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Critical Rounds

MICRO LABS LIMITED

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Inside This Issue

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Medical Team, Micro Labs Ltd

Digital technology and COVID-19

For medicine and research, the year 2020 would have been the beginning of an interesting decade, with the emergence and maturation of many new innovations that can be used to solve significant health issues and diseases.

Such emerging developments comprise the Internet of Things (IoT) for wireless networks of the next decade (e.g., 5 G); large-data analytics; deep-learning artificial intelligence (AI); and blockchain technology.

These are strongly interrelated: the emergence of IoT (e.g., sensors and instruments) in hospitals and clinics enables the development of a fully integrated digital environment, allowing for real-time data collection on a scale that could then be utilized by AI and deep learning systems to identify healthcare patterns, simulate risk interactions and forecast outcomes.

It is improved by blockchain technologies, a back-linked database of cryptographic protocols and a network of centralized machines in various organisations, combining peer-to-peer networks to ensure data is replicated to several physical sites, and updated algorithms to ensure data is safe but traceable.

Nevertheless, the planet confronts an unprecedented public health threat 3 months before 2020: the spread of a novel coronavirus– triggered by respiratory disease (COVID-19).

When the COVID-19 information progresses, through research shows it seems to be less dangerous than originally believed.

The past decade has allowed the development of a multitude of digital tools. Now they can be used to remediate the COVID-19 outbreak.

Table 1 | Digital technologies and their impact on public-health strategies

	Digital technology			
Public-health measures	**IoT**	**Big data**	**AI**	**Blockchain**
1. Monitoring, surveillance, detection and prevention of COVID-19 (directly related to COVID-19)	+++	+++	++	+
Examples	1. Real-time tracking and live updates in various online databases in the USA, UK and China	1. Modeling of disease activity, potential growth and areas of spread	1. Detection of COVID-19 from chest imaging (X-ray) (Beijing Hospital)	1. Manufacturing and distribution of COVID-19 vaccines once they are available
	2. Live tracking of the at-risk vicinity in Korea (Coronamap.live; Wuhanvirus.kr)	2. Modeling of the preparedness and vulnerability of countries in fighting a disease outbreak	2. Prognostication of disease progression via clinical data, imaging and AI	2. Insurance claims from COVID-related illness and death
2. Mitigation of impact (indirectly related to COVID-19)	+++	++	+++	++
Examples	1. Virtual clinics (PingAn, China)	1. Business modeling on pharmaceutical supplies for various medications	1. AI to automatically diagnose medical conditions unrelated to COVID-19 (Zhongshan Ophthalmic Eye Center, China)	1. Distribution of patients' regular medication to the local pharmacy or patients' doorstep
	2. Public information dissemination via WhatsApp in Singapore[a]	2. Modeling of the utility of operating theaters and clinics with manpower projections	2. Medical 'chat bots' to address public inquiries on COVID-19	

The likely impact of digital technologies on (1) disease monitoring, surveillance, detection and diagnosis, and (2) mitigation of impact: +, low (no clear example yet in either official government website); ++, moderate (one clear example); +++, high (two or more examples). Gray shading indicates potential applications that are not described in the literature thus far but should be considered by technology companies or research groups worldwide to help battle against COVID-19. Additional examples beyond those mentioned in the text are included in this table. [a]https://www.form.gov.sg/#!/5e33fa3709f80b00113b6891.

Mitigation of the effects of COVID-19 Although the emphasis on addressing the immediate effect of COVID-19 is significant, retaining central and vital clinical infrastructure is crucial in many healthcare settings.

For certain nations the immediate response is for healthcare institutions to may or even avoid certain outpatient programs, including clinic closing and postponement of medical visits or elective surgery. Nevertheless, if the COVID-19 pandemic persists past 6 months, these approaches cannot be maintained forever. Healthcare programs ought to focus on adopting new technologies. For example, 'internet clinics' may be set up using telemedicine appointments with image images (e.g., chest X-ray and/or thorax CT) stored and viewed directly from distant locations.

