

Park Lab | Program for Hospital and Intensive Care Informatics

Select Publications

Listing of relevant publications. For More Complete Bibliography:

<https://www.ncbi.nlm.nih.gov/myncbi/1jC6vxijdi-56/bibliography/public/>

2023

1. Ridha M, Megjhani M, Nametz D, Kwon SB, Velazquez A, Ghoshal S, Agarwal S, Claassen J, Roh D, Connolly ES Jr, Park S. Suboptimal Cerebral Perfusion is Associated with Ischemia After Intracerebral Hemorrhage. *Neurocrit Care*. 2023 Nov 13. Online ahead of print. PMID: 37957418.
2. Park S, Beqiri E, Smielewski P, Aries M; CLINICCA (CLINical use of Information on Continuous monitoring of Cerebral Autoregulation) Collaborators. Inaugural State of the Union: Continuous cerebral autoregulation monitoring in the clinical practice of neurocritical care and anaesthesia. *Neurocrit Care*. 2023 Oct 18. Doi: 10.1007/s12028-023-01860-9. Online ahead of print. PMID: 37853235.
3. Beqiri E, Badjatia N, Ercole A, Foreman B, Hu P, Hu X, LaRovere K, Meyfroidt G, Moberg D, Robba C, Rosenthal E, Smielewski P, Wainwright MS, Park S and the Curing Coma Campaign and its Contributing Members. Common Data Elements for Disorders of Consciousness: Recommendations from the Working Group on Physiology and Big Data. *Neurocrit Care*. 2023 Dec;39(3):593-599. Epub 2023 Sep 13. PMID: 37704934.
4. Foreman B, Kapinos G, Wainwright M, Ngwenya LB, O'Phelan KH, LaRovere K, Kirschen MP, Appavu B, Lazaridis C, Alkhachroum A, Maciel CB, Amorim E, Chang JJ, Gilmore EJ, Rosenthal ES, Park S. Practice Standards for the Use of Multimodality Neuromonitoring: A Delphi Consensus Process. *Crit Care Med*. 2023 Dec 1;51(12):1740-1753. Epub 2023 Nov 16. PMID: 37607072.
5. Kwon SB, Megjhani M, Nametz D, Agarwal S, Park S. Heart Rate and Heart Rate Variability as a Prognosticating Feature for Functional Outcome after Cardiac Arrest: A Scoping Review. *Resusc Plus*. 2023 Aug 17;15:100450. Doi: 10.1016/j.resplu.2023.100450. eCollection 2023 Sep. PMID: 37645619. PMC10461016.
6. Weirnerman B, Cheung E, Park S. Risk Factors and Post-Operative Management for the Bidirectional Glenn: A Literature Review. *Curr Pediatr Rep* 11, 174-179 (2023). Doi 10.1007/s40124-023-00294-3.
7. Megjhani M, Terilli K, Nametz D, Kwon SB, Weirnerman B, Velazquez A, Ghoshal S, Roh D, Agarwal S, Connolly ES Jr, Claassen J, Park S. Automatic Identification of Intracranial Pressure Waveform during External Ventricular Drain Clamping: Segmentation via Wavelet Analysis. *Physiol Meas*. 2023 Jul 4;44(6). PMID: 37327793. PMC10403046.
8. Ranard BL, Chow CC, Megjhani M, Asgari S, Park S*, Vodovotz Y* (*co-senior authors). A Mathematical Model of SARS-CoV-2 Immunity Predicts Paxlovid Rebound. *J Med Virol*. 2023 Jun;95(6):e28854. PMID:37287404. PMC10254150.
9. Megjhani M, Terilli K, Weirnerman B, Nametz D, Kwon SB, Velazquez A, Ghoshal S, Roh DJ,

- Agarwal S, Connolly Jr ES, Claassen J, Park S. A Deep Learning Framework for Deriving Non-Invasive Intracranial Pressure Waveforms from Transcranial Doppler. *Ann Neurol*. 2023 Jul;94(1):196-202. Epub 2023 Jun 1. PMID: 37189299. PMC10330695.
10. Kastenholz N, Megjhani M, Conzen-Dilger C, Albanna W, Veldeman M, Nametz D, Kwon SB, Schulze-Steinen H, Ridwan H, Clusmann H, Schubert GA, Park S, Weiss M. The Oxygen Reactivity Index indicates disturbed local perfusion regulation after aneurysmal subarachnoid hemorrhage: an observational cohort study. *Crit Care*. 2023 Jun 13;27(1):235. PMID: 37312192, PMC10265851.
 11. Park S*, Robba C*, Sonnevile R.* (*equally contributing co-authors) Neuromonitoring for prognostication under ECMO. *Intensive Care Med*. 2023 Apr;49(4):451-454. Epub 2023 Feb 15. PMID: 36790513.

