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Application of dopamine combined with dobutamine in children with pneumonia and heart failure

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Abstract: Pediatric pneumonia and heart failure is a common critical illness in pediatrics. This article observes the clinical effects of dopamine and dobutamine in the treatment of pneumonia and heart failure. As a key neurotransmitter in the hypothalamus and pituitary gland, dopamine plays a very important role in the central nervous excitement of the human body. Dopamine could also promote excitement in the respiratory center and reduces oxygen consumption in the breath, thereby improving the symptoms of respiratory failure in children. Observe and compare the clinical efficacy of the two groups of children, the disappearance of lung rales, the time to correct heart failure and the length of hospital stay. The total effective rate in the observation group was 91%; the total effective rate in the control group was 65.4%. There was a significant difference in the total effective rate between the two groups of children. The time of disappearance of lung rales, the time of correction of heart failure and the length of hospital stay in the observation group were significantly shorter than those in the control group ($P < 0.05$). The clinical effects of dopamine and dobutamine on pneumonia and heart failure are significant.

Keywords: Dopamine, dobutamine, pneumonia complications, heart failure.

INTRODUCTION

Pediatric pneumonia heart failure is a critical illness in pediatrics and is extremely common in the clinic (Marmitt *et al.,* 2018). Infants and young children are a high-risk group of the disease. The disease has the characteristics of fierce disease and rapid progress (Emir *et al.,* 2014; Lee *et al.,* 2017). Without timely and effective treatment, it will have serious adverse consequences and even endanger life. Studies have shown that under conventional treatment (including antibiotics, hormones, antacids and other cardiotonics, etc.), heart failure control is not ideal (Kich *et al.,* 2016; Eliane *et al.,* 2018). On this basis, combined with dopamine and dobutamine can treat children with pneumonia and heart failure significantly. Improve clinical efficacy and greatly shorten the time to recovery.

As a key neurotransmitter in the hypothalamus and pituitary gland, dopamine plays a very important role in the central nervous excitement of the human body (McIlwain *et al.,* 2013). Intravenous infusion of dopamine injection for children can stimulate the dopamine receptors in the children and release the adrenaline from the adrenal glands in the children (Chacon *et al.,* 2019). The cardiac output of the children will be effectively increased, and myocardial contraction will be improved, thereby reducing the peripheral vascular resistance in children, the pulmonary arterial pressure will be significantly increased and the absorption of pulmonary inflammation in children will be promoted (Ferreira *et al.,* 2019). At the same time, dopamine can also promote the excitement of the respiratory center, reduce the heart load of children, reduce oxygen consumption during breathing, and also have a certain effect on improving respiratory failure in children (Hernandez *et al.,* 2019). However, it should be noted that dopamine has a certain dependence and can be addictive, so the amount used should not be too large, so as not to have too many side effects on children (Lv *et al.,* 2018; Sun *et al.,* 2019).

Dopamine combined with dobutamine has a good clinical effect in the treatment of this disease. Low dose dopamine can improve the state of hypoxia and stimulate the respiratory center (Block *et al.,* 2017). Dobutamine can act on β 1 receptor, reduce heart load and improve peripheral circulation resistance (Heycarid *et al.,* 2019). The purpose of this study is to observe the clinical effect of dopamine combined with dobutamine in the treatment of pneumonia.

MATERIALS AND METHODS

General Information

Eighty children with pneumonia and heart failure who were admitted to the Department of Respiratory Medicine from May 2018 to May 2019 were randomly selected. They all met the relevant diagnostic criteria for pneumonia and heart failure. Patients have typical symptoms of bronchopneumonia, such as high fever, cough, shortness of breath, and clinical signs and signs of heart failure. These children were randomly divided into observation group and control group according to the treatment method, with 40 cases in each group (n=40). Observation group: 22 males and 18 females, aged 3 months to 4 years, with an average age of (1.4±0.6) years,

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including 3 cases of congenital heart disease, 4 cases of vitamin D deficiency rickets, and 3 cases of malnutrition. Control group: 24 males and 16 females, aged 1 month to 3.4 years, with an average age of (1.2±0.4) years, including 4 cases of congenital heart disease, 3 cases of vitamin D deficiency rickets, and 2 cases of malnutrition. This study was approved by the hospital ethics committee and informed consent was obtained from family members of the children. There was no significant difference in general information such as gender, age, and disease composition between the two groups of children (P> 0.05), and they were comparable.

