

The long-term prognosis of Transient Global Amnesia: a systematic review

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Supplementary material

Supplementary Table 1. Search Strategy.

PubMed:	Transient Global Amnesia in All Fields
Cochrane Library:	Transient Global Amnesia in All Text (word variations have been searched)
Elsevier:	Title, abstract, keywords: Transient Global Amnesia
PsycINFO	Transient Global Amnesia in the search field

Supplementary Table 2. Excluded studies with reasons.

Among excluded studies: 2 studies were uncontrolled [1 and 2], 6 studies did not implement a validated set of diagnostic criteria [3-8] and the rest of the studies were controlled studies (involving HC and/or TIA individuals), but investigated irrelevant parameters (not long-term prognosis).	
1)	Basior J, Vogel S, Mitton J. Transient global amnesia: diagnosis in the emergency department. <i>Am J Emerg Med</i> . 1985;3(4):352-357. doi:10.1016/0735-6757(85)90063-4
2)	Klötzsch C, Sliwka U, Berlit P, Noth J. An increased frequency of patent foramen ovale in patients with transient global amnesia. Analysis of 53 consecutive patients. <i>Arch Neurol</i> . 1996;53(6):504-508. doi:10.1001/archneur.1996.00550060046014
3)	Guidotti M, Anzalone N, Morabito A, Landi G. A case-control study of transient global amnesia. <i>J Neurol Neurosurg Psychiatry</i> . 1989;52(3):320-323. doi:10.1136/jnnp.52.3.320
4)	Matias-Guiu J, Pico M, Bonaventura I, Martin R, Monasterio J. Platelet aggregation in transient global amnesia. <i>Ital J Neurol Sci</i> . 1989;10(2):171-174. doi:10.1007/BF02333614
5)	Feuer D, Weinberger J. Extracranial carotid artery in patients with transient global amnesia: evaluation by real-time B-mode ultrasonography with duplex Doppler flow. <i>Stroke</i> . 1987;18(5):951-953. doi:10.1161/01.str.18.5.951
6)	Matias-Guiu J, Colomer R, Segura A, Codina A. Cranial CT scan in transient global amnesia. <i>Acta Neurol Scand</i> . 1986;73(3):298-301. doi:10.1111/j.1600-0404.1986.tb03280.x
7)	Matias-Guiu J, Codina A. Neuropsychological functions in the follow-up of transient global amnesia. <i>J Neurol Neurosurg Psychiatry</i> . 1985;48(7):713. doi:10.1136/jnnp.48.7.713
8)	Kushner MJ, Hauser WA. Transient global amnesia: a case-control study. <i>Ann Neurol</i> . 1985;18(6):684-691. doi:10.1002/ana.410180610
9)	Hodel J, Leclerc X, Zuber M, et al. Structural Connectivity and Cortical Thickness Alterations in Transient Global Amnesia. <i>AJNR Am J Neuroradiol</i> . 2020;41(5):798-803. doi:10.3174/ajnr.A6530
10)	Paech D, Kuder TA, Roßmanith C, et al. What remains after transient global amnesia (TGA)? An ultra-high field 7 T magnetic resonance imaging study of the hippocampus. <i>Eur J Neurol</i> . 2020;27(2):406-409. doi:10.1111/ene.14099
11)	Kim SH, Park YH, Kim S, Kim JS. Impaired Smooth Pursuit During Transient Global Amnesia. <i>J Clin Neurol</i> . 2019;15(3):301-307. doi:10.3988/jcn.2019.15.3.301
12)	Zidda F, Griebel M, Ebert A, et al. Resting-state connectivity alterations during transient global amnesia. <i>Neuroimage Clin</i> . 2019;23:101869. doi:10.1016/j.nicl.2019.101869
13)	Park KM, Lee BI, Kim SE. Is Transient Global Amnesia a Network Disease?. <i>Eur Neurol</i> . 2018;80(5-6):345-354. doi:10.1159/000496511
14)	Han K, Hu HH, Chao AC, et al. Transient Global Amnesia Linked to Impairment of Brain Venous Drainage: An Ultrasound Investigation. <i>Front Neurol</i> . 2019;10:67. Published 2019 Feb 5. doi:10.3389/fneur.2019.00067