2022

1. Tas J, Czosnyka M, van der Horst ICC, Park S, van Heugten C, Sekhon M, Robba C, Menon DK, Zeiler FA, Aries MJH. Cerebral multimodality monitoring in adult neurocritical care patients with acute brain injury: a narrative review. *Front Physiol*. 2022 Dec 1;13:1071161. eCollection 2022. PMID: 36531179. PMCID9751622.
2. Megjhani M*, Weiss M*, Ford J, Terilli K, Kastenholz N, Nametz D, Kwon SB, Velazquez A, Agarwal S, Roh DJ, Conzen-Dilger C, Albanna W, Veldeman M, Connolly Jr ES, Claassen J, Aries M, Schubert GA, Park S. Optimal Cerebral Perfusion Pressure and Brain Tissue Oxygenation in Aneurysmal Subarachnoid Hemorrhage. *co-first authors (equal contribution). *Stroke*. 2023 Jan;54(1):189-197. Epub 2022 Oct 31. PMID: 36314124.
3. Mainali S, Park S. Artificial Intelligence and Big Data Science in Neurocritical Care. *Crit Care Clin*. 2023 Jan;39(1):235-242. Epub 2022 Oct 9. PMID: 36333034.
4. Gomez LA, Shen Q, Doyle K, Vrosgou A, Velazquez A, Megjhani M, Ghoshal S, Roh D, Agarwal S, Park S, Claassen J, Kleinberg S. Classification of Level of Consciousness in a Neurological ICU using Physiologic Data. *Neurocrit Care*. 2023 Feb;38(1):118-128. Epub 2022 Sep 15. PMID: 36109448.
5. Claassen J, Park S. Spontaneous Subarachnoid Haemorrhage. *Lancet*. 2022 Sep 10;400(100355):846-862. Epub 2022 Aug 16. PMID: 35985353.
6. Ranard BL, Megjhani M, Terilli K, Yarmohammadi H, Ausiello J, Park S. Heart rate variability and adrenal size provide clues to sudden cardiac death in hospitalized COVID-19 patients. *J Crit Care*. 2022 Jul 18;71:154114. PMID: 35863211 PMCID: PMC9291038.
7. Rubinos C*, Kwon SB*, Megjhani M, Terilli K, Wong B, Cespedes L, Ford J, Reyes R, Kirsch H, Alkhachroum A, Velazquez A, Roh D, Agarwal S, Claassen J, Connolly ES Jr, Park S. Predicting Shunt Dependency from the Effect of Cerebrospinal Fluid Drainage on Ventricular Size. *Neurocrit Care*. 2022 Jun 25. Online ahead of print. PMID: 35750930.
8. Ack S, Loiseau SY, Sharma G, Goldstein JN, Lissak IA, Duffy SM, Amorim E, Vespa P, Moorman JR, Hu X, Clermont G, Park S, Kamaleswaran R, Foreman BP, Rosenthal ES. Neurocritical Care Performance Measures Derived from Electronic Health Record Data are Feasible and Reveal Site-Specific Variation: A CHoRUS Pilot Project. *Neurocrit Care*. 2022 Aug;37(Suppl 2):276-290. Epub 2022 Jun 10. PMID: 35689135. Special Issue: Big Data in Neurocritical Care
9. Weiss M, Albanna W, Conzen C, Kastenholz N, Seyfried K, Ridwan H, Weismann M, Veldeman M, Schmidt T, Tas J, Megjhani M, Schulze-Steinen H, Clusmann H, Aries MJ, Park S, Schubert