This will mean that patients tend to provide quality health treatment thereby reducing patient physical crowding on hospital premises. Digital e-learning systems are gradually being used for many primary hospital tasks (e.g., science and education), to reduce physical meetings. Second, the usage of different AI-based triage programs may theoretically relieve the physicians 'clinical burden. An online chat bot may help patients understand early symptoms, inform people about the value of hand hygiene, and direct people to medical attention should exacerbate symptoms.

Additionally, phone-based apps can discourage needless medical visits for patients with minor flu-like symptoms from identifying and tracking patient details (e.g. average temperature and symptoms). These data could also be translated into AI algorithms for COVID-19 detection. Third, several hospitals in China are partnering with blockchain firms and pharmacies to bring the drug to

their doorsteps for patients. Hospitals will ensure prompt distribution of pharmaceutical products with precise monitoring by using blockchain.

To sum up, while the planet tends to depend on classic public safety initiatives to address the COVID-19 pandemic, there is already a broad variety of new technologies emerging in 2020 that can be utilized to improve and strengthen these public safety approaches. There's a longer-term target, too. The rapid usage and effective use of emerging technology to tackle a significant global public health problem in 2020 is expected to accelerate public and policy awareness of these innovations for other healthcare fields, including potential chronic disease.

REFERENCES

1. Ting DSW, Carin L, Dzau V. et al. Digital technology and COVID-19. Nat Med 2020. https://doi.org/10.1038/s41591-020-0824-5
2. Shilo S, Rossman H, Segal E. Axes of a revolution: challenges and promises of big data in healthcare. Nat Med. 2020;26(1):29–38. doi:10.1038/s41591-019-0727-5
3. Wu J T, Leung K, Leung GM. Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study. Lancet 2020;395: 689–697 (2020).

Are Fingertip Skin Blood Flow Alterations Related to Mortality in Patients With Circulatory Shock

INTRODUCTION

During the circulatory shock, the skin blood supply is quickly altered and can stay altered given obvious hemodynamic systemic stabilization. Owing to the difficulty of effectively measuring skin perfusion by clinical assessment, many methods have been created to more precisely measure peripheral perfusion, including transcutaneous measurement of carbon dioxide and oxygen concentrations utilizing cutaneous electrodes, analysis of muscle oxygen saturation utilizing near-infrared spectroscopy (NIRS), and assessment of skin blood flow (SBB) using skin laser Doppler (SLD).

Although there is some data to indicate that SBF dysfunction at the hands measured using SLD is associated with disease frequency, these trials were performed in patients with systemic sclerosis, and no trials were performed in circulatory pain. A blunted fingertip SBF reaction to a thermal test was suspected to be correlated with increased mortality in patients with circulatory shock. The study was performed to determine whether shifts in the distribution of skin blood during circulatory shock is linked to survival.

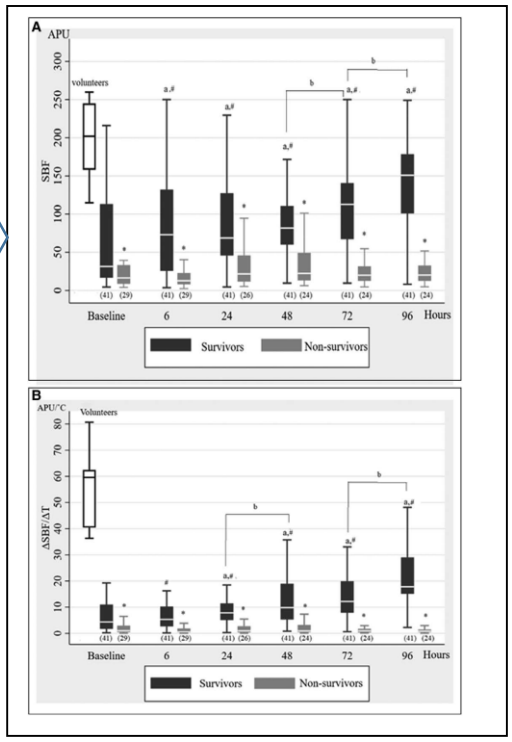
Methods

Subjects: Twenty safe volunteers and 70 patients with circulatory shock (< 12 hr duration), identified as the need for vasopressors to sustain mean blood pressure greater than or equivalent to 65 mm Hg and signs of altered tissue perfusion.

