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LETTER

Oral water ingestion in the treatment of shock patients: a prospective randomized study

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Dear Editor,

While the cardiovascular effect of intravenous saline has been investigated in shock patients, the cardiovascular effects of oral water are unknown [1]. Oral resuscitation can improve cardiac output (CO) and blood pressure, thus outcomes of burn and septic patients [2–4]. We do not have data in shock patients. This study was designed to assess the effect of oral water on stroke volume (SV), blood pressure and tissue perfusion parameters in shock patients.

After IRB approval and written consent, a prospective, open-label, randomized, controlled, parallel-arm, monocentric clinical trial was conducted at the anesthesia and critical care department of the Dijon University Hospital (France). Patients were randomized 1:1 to an intervention (500 ml via nasogastric tube over 15 min of water, Cristaline™) or standard care group (500 ml of intravenous saline solution over 15 min). The main outcome was the SV change (%) between baseline and immediately after the end of fluid expansion. The secondary outcomes were the changes of arterial blood pressure, CO, gap CO_2/oxygen arteriovenous difference ratio, oxygen delivery, oxygen consumption, and arterial lactate. The study protocol (inclusion/exclusion criteria, ICU management, measurements, statistical analysis) is described in the supplementary file. Data were expressed as median [interquartile range] or number (percentages). Mann–Whitney or Wilcoxon test were used. The threshold for statistical significance was set at $p < 0.05$.

Fifty patients were included between May 2019 and February 2020. Most of the patients were suffering from septic shock, and the baseline characteristics were similar between the two groups (supplementary File). Baseline SV did not differ between the two groups (36 ml [28; 51] vs 38 ml [30; 51], $p = 0.900$). The median change in SV with fluid expansion did not differ between the two groups (22% [16; 51] vs 21% [16; 35], $p = 0.578$). The number of patients with SV change over 15% after fluid expansion did not differ between the two groups ($n = 19$ (76%) vs $n = 18$ (72%), $p = 1$). Blood pressure and tissue perfusion improved in both groups (Table 1).

The main result of the present study is that oral water increases CO, blood pressure, and improve tissue perfusion parameters. These effects are not different from those with saline solution. These results can be explained by known physiological mechanisms of oral water such as volume expansion and pressor effects [2]. Studies have demonstrated that oral resuscitation is associated with positive clinical effects such as an improvement in blood pressure, a lower fluid balance and a shorter hospital stay [3, 4]. Oral fluids have traditionally been considered contraindicated in shock patients because of vasopressor use and gut dysfunction. Our results demonstrated that cardiovascular effects of oral water may be of interest for fluid therapy in ICU patients. Because maintenance and creep fluids may account for 30% of fluid balance, oral water could be associated with a lower sodium and thus fluid balance in comparison to intravenous fluid [3–5].

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The members of the Water Study Group are listed in "Acknowledgements".

Table 1 Change in the hemodynamic and tissue perfusion parameters

	Saline group ($n=25$)	Water group ($n=25$)	p value intergroup
Heart rate (BPM)			
Baseline	94 [80; 107]	90 [80; 109]	0.580
Fluid	86 [77; 104]*	89 [79; 104]*	0.892
MAP (mmHg)			
Baseline	66 [62; 72]	68 [62; 73]	0.449
Fluid	74 [67; 81]*	77 [72; 84]*	0.105
SAP (mmHg)			
Baseline	95 [83; 109]	99 [92; 110]	0.346
Fluid	110 [96; 126]*	111 [105; 124]*	0.420
CVP (mmHg)			
Baseline	9 [6; 11]	10 [8; 12]	0.234
Fluid	11 [8; 15]*	11 [9; 12]*	0.967
SV (ml)			
Baseline	36 [28; 51]	38 [30; 51]	0.900
Fluid	44 [36; 60]*	44 [37; 59]*	0.977
Cardiac output (ml min^{-1})			
Baseline	3.40 [2.62; 4.92]	3.89 [2.34; 4.58]	0.839
Fluid	4.41 [3.47; 5.13]*	4.46 [2.55; 5.28]*	0.808
O_2 delivery (ml min^{-1} m^{-2})			
Baseline	298 [188; 364]	242 [209; 327]	0.455
Fluid	299 [255; 404]*	271 [181; 369]*	0.607
O_2 consumption (ml min^{-1} m^{-2})			
Baseline	75 [55; 109]	80 [67; 119]	0.341
Fluid	96 [67; 123]*	95 [73; 138]*	0.416
$ScVO_2$ (%)			
Baseline	73 [61; 78]	68 [59; 76]	0.358
Fluid	73 [64; 81]	64 [58; 73]	0.060
pCO_2 gap/$DavO_2$ ratio (mmHg)			
Baseline	1.79 [1.50; 2.15]	2.02 [1.63; 2.78]	0.353
Fluid	2.02 [1.69; 2.53]	2.18 [1.74; 2.49]	0.613
Arterial lactates (mmol l^{-1})			
Baseline	3.8 [1.8; 4.9]	3.3 [2.2; 4.2]	0.969
Fluid	3.4 [1.4; 5]*	2.8 [2.1; 4.2]*	0.930
Capillary refill time (s)			
Baseline	4 [3; 5]	4 [3; 5]	0.234
Fluid	3 [3; 5]*	3 [3; 4]*	0.967
Na+			
Baseline	138 [134; 141]	139 [137; 141]	0.216
Fluid	138 [134; 140]	138 [135; 141]*	0.770
Cl−			
Baseline	109 [106; 114]	109 [107; 110]	0.946
Fluid	110 [106; 114]*	109 [108; 110]	0.576

MAP mean arterial pressure, *SAP* systolic arterial pressure, *CVP* central venous pressure, *SV* stroke volume, DO_2 oxygen delivery, VO_2: oxygen consumption

*Significantly different ($p < 0.05$) between baseline and immediately after intervention

Because patients were included during the resuscitation phase, we cannot exclude that observed hemodynamic effects were in part related to prior hemodynamic treatments. This is a preliminary study that provides data to construct further studies. In conclusion, the administration of oral water is associated with improvements in blood pressure, blood flow, and tissue perfusion.

Electronic supplementary material
The online version of this article (https://doi.org/10.1007/s00134-020-06215-y) contains supplementary material, which is available to authorized users.

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Compliance with ethical standards

Conflicts of interest
The authors declare that they have no conflict of interest.

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