- GA. Intraarterial nimodipine versus induced hypertension for delayed cerebral ischemia – a modified treatment protocol. *Stroke*. 2022 Aug;53(8):2607-2616. Epub 2022 Jun 8. PMID: 35674046.
10. Rasulo FA, Calza S, Robba C, Taccone FS, Biasucci DG, Badenes R, Piva S, Savo D, Citerio G, Dibu JR, Curto F, Meriadri M, Gritti P, Fassini P, Park S, Lamperti M, Bouzat P, Malacarne P, Chierigato A, Bertuetti R, Aspide R, Cantoni A, McCredie V, Guadrini L, Latronico N. Transcranial Doppler as a screening test to exclude Intracranial hypertension in brain-Injured patients: the IMPRESSIT-2 prospective multicenter international study. *Crit Care*. 2022 Apr 15;26(1):110. PMID: 35428353.
 11. Megjhani M, Weiss M, Kwon SB, Ford J, Nametz D, Kastenhof N, Fogel H, Velazquez A, Roh D, Agarwal S, Connolly Jr ES, Claassen J, Schubert GA, Park S. Vector angle analysis of multimodal neuromonitoring data for real-time prediction of delayed cerebral ischemia. *Neurocrit Care*. 2022 Aug;37(Suppl 2):230-2336. Epub 2022 Mar 30. PMID: 35352273.
 12. Cao H, Finer J, Megjhani M, Nametz DC, Lorenzi V, Mamykina L, Meyers R, Rossetti SC, Park S. Machine Learning Model Deployment Using Real-Time Physiological Monitoring: Use Case of Detecting Delayed Cerebral Ischemia. 2022 IEEE Healthcare Innovations and Point of Care Technologies (HI-POCT), 2022, pp 42-45, doi:10.1109/HI-POCT54491.2022.9744076.
 13. Weiss M, Albanna W, Conzen C, Megjhani M, Tas J, Seyfried K, Kastenhof N, Veldeman M, Schmidt TP, Schulze-Steinen H, Wiesmann M, Clusmann H, Park S, Aries M, Schubert GA. Optimal cerebral perfusion pressure during delayed cerebral ischemia after aneurysmal subarachnoid hemorrhage. *Crit Care Med*. 2022 Feb 1;50(2):183-191. PMID: 35100191.

2021

1. Ranard BL, Megjhani M, Terilli K, Doyle K, Claassen J, Pinsky MR, Clermont G, Vodovotz Y, Asgari S, Park S. Identification of Endotypes of Hospitalized COVID-19 Patients. *Front Med (Lausanne)*. 2021 Nov 11;8:770343. PMID: 34859018. PMCID: PMC8632028.
2. Day JD*, Park S*, Ranard BL, Singh H, Chow CC#, Vodovotz Y#. Divergent COVID-19 Disease Trajectories Predicted by a DAMP-Centered Immune Network Model. *Co-First Authors; #Co-Senior Authors. *Front Immunol*. 2021;12:754127. eCollection 2021. PMID: 34777366; PMCID: 8582279.
3. Megjhani M, Terilli K, Kalasapudi L, Chen J, Carlson J, Miller S, Badjatia N, Hu P, Velazquez A, Roh DJ, Agarwal S, Claassen J, Connolly ES, Hu X, Morris N, Park S. Dynamic Intracranial Pressure Waveform Morphology Predicts Ventriculitis. *Neurocrit Care*. 2022 Apr;36(2):404-411. Epub 2021 Jul 30. PMID: 34331206.
4. Veldeman M, Albanna W, Weiss M, Park S, Hoellig A, Clusmann H, Helbok R, Temel Y, Schubert GA. Invasive Multimodal Neuromonitoring in Aneurysmal Subarachnoid Hemorrhage – a Systematic Review. *Stroke*. 2021 Nov;52(11):3624-3632. Epub Jul 26. PMID: 34304602.
5. Megjhani M, Terilli K, Kaplan A, Wallace BK, Alkhachroum A, Hu X, Park S. Use of Clustering to Investigate Changes in Intracranial Pressure Waveform Morphology in Patients with Ventriculitis. *Acta Neurochir Suppl*. 2021;131:59-62. PMID: 33839819.
6. Megjhani M, Terilli K, Weiss M, Savarraj JP, Chen LH, Alkhachroum A, Roh DJ, Agarwal S, Connolly ES Jr, Velazquez A, Boehme A, Claassen J, Choi H, Schubert G, Park S. Dynamic

Detection of Delayed Cerebral Ischemia: A Study in Three Centers. *Stroke*. 2021 Apr;52(4):1370-1379. Epub 2021 Feb 18. PMID: 33596676, PMC8247633.