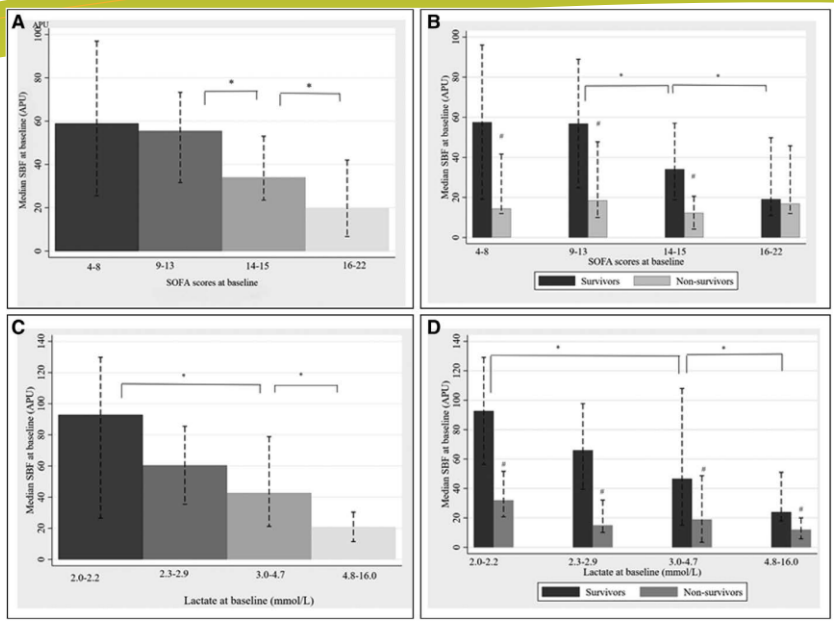
Interventions: Skin blood flow was measured using skin laser Doppler on the fingertip for 3 minutes at basal temperature (SBFBT) and 37 ° C (SBF37) (thermal challenge test) once in volunteers once at inclusion period, once 6, 24, 48, 72 and 96 hours in shock patients. On the contralateral side, capillary refill period and peripheral perfusion index were calculated in points at the same period.

Measurements and Main Results: The thermal challenge response (ΔSBF/ΔT) was calculated using the following formula: (SBF37– SBFBT)/(37–basal temperature). Area under the receiver operating characteristic curves were calculated to evaluate variables predictive of ICU mortality. At inclusion, skin blood flow and ΔSBF/ΔT were lower in patients than in volunteers. Baseline skin blood flow (31 [17–113] vs 16 [9–32] arbitrary perfusion units; p = 0.01) and ΔSBF/ΔT (4.3 [1.7–10.9] vs 0.9 [0.4–2.9] arbitrary perfusion unit/s) were greater in survivors than in nonsurvivors.

Capillary refill time was shorter in survivors than in nonsurvivors; peripheral perfusion index was similar in the two groups. ΔSBF/ΔT (area under the receiver operating characteristic curve 0.94 [0.88–0.99]) and SBFBT (area under the receiver operating characteristic curve 0.83 [0.73–0.93]) had the best predictive value for ICU mortality with cutoff values less than or equal to 1.25 arbitrary perfusion unit/°C (sensitivity 88%, specificity 89%) and less than or equal to 21 arbitrary perfusion unit (sensitivity 84%, specificity 81%), respectively.