- 15) Erdur H, Siegerink B, Ganeshan R, et al. Myocardial injury in transient global amnesia: a case-control study. *Eur J Neurol*. 2019;26(7):986-991. doi:10.1111/ene.13920
- 16) Hanert A, Pedersen A, Bartsch T. Transient hippocampal CA1 lesions in humans impair pattern separation performance. *Hippocampus*. 2019;29(8):736-747. doi:10.1002/hipo.23073
- 17) Schöberl F, Irving S, Pradhan C, et al. Prolonged allocentric navigation deficits indicate hippocampal damage in TGA. *Neurology*. 2019;92(3):e234-e243. doi:10.1212/WNL.0000000000006779
- 18) Griebe M, Ebert A, Nees F, Katic K, Gerber B, Szabo K. Enhanced cortisol secretion in acute transient global amnesia. *Psychoneuroendocrinology*. 2019;99:72-79. doi:10.1016/j.psyneuen.2018.08.033
- 19) Yi M, Sherzai AZ, Ani C, et al. Strong Association Between Migraine and Transient Global Amnesia: A National Inpatient Sample Analysis. *J Neuropsychiatry Clin Neurosci*. 2019;31(1):43-48. doi:10.1176/appi.neuropsych.17120353
- 20) Imperatori C, Farina B, Todini F, et al. Abnormal EEG Power Spectra in Acute Transient Global Amnesia: A Quantitative EEG Study. *Clin EEG Neurosci*. 2019;50(3):188-195. doi:10.1177/1550059418780780
- 21) Jovanovic ZB, Pavlovic AM, Vujisic Tesic BP, et al. Comprehensive Ultrasound Assessment of the Craniocervical Circulation in Transient Global Amnesia. *J Ultrasound Med*. 2018;37(2):479-486. doi:10.1002/jum.14355
- 22) Yi S, Park YH, Jang JW, Lim JS, Chun IK, Kim S. Decreased Metabolism in the Posterior Medial Network with Concomitantly Increased Metabolism in the Anterior Temporal Network During Transient Global Amnesia. *Brain Topogr*. 2018;31(3):468-476. doi:10.1007/s10548-017-0602-y
- 23) Buratti L, Petrelli C, Potente E, et al. Prevalence of obstructive sleep apnea syndrome in a population of patients with transient global amnesia. *Sleep Med*. 2017;32:36-39. doi:10.1016/j.sleep.2016.04.009
- 24) Himeno T, Kuriyama M, Takemaru M, et al. Vascular Risk Factors and Internal Jugular Venous Flow in Transient Global Amnesia: A Study of 165 Japanese Patients. *J Stroke Cerebrovasc Dis*. 2017;26(10):2272-2278. doi:10.1016/j.jstrokecerebrovasdis.2017.05.010
- 25) Kim HC, Lee BI, Kim SE, Park KM. Cortical morphology in patients with transient global amnesia. *Brain Behav*. 2017;7(12):e00872. Published 2017 Nov 19. doi:10.1002/brb3.872
- 26) Nees F, Griebe M, Ebert A, et al. Implicit Learning in Transient Global Amnesia and the Role of Stress. *Front Behav Neurosci*. 2016;10:222. Published 2016 Nov 17. doi:10.3389/fnbeh.2016.00222
- 27) Döhring J, Stoldt A, Witt K, et al. Motor skill learning and offline-changes in TGA patients with acute hippocampal CA1 lesions. *Cortex*. 2017;89:156-168. doi:10.1016/j.cortex.2016.10.009
- 28) Park YH, Kim JY, Yi S, et al. Transient Global Amnesia Deteriorates the Network Efficiency of the Theta Band. *PLoS One*. 2016;11(10):e0164884. Published 2016 Oct 14. doi:10.1371/journal.pone.0164884