7. Fedriga M, Czigler A, Nasr N, Zeiler FA, Park S, Donnelly J, Papaioannou V, Frisvold SK, Wolf S, Rasulo F, Sykora M, Smielewski P, Czosnyka M. Autonomic Nervous System Activity During Refractory Rise in Intracranial Pressure. *J Neurotrauma*. 2021 Jun 15;38(12):1662-1669. Epub 2021 Jan 12. PMID: 33280491.
8. Savarraj JPJ, Hergenroeder G, Zhu L, Chang T, Park S, Megjhani M, Vahidy F, Zhao Z, Kitagawa R, Choi HA. Machine Learning to Predict Delayed Cerebral Ischemia and Outcomes in Subarachnoid Hemorrhage. *Neurology*. 2021 Jan 26;96(4):e553-e562. Epub 2020 Nov 12. PMID 33184232.

2020

1. Rasulo F, Piva S, Park S, Oddo M, Megjhani M, Cardim D, Matteotti I, Gandolfi L, Robba C, Taccone FS, Latronico N. The association between peri-hemorrhagic metabolites and cerebral hemodynamics in patients with spontaneous intracerebral hemorrhage: an international multicenter pilot study analysis. *Front Neurol*. 2020 Oct 26;11:568536. PMID: 33193007.
2. Alkhachroum A*, Terilli K*, Megjhani M*, Park S. Harnessing Big Data in Neurocritical Care in the Era of Precision Medicine. *Curr Treat Options Neurol* 22,15 (2020). <https://doi.org/10.1007/s11940-020-00622-8>.
3. Stember JN, Terilli K, Perez E, Megjhani M, Cooper C, Jambawalikar S, Park S. Surface Point Cloud Ultrasound with Transcranial Doppler: coregistration of surface point cloud ultrasound with magnetic resonance angiography for improved reproducibility, visualization and navigation in transcranial Doppler ultrasound. *J Digit Imaging*. 2020 Aug;33(4):930-936. Epub 2020 Feb 19. PMID: 32076925.
4. Alkhachroum A, Megjhani M, Terilli K, Rubinos C, Ford J, Wallace BK, Roh DJ, Agarwal S, Connolly ES, Boehme AK, Claassen J, Park S. Hyperemia in Subarachnoid Hemorrhage Patients is Associated with an Increased Risk of Seizures. *J Cereb Blood Flow Metab*. 2020 Jun;40(6):1290-1299. Epub 2019 Jul 11. PMID: 31296131.
5. Megjhani M, Kaffashi F, Terilli K, Alkhachroum A, Esmaeili B, Doyle KW, Murthy S, Velazquez AG, Connolly, ES Jr, Roh DJ, Agarwal S, Loparo KA, Claassen J, Boehme A, Park S. Heart Rate Variability as a Biomarker of Neurocardiogenic Injury after Subarachnoid Hemorrhage. *Neurocrit Care*, 2020 Feb;32(1):162-171. Epub 2019 May 15. PMID: 31093884, PMC6856427.
6. Park S, Rogers ML (2020) Intensive Care Unit Collaboration and Workflow in the Information Age. In: De Georgia M and Loparo K (eds) *Neurocritical Care Informatics*. Springer, Berlin, Heidelberg.

2019

1. Robba C, Goffi A, Geeraert T, Cardim D, Via G, Czosnyka M, Park S, Sarwal A, Padayachy L, Rasulo F, Citerio G. Brain ultrasonography: methodology, basic and advanced principles and clinical applications. A narrative review. *Intensive Care Med* 2019 Jul;45(7):913-927. Epub 2019 Apr 25. PMID: 31025061.
2. Al-Mufti F, Amuluru K, Damodara N, Dodson V, Roh D, Agarwal S, Meyers PM, Connolly ES Jr, Schmidt JM, Claassen J, Park S. Admission Neutrophil-Lymphocyte Ratio Predicts Delayed

Cerebral Ischemia Following Aneurysmal Subarachnoid Hemorrhage. *Journal of Neurointerv Surg*. 2019 Nov;11(11):1135-1140. Epub 2019 Apr 12. PMID: 30979846.