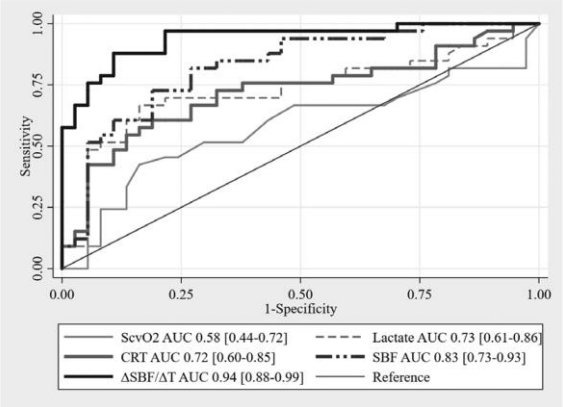


Skin blood flow (SBF) and thermal challenge response (ΔSBF/ΔT) during the study period in survivors and nonsurvivors. A, SBF. B, ΔSBF/ΔT. Data are expressed as medians with 95% CIs. *p < 0.05 versus survivors; AP < 0.05 versus baseline in the same group; bp < 0.05 versus the indicated time point within the same group; #p < 0.05 versus volunteers. APU = arbitrary perfusion units.



Median baseline skin blood flow (SBF) for different quartiles of Sequential Organ Failure Assessment (SOFA) score and blood lactate level. Median baseline SBF for different quartiles of SOFA score in all patients (A) and in survivors and nonsurvivors (B). Median baseline SBF for different quartiles of lactate level in all patients (C) and in survivors and nonsurvivors (D). Data are expressed as medians with 95% CIs. *p < 0.05 between quartiles, #p < 0.05 versus survivors. APU = arbitrary perfusion units.

Prediction of ICU mortality by baseline variables. AUC = area under the curve, CRT = capillary refill time, SBF = skin blood flow, Scvo2 = central venous oxygen saturation, ΔSBF/ΔT = thermal challenge response.



CONCLUSIONS

In patients with circulatory pain, shifts in fingertip skin blood supply may be measured using a Doppler laser thermal test technique and are closely linked to the result. Such new methods of tracking may theoretically be used to direct the resuscitation.

REFERENCES

Mongkolpun W, et al. Alterations in Skin Blood Flow at the Fingertip Are Related to Mortality in Patients with Circulatory Shock. Criti Care Med Apr 2020;48(4):443-450

A comparison of mannitol plus hypertonic saline combination with hypertonic saline monotherapy on acute kidney injury after traumatic brain injury

INTRODUCTION

Traumatic brain injury (TBI) can cause high intracrane pressure (ICP) and low cerebral perfusion (CPP) pressure. That can contribute to cerebral hypoxia, herniation of the brain and death. Hyperosmolar agents such as mannitol and hypertonic saline (HS) are pharmacological options for ICP reduction, especially in patients with serious head injury.

There are currently no guidelines on which hyperosmolar agent is favored. Although there are few randomized controlled trials of high quality comparing such drugs, evolving data indicates that HS could have superior effects on both ICP and CPP. Therefore, local requirements, supply, and clinician choice determine the use of hyperosmolar agents for TBI. For certain cases, during the process of hospitalization patients may obtain both mannitol and HS. It may arise when elevated ICP becomes refractory, when hyperosmolar agents are substituted according to supplier selection, or when laboratory conditions require a shift to a particular pharmacology. The occurrence of acute kidney injury (AKI) is one possible consequence of utilizing mannitol and HS in conjunction.

Individually, mannitol and HS may induce AKI through different mechanisms. Mannitol may induce diuresis, hypovolemia, and renal vasoconstriction, which can decrease blood flow to the renal system. It is troublesome with emergency victims, which usually need fluid resuscitation to maximize the amount of blood. Food and Drug Administration safety material for mannitol also includes an alert about renal risks including renal failure. HS can increase concentrations of sodium and chloride, and can also contribute to renal vasoconstriction, thus rising renal perfusion. The study hypothesized that the TBI patients obtaining both mannitol and HS are at greater risk of experiencing renal dysfunction. The purpose of this analysis was therefore to evaluate the impact of mannitol plus the hypertonic saline combination (MHS) versus HS monotherapy on renal function in TBI patients.