- 29) Noël A, Quinette P, Dayan J, et al. Influence of depressive symptoms on memory in transient global amnesia. *J Neuropsychol.* 2017;11(1):108-121. doi:10.1111/jnp.12080
- 30) Park KM, Han YH, Kim TH, et al. Pre-existing structural abnormalities of the limbic system in transient global amnesia. *J Clin Neurosci.* 2015;22(5):843-847. doi:10.1016/j.jocn.2014.11.017
- 31) Griebe M, Nees F, Gerber B, et al. Stronger pharmacological cortisol suppression and anticipatory cortisol stress response in transient global amnesia. *Front Behav Neurosci.* 2015;9:63. Published 2015 Mar 9. doi:10.3389/fnbeh.2015.00063
- 32) Park YH, Jeong HY, Jang JW, et al. Disruption of the Posterior Medial Network during the Acute Stage of Transient Global Amnesia: A Preliminary Study. *Clin EEG Neurosci.* 2016;47(1):69-74. doi:10.1177/1550059414543684
- 33) Han K, Chao AC, Chang FC, et al. Obstruction of Venous Drainage Linked to Transient Global Amnesia. *PLoS One.* 2015;10(7):e0132893. Published 2015 Jul 14. doi:10.1371/journal.pone.0132893
- 34) Döhring J, Schmuck A, Bartsch T. Stress-related factors in the emergence of transient global amnesia with hippocampal lesions. *Front Behav Neurosci.* 2014;8:287. Published 2014 Aug 29. doi:10.3389/fnbeh.2014.00287
- 35) Juskenaite A, Quinette P, Desgranges B, de La Sayette V, Viader F, Eustache F. Mental simulation of future scenarios in transient global amnesia. *Neuropsychologia.* 2014;63:1-9. doi:10.1016/j.neuropsychologia.2014.08.002
- 36) Lochner P, Nedelmann M, Kaps M, Stolz E. Jugular valve incompetence in transient global amnesia. A problem revisited. *J Neuroimaging.* 2014;24(5):479-483. doi:10.1111/jon.12042
- 37) Kang Y, Kim E, Kim JH, et al. Time of flight MR angiography assessment casts doubt on the association between transient global amnesia and intracranial jugular venous reflux. *Eur Radiol.* 2015;25(3):703-709. doi:10.1007/s00330-014-3448-7
- 38) Jang JW, Park SY, Hong JH, Park YH, Kim JE, Kim S. Different risk factor profiles between transient global amnesia and transient ischemic attack: a large case-control study. *Eur Neurol.* 2014;71(1-2):19-24. doi:10.1159/000354023
- 39) Baracchini C, Farina F, Ballotta E, Meneghetti G, Manara R. No signs of intracranial arterial vasoconstriction in transient global amnesia. *J Neuroimaging.* 2015;25(1):92-96. doi:10.1111/jon.12090
- 40) Hainselin M, Quinette P, Juskenaite A, et al. Just do it! How performing an action enhances remembering in transient global amnesia. *Cortex.* 2014;50:192-199. doi:10.1016/j.cortex.2013.10.007
- 41) Marin-Garcia E, Ruiz-Vargas JM, Kapur N. Mere exposure effect can be elicited in transient global amnesia. *J Clin Exp Neuropsychol.* 2013;35(10):1007-1014. doi:10.1080/13803395.2013.844774
- 42) Della Marca G, Mazza M, Losurdo A, et al. Sleep modifications in acute transient global amnesia. *J Clin Sleep Med.* 2013;9(9):921-927. doi:10.5664/jcsm.2994

- 43) Buhr J, Evers S, Husstedt IW, Frese A. Event related potentials in patients with transient global amnesia--a prospective controlled study. *J Neurol Sci.* 2013;325(1-2):57-60. doi:10.1016/j.jns.2012.11.017
- 44) Baracchini C, Tonello S, Farina F, et al. Jugular veins in transient global amnesia: innocent bystanders. *Stroke.* 2012;43(9):2289-2292. doi:10.1161/STROKEAHA.112.654087
- 45) Hainselin M, Quinette P, Desgranges B, et al. Awareness of disease state without explicit knowledge of memory failure in transient global amnesia. *Cortex.* 2012;48(8):1079-1084. doi:10.1016/j.cortex.2012.02.003
- 46) Uttner I, Prexl S, Freund W, Unrath A, Bengel D, Huber R. Long-term outcome in transient global amnesia patients with and without focal hyperintensities in the CA1 region of the hippocampus. *Eur Neurol.* 2012;67(3):155-160. doi:10.1159/000334735
- 47) Hainselin M, Quinette P, Desgranges B, et al. Can we remember future actions yet forget the last two minutes? Study in transient global amnesia. *J Cogn Neurosci.* 2011;23(12):4138-4149. doi:10.1162/jocn_a_00076
- 48) Baracchini C, Perini P, Calabrese M, Causin F, Rinaldi F, Gallo P. No evidence of chronic cerebrospinal venous insufficiency at multiple sclerosis onset. *Ann Neurol.* 2011;69(1):90-99. doi:10.1002/ana.22228
- 49) Uttner I, Weber S, Freund W, et al. Hippocampal cavities are not associated with cognitive impairment in transient global amnesia. *Eur J Neurol.* 2011;18(6):882-887. doi:10.1111/j.1468-1331.2010.03310.x
- 50) Thoma P, Schwarz M, Daum I. Levels-of-processing effects on recollection and familiarity during transient global amnesia and after recovery. *Neuropsychology.* 2010;24(6):795-803. doi:10.1037/a0020136
- 51) Bartsch T, Schönfeld R, Müller FJ, et al. Focal lesions of human hippocampal CA1 neurons in transient global amnesia impair place memory. *Science.* 2010;328(5984):1412-1415. doi:10.1126/science.1188160
- 52) Cejas C, Cisneros LF, Lagos R, Zuk C, Ameriso SF. Internal jugular vein valve incompetence is highly prevalent in transient global amnesia. *Stroke.* 2010;41(1):67-71. doi:10.1161/STROKEAHA.109.566315
- 53) Enzinger C, Thimary F, Kapeller P, et al. Transient global amnesia: diffusion-weighted imaging lesions and cerebrovascular disease. *Stroke.* 2008;39(8):2219-2225. doi:10.1161/STROKEAHA.107.508655
- 54) Noël A, Quinette P, Guillery-Girard B, et al. Psychopathological factors, memory disorders and transient global amnesia. *Br J Psychiatry.* 2008;193(2):145-151. doi:10.1192/bjp.bp.107.045716
- 55) Agosti C, Borroni B, Archetti S, Akkawi NM, Padovani A. The brain-derived neurotrophic factor (BDNF) Val66Met polymorphism is not significantly correlated to Transient Global Amnesia:

