Unexpected hypotension in catecholamine reversal: a case report

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Abstract

Background: Catecholamine agents are commonly used to support circulation; however, they may cause unexpected hypotension in a special situation. Here we describe the first unexpected case of hypotension in response to catecholamine agents.

Case presentation: A 29-year-old Japanese man with schizophrenia was transferred to our emergency department. He was in shock and in coma. After fluid resuscitation, we induced catecholamine agents; however, his blood pressure decreased to 59/40 mmHg in response to catecholamine infusion. On the other hand, after we started vasopressin, his blood pressure markedly improved, and he finally became stable. On day 2, he admitted to ingesting a large amount of risperidone, and we diagnosed risperidone overdose. We believe that this unexpected hypotension in response to catecholamine infusion was caused by an α-adrenergic blockade effect of risperidone. Animal experiments proved that the simultaneous administration of adrenaline with an α-adrenergic blockade provoked a fall in blood pressure; this phenomenon is called "adrenaline reversal." In our case, catecholamine infusion under the α-adrenergic blockade effect of risperidone might have caused a fall in blood pressure in the same mechanism; we call this phenomenon "catecholamine reversal." In such a situation, because the mechanism of vasopressin is different from that of catecholamine, we recommend vasopressin for maintaining the blood pressure.

Conclusions: We described the first clinical case of "catecholamine reversal" and highlighted that if unexpected hypotension occurs in response to catecholamine infusion, we should suspect the use of α-adrenergic antagonists. In such situations, we should consider the administration of vasopressin instead.

Keywords: Adrenaline reversal, Alpha-adrenergic blockade, Vasopressin, Noradrenaline, Side effect, Risperidone, Case report
worsened to 66/37 mmHg (Fig. 2). Sixty minutes after arrival, we inserted the central venous line and initiated noradrenaline infusion at 0.1 \( \mu \text{g/kg per minute} \), which was subsequently increased to 0.3 \( \mu \text{g/kg per minute} \). Moreover, 90 minutes after arrival, we initiated dobutamine at 5 \( \mu \text{g/kg per minute} \). However, his BP unexpectedly decreased to 59/40 mmHg. Head computed tomography, enhanced chest-abdominal computed tomography, point of care sonography, and laboratory data (Table 1) did not reveal the cause of coma and hypotension. His systemic vascular resistance index (SVRI) was very low (432 dynes/second/cm/m\(^2\); normal range, 1970 to 2400 dynes/second/cm/m\(^2\); Vigileo FloTrac™, Edwards, USA). Thus, we suspected unknown distributive shock refractory to a large amount of catecholamine infusion. Therefore, in addition to catecholamine infusion, we initiated vasopressin at 3 U/hour 150 minutes after arrival.
Table 1 Laboratory data on admission

| Test                  | Value     |
|----------------------|-----------|
| WBC                  | 5600/μl   |
| RBC                  | 458 x 10^6/μl |
| Hb                   | 13.1 g/dl |
| Pt                   | 17.9 x 10^9/μl |
| pH                   | 7.364     |
| pCO2                 | 36.8 mmHg |
| pO2                  | 483 mmHg  |
| HCO3                 | 20.4 mmol/l |
| Base excess          | 3.9 mmol/l |
| Lac                  | 4.9 mmol/l |
| Cr                   | 12.1 mg/d |
| Na                   | 141 meq/l |
| K                    | 2.7 meq/l |
| Cl                   | 103 meq/l |
| CRP                  | 0.08 mg/d |
| PCT                  | 0.03 ng/d |

ALT alanine aminotransferase, APTT activated partial thromboplastin time, AST aspartate aminotransferase, BUN blood urea nitrogen, Cl chloride, CPK creatine phosphokinase, Cr creatinine, CRP C-reactive protein, Fib fibrinogen, FiO2 fraction of inspired oxygen, Hb hemoglobin, HCO3 bicarbonate, Ht hematocrit, K potassium, Lac lactate, Na sodium, pCO2 partial pressure of carbon dioxide, PCT procalcitonin, pH potential of hydrogen, Platelets platelets, pO2 partial pressure of oxygen, PT-INR prothrombin time-international normalized ratio, RBC red blood cells, WBC white blood cells

Table 2 Arterial blood gas analysis in intensive care unit

| Test                  | Value     |
|----------------------|-----------|
| PaCO2                | 34.8 mmHg |
| PaO2                 | 214 mmHg  |
| HCO3                 | 14.6 mmol/l |
| Base excess          | −11.4 mmol/l |
| Na+                  | 141 mmol/l |
| K+                   | 2.8 mmol/l |
| Cl−                  | 107 mmol/l |
| Lac                  | 12.6 mmol/l |
| pH                   | 7.246     |

Therefore, we suggest that we should avoid noradrenaline in such a situation.

Discussion

We experienced unexpected hypotension in response to catecholamine infusion, and we believe that this unexpected hypotension was caused by a pharmacological phenomenon: the catecholamine effect under the α-adrenergic blockade effect of risperidone. In animal experiments, if adrenaline is simultaneously administered with α-adrenergic receptor blockers such as phentolamine, the α-adrenergic effects are masked and the β2-adrenergic effects are predominantly enhanced (Fig. 1) [3]. Consequently, vasodilation occurs and the BP decreases. This unique phenomenon is called “adrenaline reversal” [3]. Adrenaline reversal has also been reported in clinical situations; paradoxical hypotension due to adrenaline infusion has been reported in a case of massive quetiapine overdose because quetiapine has an α-adrenergic blockade effect [4]. This report suggested that adrenaline reversal occurs even in cases of massive antipsychotic overdose. This report recommended selecting noradrenaline for hypotension under an α-adrenergic blockade effect, such as an overdose of quetiapine; however, we disagree with this. This is because other animal experiments proved that noradrenaline could also cause the same phenomenon as “noradrenaline reversal” [5], although noradrenaline has stronger α-adrenergic effects than β-adrenergic effects. Therefore, we suggest that we should avoid noradrenaline in such a situation.

Dopamine and dobutamine also have both α-adrenergic and β-adrenergic effects [6]; we think that there is a possibility that dopamine and dobutamine also may cause catecholamine reversal. Thus, catecholamine agents other than adrenaline can potentially provoke “catecholamine reversal” in patients who have used α-
adrenergic antagonists. In our case, because risperidone has an α-adrenergic blockade effect, a large amount of catecholamine infused under the effect of an α-adrenergic blockade might have caused hypotension in the same mechanism.

On the other hand, vasopressin is a type of vasoactive agent that increases peripheral vasoconstriction via V1 receptors [3] and is commonly used to maintain vasoconstriction, particularly in distributive shock [1]. In our patient, severe hypotension immediately improved after administering vasopressin. This could be attributed to the fact that the mechanism action of vasopressin is different from that of catecholamines. Thus, vasopressin may be useful to support circulation in patients who have used α-adrenergic antagonists.

This is the first clinical case to describe unexpected hypotension as “catecholamine reversal.” Most antipsychotic agents have α-adrenergic blockade; thus, this educational case highlights that we should determine which vasoactive agent should be selected for the patient who uses these medicines.

Conclusions
We described the first clinical case of “catecholamine reversal” and highlighted that if unexpected hypotension occurs in response to catecholamine infusion, we should suspect that the patient has used α-adrenergic antagonists. In such a situation, we should consider administration of vasopressin instead.

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Authors’ contributions
YO was the major contributor in writing the manuscript. RL, WI, and HN supervised the whole work. All authors have read and approved the final manuscript.

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Not applicable.

Consent for publication
Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests
The authors declare that they have no competing interests.

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