METHODS

It was a direct study of the evidence from the Hypertonic Saline Test Shock Research Resuscitation Outcomes Project and the Traumatic Brain Injury Report. Included in the sample population was a likelihood related group of TBI patients that earned MHS or HS. The primary outcome measure was the maximum serum creatinine value during critical illness

RESULTS

The maximum serum creatinine value during hospitalization was 82 ± 47 µmol/L (0.86 ± 0.26 mg/dL) in the MHS group and 76 ± 23 µmol/L (0.92 ± 0.53 mg/dL) in the HS group (difference -6 µmol/L, 95% CI -14 to 2 µmol/L, p=0.151). The mean lowest eGFR was 108 ± 25 ml/min the MHS group versus 111 ± 24 ml/min in the HS group (difference -4 ml/min, 95% CI -9 to 1 ml/min, p=0.150). Stage 1 or more acute kidney injury (≥0.3 mg/dL (≥26.5 µmol/L) increase in serum creatinine) occurred in 14% (n=23) of the MHS group versus 9% (n=15) in the HS group (p=0.227).

Stage 2 or more severe kidney damage occurred in MHS group 3 per cent (n=4) and HS group 1 per cent (n=2) (p=0.685). Patients who survived hospital discharge were improving from renal failure. The median cumulative dose administered in these patients was 2.5 gm/kg. The median number of doses administered was 1 (range 1 to 10) doses. There was no significant association between mannitol dose and maximum serum creatinine in this subset.

DISCUSSION

Both mannitol and HS individually have a mechanistic basis for causing AKI. Mannitol can be correlated with vasoconstriction of the renal, diuresis, natriuresis, and osmotic nephropathy due to tubular cell swelling. Such results are likely to be more troublesome in multisystem trauma patients that require resuscitation due to blood failure than people with isolated TBI. The results on AKI tend to be dose-dependent, with a more negative impact on higher doses.

Nevertheless, the threats to renal function can be mitigated by judicious usage of close control of ICP. They did not noticed any correlation between combined dose of mannitol and renal function at the doses used in this research. HS can also induce AKI, induced by its effect on sodium and chloride in the serum. The rise in sodium levels in the renal artery has been shown in animal research to reduce the renal blood supply, glomerular filtration rate and release of renin. Chloride infusion often has an effect on renin release and renal arteriole constriction. But patients with chronically ill hyperchloremia may be predisposed to AKI.

These findings showed that patients in the MHS community had a significantly higher concentration of serum sodium, but a comparable concentration of serum chloride. This did not turn into negative effects on kidney activity.

CONCLUSION

For this cohort of younger TBI patients, Mannitol plus Hypertonic Saline did not raise the likelihood of renal failure as opposed to Hypertonic Saline alone. The average frequency of AKI in these patients was small, and intermittent. In order to endorse these findings, prospective studies evaluating the safety and effectiveness of these hyperosmotic agents individually and in combination are needed.

REFERENCES

1. Narayan SW, Castelino R, Hammond N, Patanwala AE. Effect of mannitol plus hypertonic saline combination versus hypertonic saline monotherapy on acute kidney injury after traumatic brain injury [published online ahead of print, 2020 Mar 19]. J Crit Care. 2020;57:220–224.

2. Witherspoon B, Ashby NE: The Use of Mannitol and Hypertonic Saline Therapies in Patients with Elevated Intracranial Pressure: A Review of the Evidence. Nurs Clin North Am 2017;52:249-60.

3. Gu J, Huang H, Huang Y, Sun H, Xu H: Hypertonic saline or mannitol for treating elevated intracranial pressure in traumatic brain injury: a meta-analysis of randomized controlled trials. Neurosurg Rev 2019;42:499-509.