- preliminary results of an on-going study in Brescia Province, Italy. *Neurosci Lett*. 2008;443(3):228-231. doi:10.1016/j.neulet.2008.07.082
- 56) Jäger T, Szabo K, Griebe M, Bätzner H, Möller J, Hennerici MG. Selective disruption of hippocampus-mediated recognition memory processes after episodes of transient global amnesia. *Neuropsychologia*. 2009;47(1):70-76. doi:10.1016/j.neuropsychologia.2008.08.019
- 57) Chung YA, Jeong J, Yang DW, et al. A Tc-99m SPECT study of regional cerebral blood flow in patients with transient global amnesia. *Neuroimage*. 2009;47(1):50-55. doi:10.1016/j.neuroimage.2008.11.011
- 58) Chung CP, Hsu HY, Chao AC, Sheng WY, Soong BW, Hu HH. Transient global amnesia: cerebral venous outflow impairment-insight from the abnormal flow patterns of the internal jugular vein. *Ultrasound Med Biol*. 2007;33(11):1727-1735. doi:10.1016/j.ultrasmedbio.2007.05.018
- 59) Uttner I, Weber S, Freund W, Schmitz B, Ramspott M, Huber R. Transient global amnesia--full recovery without persistent cognitive impairment. *Eur Neurol*. 2007;58(3):146-151. doi:10.1159/000104715
- 60) Chung CP, Hsu HY, Chao AC, Chang FC, Sheng WY, Hu HH. Detection of intracranial venous reflux in patients of transient global amnesia. *Neurology*. 2006;66(12):1873-1877. doi:10.1212/01.wnl.0000219620.69618.9d
- 61) Quinette P, Guillery-Girard B, Noël A, et al. The relationship between working memory and episodic memory disorders in transient global amnesia. *Neuropsychologia*. 2006;44(12):2508-2519. doi:10.1016/j.neuropsychologia.2006.03.031
- 62) Guillery-Girard B, Quinette P, Desgranges B, et al. Long-term memory following transient global amnesia: an investigation of episodic and semantic memory. *Acta Neurol Scand*. 2006;114(5):329-333. doi:10.1111/j.1600-0404.2006.00625.x
- 63) Schreiber SJ, Doepp F, Klingebiel R, Valdueza JM. Internal jugular vein valve incompetence and intracranial venous anatomy in transient global amnesia. *J Neurol Neurosurg Psychiatry*. 2005;76(4):509-513. doi:10.1136/jnnp.2004.043844
- 64) Winbeck K, Etgen T, von Einsiedel HG, Röttinger M, Sander D. DWI in transient global amnesia and TIA: proposal for an ischaemic origin of TGA. *J Neurol Neurosurg Psychiatry*. 2005;76(3):438-441. doi:10.1136/jnnp.2004.042432
- 65) Nedelmann M, Eicke BM, Dieterich M. Increased incidence of jugular valve insufficiency in patients with transient global amnesia. *J Neurol*. 2005;252(12):1482-1486. doi:10.1007/s00415-005-0894-9
- 66) Nakada T, Kwee IL, Fujii Y, Knight RT. High-field, T2 reversed MRI of the hippocampus in transient global amnesia. *Neurology*. 2005;64(7):1170-1174. doi:10.1212/01.WNL.0000156158.48587.EA
- 67) Le Pira F, Giuffrida S, Maci T, Reggio E, Zappalà G, Perciavalle V. Cognitive findings after transient global amnesia: role of prefrontal cortex. *Appl Neuropsychol*. 2005;12(4):212-217. doi:10.1207/s15324826an1204_5

