, N., Wong-din-Dam, S., Tungtrongchitr, A., Reamtong, O., Indrawattana, N., Sakolvaree, Y., et al. (2014). Proteome and allergenome of Asian wasp (*Vespa affinis*) venom and IgE reactivity of the venom components. *Journal of Proteome Research, 13*(3), 1336–1344. doi: 10.1021/pr4009139

Jameson, J. L., Fauci, A. S., Kasper, D. L., Hauser, S. L., Longo, D. L., & Loscalzo, J. (2020). *Medicina Interna de Harrison-2 Volumes-20*. McGraw Hill Brasil. https://books.google.co.in/books?hl=en&lr=&id=CeDDDwAAQBAJ&oi=fnd&pg=PT15&dq=Medicina+interna+de+Harrison+(20th+ed.).+McGraw+Hill+Brasil.&ots=fN226-5lQs&sig=PdGMB4cUeq5q96daTckptAMriRU&redir_esc=y#v=onepage&q=Medicina%20interna%20de%20Harrison%20(20th%20ed.).%20McGraw%20Hill%20Brasil.&f=false

Yang, S., Wellington, J., Chen, J., Regenhardt, R. W., Chen, A. Y., Li, G., et al. (2022). Cerebral infarction following bee stings: Case report and literature review. *Translational Neuroscience, 13*(1), 163–171. PMCID: PMC9267306. DOI: 10.1515/tnsci-2022-0225

Mahale, R., Mehta, A., Shankar, A. K., Buddaraju, K., John, A. A., Javali, M., et al. (2016). Isolated posterior circulation stroke following honey-bee sting. *Neurology India, 64*(Suppl 1), S116–S118. Doi - 10.4103/0028-3886.178053

Rajendiran, C., Puvanalingam, A., Thangam, D., et al. (2012). Stroke after multiple bee sting. *Journal of*

the Association of Physicians of India, 60, 122–124. PMID: 22715562. https://pubmed.ncbi.nlm.nih.gov/22715562/

Viswanathan, S., Muthu, V., Singh, A. P., et al. (2012). Middle cerebral artery infarct following multiple bee stings. *Journal of Stroke and Cerebrovascular Diseases, 21*, 148–150. PMID: 20702115. DOI: 10.1016/j.jstrokecerebrovasdis.2010.06.003

Gök, S., Ulker, S., Hüseyinov, A., Hatip, F. B., Cinar, M. G., & Evinç, A. (2000). Role of leukotrienes on coronary vasoconstriction in isolated hearts of arthritic rats: Effect of in vivo treatment with CI-986, a dual inhibitor of cyclooxygenase and lipoxygenase. *Pharmacology, 60*(1), 41–46. https://doi.org/10.1159/000028345

Kulhari, A., Rogers, A., Wang, H., Kumaraswamy, V. M., Xiong, W., & DeGeorgia, M. (2016). Ischemic stroke after wasp sting. *Journal of Emergency Medicine, 51*(4), 405–410. PMID: 27545856. DOI: 10.1016/j.jemermed.2016.06.016.

Min, L., Wenning, Z., Wei, W., & Wei, T. (2022). Acute progressive large-area cerebral infarction caused by wasp sting: A case report. *Neurocase, 28*(4), 364–368. PMID: 36279512. DOI: 10.1080/13554794.2022.2129027.

Tao, X., Huang, L., Fang, C., Liu, C., Qing, L., & Cai, H. (2017). Ischemic stroke due to wasp sting: A case report. *Clinical Toxicology, 55*(7), 682–683. doi.org/10.1080/15563650.2017.1306072

Sundaramoorthy, K., Viswanathan, S., & Arulneyam, J. (2011). Wasp stings-related cerebral infarction in a toddy tapper with multiple previous stings. *European Journal of Neurology, 18*, 1–3. https://www.researchgate.net/publication/234167521_Wasp_Stings-Related_Cerebral_Infarction_in_a_Toddy_Tapper_with_Multiple_Previous_Stings

Moein, P., & Zand, R. (2017). Cerebral infarction as a rare complication of wasp sting. *Journal of Vascular and Interventional Neurology, 9*(4), 13–16. PMID: 28702114

Thavara, B. D., Parambil, R. M., Jose, B. V., Cholakkal, S., Sebastian, E., & Keshavrao, A. K. (2025). A Rare Case of Multiple Wasp Stings Causing Bilateral Ischemic Stroke. *Iranian Journal of Neurosurgery*, *11*, 0-0. 10.32598/irjns.11.8.

Karri, M., Ramasamy, B., Perumal, S., & Kannan, K. T. (2021). Wasp sting—causing a fatal menace. *Brain Circulation, 7*(2), 132–134. 10.4103/bc.bc_33_20. PMC8191535

Bernhardt, J., Godecke, E., Johnson, L., & Langhorne, P. (2017). Early rehabilitation after stroke. *Current Opinion in Neurology, 30*(1), 48–54. 10.1097/WCO.0000000000000404. https://pubmed.ncbi.nlm.nih.gov/27845945

Gordon, B. R., McDowell, C. P., Hallgren, M., Meyer, J. D., Lyons, M., & Herring, M. P. (2018). Association of efficacy of resistance exercise training with depressive symptoms: A meta-analysis and meta-regression analysis of randomized clinical trials. *JAMA Psychiatry, 75*(6), 566–576. 10.1001/jamapsychiatry.2018.0572. PMCID: PMC6137526. https://pubmed.ncbi.nlm.nih.gov/29800984

Kim, Y., Lai, B., Mehta, T., Thirumalai, M., Padalabalanarayanan, S., Rimmer, J. H., et al. (2019). Exercise training guidelines for multiple sclerosis, stroke, and Parkinson disease: Rapid review and synthesis. *American Journal of Physical Medicine & Rehabilitation, 98*(7), 613–621. 10.1097/PHM.0000000000001174.PMCID: PMC6586489. https://pmc.ncbi.nlm.nih.gov/articles/PMC6586489/

Malik, A. N., Tariq, H., Afridi, A., & Azam Rathore, F. (2022). Technological advancements in stroke rehabilitation. *Journal of the Pakistan Medical Association, 72*(8), 1672–1674. 10.47391/JPMA.22-90. https://pubmed.ncbi.nlm.nih.gov/36280946/