3. Witsch J, Al-Mufti F, Connolly ES, Agarwal S, Melmed K, Roh DJ, Claassen J, Park S. Statins and perihemorrhagic edema in patients with spontaneous intracerebral hemorrhage. *Neurology*. 2019 Apr 30;92(18):e2145-e2149. Epub 2019 Feb 6. PMID: 30728307.
4. Megjhani M, Alkhachroum A, Terilli K, Ford J, Rubinos C, Kromm J, Wallace BK, Connolly ES, Roh D, Agarwal S, Claassen J, Padmanabhan R, Hu X, Park S. An active learning framework for enhancing identification of non-artifactual intracranial pressure waveforms. *Physiol Meas*. 2019 Jan 18;40(1):015002. Epub 2018 Dec 18. PMID: 30562165, PMC6681897.
5. Megjhani M, Terilli K, Frey H-P, Velazquez AG, Doyle KW, Connolly Jr ES, Roh DJ, Agarwal S, Claassen J, Elhadad N, Park S. Incorporating High-Frequency Physiologic Data Using Computational Dictionary Learning Improves Prediction of Delayed Cerebral Ischemia Compared to Existing Methods. *Front Neurol*. 2018 Mar 7;9:122. PMID: 29563892.
6. Park S, Megjhani M, Frey H-P, Grave E, Wiggins C, Terilli KL, Roh DJ, Velazquez A, Agarwal S, Connolly ES Jr, Schmidt JM, Claassen J, Elhadad N. Predicting Delayed Cerebral Ischemia after Subarachnoid Hemorrhage Using Physiological Time Series Data. *J Clin Monit Comput*. 2019 Feb;33(1):95-105. Epub 2018 Mar 20. PMID: 29556884, PMC6681895.

2018

1. Megjhani M, Terilli K, Martin A, Velazquez A, Claassen J, Roh D, Agarwal S, Smielewski P, Boehme AK, Schmidt JM, Park S. Deriving PRx and CPPopt from 0.2 Hz data: Establishing Generalizability to Bedmaster users. *Acta Neurochir Suppl* 2018;126:179-182. PMID: 29492557.
2. Francoeur CL, Roh D, Schmidt JM, Mayer SA, Falo MC, Agarwal S, Connolly ES, Claassen J, Elkind MS, Park S. Desmopressin administration and rebleeding in subarachnoid hemorrhage: analysis of an observational prospective database. *J Neurosurg* 2018 Jan 1:1-7. Online ahead of print. PMID: 29393750. PMC6688966.
3. Morris NA, Manning N, Marshall R, Connolly ES, Claassen J, Agarwal S, Roh DJ, Schmidt JM, Park S. Transcranial Doppler Waveforms during Intra-aortic Balloon Pump Counterpulsation for Vasospasm Detection after Subarachnoid Hemorrhage. *Neurosurgery*. 2018 Sep 1;83(3):416-421. Epub 2017 Jul 21. PMID 28973669.

2017

1. Hsu W, Park S, Kahn CE Jr. Sensor, Signal, and Imaging Informatics. *Yearb Med Inform* 2017 Aug;26(1):120-124. PMID: 29063550.
2. Schmidt JM, Park S. (2017). Neurophysiologic Decision Support Systems. Lee K (Ed.). In *The NeuroICU Book* (pp 351-360). New York: McGraw-Hill Medical.

2016

1. Wanderer JP, Nelson SE, Ehrenfeld JM, Monahan S, Park S. Clinical Data Visualization: The Current State and Future Needs. *J Med Syst* 2016 Dec;40(12):275. Epub 2016 Oct 27. PMID: 27787779.

2. Arroyo-Palacios J, Rudz M, Fidler R, Smith W, Ko N, Park S, Bai Y, Hu X. Characterization of Shape Differences among ICP Pulses Predicts Outcome of External Ventricular Drainage Weaning Trial. *Neurocrit Care*. 2016 Dec;25(3):424-433. PMID 27106888.
3. Roh D, Park S. Brain Multimodality Monitoring: Updated Perspectives. *Current Neurology and Neuroscience Reports*. 2016;16(6):56-65. PMID: 27095434, PMC4863980.
4. Park S, Czosnyka M, Smielewski P. Brain Oxygen Relationship to Cerebral Perfusion Pressure Depends on Tip Location and Time Window: Can Brain O₂ be an adjunctive modality for determining optimal CPP? *Acta Neurochir Suppl*. 2016;122:133-135. PMID: 27165893.