- 68) Hirabayashi H, Shimizu M, Kohara S, Shinohara Y. Activated platelets in transient global amnesia and TIA. *Neurology*. 2004;63(4):736-738. doi:10.1212/01.wnl.0000134602.92612.be
- 69) Takeuchi R, Matsuda H, Yoshioka K, Yonekura Y. Cerebral blood flow SPET in transient global amnesia with automated ROI analysis by 3DSRT. *Eur J Nucl Med Mol Imaging*. 2004;31(4):578-589. doi:10.1007/s00259-003-1406-8
- 70) Borroni B, Agosti C, Brambilla C, et al. Is transient global amnesia a risk factor for amnesic mild cognitive impairment?. *J Neurol*. 2004;251(9):1125-1127. doi:10.1007/s00415-004-0497-x
- 71) Maalikjy Akkawi N, Agosti C, Anzola GP, et al. Transient global amnesia: a clinical and sonographic study. *Eur Neurol*. 2003;49(2):67-71. doi:10.1159/000068501
- 72) Stracciari A, Lorusso S, Delli Ponti A, Mattarozzi K, Tempestini A. Cognitive functions after transient topographical amnesia. *Eur J Neurol*. 2002;9(4):401-405. doi:10.1046/j.1468-1331.2002.00426.x
- 73) Kessler J, Markowitsch HJ, Rudolf J, Heiss WD. Continuing cognitive impairment after isolated transient global amnesia. *Int J Neurosci*. 2001;106(3-4):159-168. doi:10.3109/00207450109149746
- 74) Akkawi NM, Agosti C, Rozzini L, Anzola GP, Padovani A. Transient global amnesia and disturbance of venous flow patterns. *Lancet*. 2001;357(9260):957. doi:10.1016/S0140-6736(05)71655-X
- 75) Akkawi NM, Agosti C, Rozzini L, Anzola GP, Padovani A. Transient global amnesia and venous flow patterns. *Lancet*. 2001;357(9256):639. doi:10.1016/S0140-6736(05)71434-3
- 76) Trinka E, Pfisterer G, Unterrainer J, et al. Multimodal event-related potential P3 after transient global amnesia. *Eur J Neurol*. 2000;7(1):81-85. doi:10.1046/j.1468-1331.2000.00011.x
- 77) Sander D, Winbeck K, Etgen T, Knapp R, Klingelhöfer J, Conrad B. Disturbance of venous flow patterns in patients with transient global amnesia. *Lancet*. 2000;356(9246):1982-1984. doi:10.1016/S0140-6736(00)03313-4
- 78) Schmidtke K, Ehmsen L. Transient global amnesia and migraine. A case control study. *Eur Neurol*. 1998;40(1):9-14. doi:10.1159/000007948
- 79) Lauria G, Gentile M, Fassetta G, Casetta I, Caneve G. Transient global amnesia and transient ischemic attack: a community-based case-control study. *Acta Neurol Scand*. 1998;97(6):381-385. doi:10.1111/j.1600-0404.1998.tb05970.x
- 80) Inzitari D, Pantoni L, Lamassa M, Pallanti S, Pracucci G, Marini P. Emotional arousal and phobia in transient global amnesia. *Arch Neurol*. 1997; 54(7): 866-873. doi:10.1001/archneur.1997.00550190056015
- 81) Primavera A, Novello P, Stara S. Transient global amnesia: a quantified electroencephalographic study. *Acta Neurol Scand*. 1993;87(2):115-117. doi:10.1111/j.1600-0404.1993.tb04088.x
- 82) Gallassi R, Stracciari A, Morreale A, Lorusso S, Rebutti GG, Lugaresi E. Transient global amnesia: neuropsychological findings after single and multiple attacks. *Eur Neurol*. 1993;33(4):294-298. doi:10.1159/000116957
- 83) Melo TP, Ferro JM, Ferro H. Transient global amnesia. A case control study. *Brain*. 1992;115 Pt 1:261-270. doi:10.1093/brain/115.1.261

- 84) Faglioni P, Scarpa M, Colombo A, Botti C, Grisanti A. A model-based study of learning and memory following transient global amnesia attacks. *Cortex*. 1992;28(1):9-22. doi:10.1016/s0010-9452(13)80162-1
- 85) Hodges JR, Oxbury SM. Persistent memory impairment following transient global amnesia. *J Clin Exp Neuropsychol*. 1990;12(6):904-920. doi:10.1080/01688639008401030