2015

1. Citerio G, Park S, Schmidt JM, Moberg R, Suarez JI, LeRoux PD; Second Neurocritical Care Research Conference Investigators. Data Collection and Interpretation. *Neurocritical Care* 2015 Jun;22(3):360-368. PMID: 25846711.

2014

1. Roederer A, Holmes JH, Smith MJ, Lee I, Park S. Prediction of Significant Vasospasm in Aneurysmal Subarachnoid Hemorrhage Using Automated Data. *Neurocritical Care* 2014 21(3):444-450. PMID: 24715326
2. Roederer A, Soegaard J, Lee I, Wanderer J, Park S. Wandering Data: A Scalable, Durable System for Effective Visualization of Patient Health Data. *Proceedings from 2014 IEEE 27th International Symposium on Computer-Based Medical Systems*. P.547-548. DOI: 10.1109/CBMS.2014.131.

2013

1. Park S, Kaffashi F, Loparo KA, Jacono FJ. The Use of Heart Rate Variability for the Early Detection of Treatable Complications after Aneurysmal Subarachnoid Hemorrhage. *Journal of Clinical Monitoring and Computing* 2013;27(4):385-393. PMID: 23615846.
2. Goodman D, Kasner SE, Park S. Predicting Early Awakening from Coma after Intracerebral Hemorrhage. *Frontiers in Neurology* 2013 Oct 16;4:162. PMID: 24137155.

2012

1. Fishman M, Jacono FJ, Park S, Jamasebi R, Thungtong A, Loparo KA, Dick TE. A Method for Analyzing Temporal Patterns of Variability of a Time Series from Poincare Plots. *Journal of Applied Physiology*. 2012 Jul;113(2):297-306. PMID: 22556398.
2. Roederer A, Hicks A, Oyeniran E, Lee I, Park S. Clinical Decision Support for Integrated Cyber-Physical Systems: A Mixed Methods Approach. *Proceedings of the 2nd ACM SIGHIT International Health Informatics Symposium (IHI '12)* 2012 January. P. 871-874. Demo Paper, Miami, FL. DOI:10.1145/2110363.2110476.
3. Chandra M, Minkoff DL, Schenkel SS, Frangos S, Mesquita RC, Kosty JA, Park S, Kofke A, Yodh A. Long Term Monitoring of Cerebral Blood Flow in Subarachnoid Hemorrhage Patients Using Diffuse Correlation Spectroscopy. *Biomedical Optics and 3D Imaging OSA Conference Paper*. 2012:JM3A.14. doi:10.1364/BIOMED.2012.JM3A.14.
4. Arney D, Mattegunta P, King A, Lee I, Park S, Mullen-Fortino M, Goldman JM. Device Time, Data Logging, and Virtual Medical Devices. *Journal of Medical Devices* 3/12/2012;

6(1):017596. DOI:10.1115/1.4026774. 2012 Design of Medical Devices Conference Technical Brief, Minnesota, MN.

2011

1. Park S, Roederer A, Mani R, Schmitt S, LeRoux PD, Ungar LH, Lee I, Kasner SE. Limitations of Threshold-Based Brain Oxygen Monitoring for Seizure Detection. *Neurocritical Care* 2011;15(3):469-476. PMID: 21523525.
2. Wendell L, Raser J, Kasner S, Park S. Predictors of Extubation Success in Patients with Middle Cerebral Artery Acute Ischemic Stroke. *Stroke Res Treat*. 2011;2011:248789. PMID: 21977336.

2010

1. King A, Roederer A, Chen S, Asare P, Fortino-Mullen M, Park S, Sokolsky O, Lee I. (2010) 'Demo of the Generic Smart Alarm: a Framework for the Design, Analysis, and Implementation of Smart Alarms and Other Clinical Decision Support Systems,' In *Wireless Health 2010*, San Diego, CA, October 5-7, 2010, pp. 210-211 (ACM Digital Library). doi: 10.1145/1921081.1921116