Treatment methods

The children in the control group were given conventional treatment, including drugs such as hormones, cardiac glycosides and other cardiotonics, to achieve effective antipyretic, diuretic, and phlegm elimination. For example, to effectively maintain a quiet environment, let the child lie on his back, let him eat easily digestible and nutritious food, and strictly limit the amount of fluid to 75mL / (kg · d). Effectively clean up the respiratory secretions of children, keep their unobstructed airways, and let them apply oxygen through a nasal catheter to control the oxygen flow to 1-2L / min. If the child is hypoxic, give the mask oxygen to control the oxygen flow rate between 2-4L / min. If the child is younger than 2 years old, let him take 0.04mg / kg desacetyl furanoside, the first dose is 0.02mg / kg, the second dose is 0.01mg / kg, and the third dose It is 0.01mg / kg, and the interval between three doses is 4-6h. After 12h, the child is given a maintenance amount of 0.005mg / kg, and if the child is> 2 years old, he is given 0.03mg / kg deacetylated hair Glucoside, the first dose is 0.015 mg / kg, the second dose is 0.0075 mg / kg, the third dose is 0.0075 mg / kg, the interval between the three doses is 4-6h, and the dose is given after 12h The maintenance amount of 0.0075mg / kg in children, the standard of discontinuation is effective control of heart failure. If the child's heart failure is not effectively controlled, or accompanied by obvious edema, let him add 1-2mg/kg furosemide. Effectively maintain electrolyte and acid-base balance. Children in the observation group were treated with dopamine and dobutamine on the basis of conventional treatment. Give the child a micro-injection pump to continuously pump 4g / (kg · min) of dopamine + 6g / (kg · min) of dobutamine, and control the frequency of treatment of the child to 1-4 according to the actual condition of the child Between times / day, 1 week is a course of treatment. During the treatment process, the clinical symptoms and signs of children are closely observed.

Efficacy Evaluation

Significant effect: Clinical symptoms and signs of heart failure, cough, shortness of breath, lung snoring, skin cyanosis, etc. were significantly improved within 2 days after treatment, with normal liver and significantly slower heart rate; internal symptoms within 2 days after effective treatment Children's heart failure, cough, shortness of breath, lung snoring, skin cyanosis and other clinical symptoms and signs were effectively relieved, with a slow heart rate; Ineffective: 3d after treatment, children with heart failure, cough, shortness of breath, lungs The clinical symptoms and signs such as rales and skin cyanosis have not been effectively alleviated, and even worsened to some extent.

Observation indicators

The clinical efficacy of the two groups of children; The disappearance time of lung rales, the correction time of heart failure and the length of hospital stay; Adverse reactions.

Ethical approval

All patients were approved by Ethics Committee of our hospital and signed on the informed consent. Ethical approval number as 17JFPHTD2.

STATISTICAL ANALYSIS

All the data were processed by SPSS 21.0 statistical software. Grouped t-test was used for normal test, Rank sum test was used for unsatisfactory test, Chi square test is applicable to the significance test of the rate or percentage difference between two groups and independent sample t-test was used for comparison between groups. $P < 0.05$ showed significant difference.

RESULTS

Basic indicators

Comparison of heart rate, pulse pressure, 24-hour urine volume, and ejection fraction before and after treatment in the two groups of children.There was no significant difference in heart rate, pulse pressure, 24-hour urine volume, and ejection fraction between the two groups of children before treatment (P> 0.05). The heart rate of children in the observation group was lower than that in the control group. The ejection fractions were all higher than the control group, and the difference was statistically significant (P <0.05, as shown in table 1).

Comparison of clinical efficacy between two groups of children

Observation group: 24 cases were markedly effective, 12 cases were effective, the total effective rate was 90.00% (36/40); Control group: 11 cases were markedly effective, 16 cases were effective, and the total effective rate was 67.50% (27/40). The difference in efficiency was statistically significant (P <0.05), as shown in table 2.

Comparison of the disappearance time of lung rales, the correction time of heart failure and the length of hospital stay in the two groups of children. The time of

Table 1: Comparison of heart rate, pulse pressure, 24-hour urine volume, and ejection fraction of children in the two groups before and after treatment (x ± s)

Group	Number of cases	Heart rate (times / min)		Pulse pressure (mm Hg)		24h urine output (L)		Ejection fraction (%)	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Control group	40	116.2±7.1	104.7±8.3a	29±4	32±5	90.68±8.21	114.24±8.63a	0.76±0.15	1.27±0.31a
Observation group	40	115.4±6.7	93.6±7.3a	28±4	36±6a	91.35±7.32	134.35±8.57a	0.73±0.12	1.89±0.42a
t value		1.86	13.78	1.23	4.67	1.15	19.73	1.26	8.47
P value		>0.05	<0.05	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05

Note: Compared with before treatment, [a]P <0.05

Table 2: Comparison of clinical symptoms between the two groups (cases, %, n = 40)

Group	Markedly effective	Effective	Invalid
Observation group	24(60.00) *	12(30.00) *	4(10.00) *
Control group	11(27.50)	16(40.00)	13(32.50)

Table 3: Comparison of the disappearance time of lung rales, the correction time of heart failure and the length of hospital stay in children in two groups (d, x ± s, n = 40)

Group	Disappearance time of lung rales	Heart failure correction time	Length of stay
Observation group	2.86±0.69*	5.11±0.47*	7.06±0.77*
Control group	4.12±1.07	6.88±1.19	9.49±1.48

* Comparison with control group: P <0.05

Table 4: Comparison of serum NT-proBNP, cTnI, PANP and peptin levels between two groups of children after treatment

Group	Number of cases	NT-proBNP (μg/L)	CTnI (ng/L)	PANP (ng/L)	Peptin (ng / L)
Control group	40	0.14±0.01	0.19±0.01	856.74±17.21	14.32±3.75
Observation group	40	0.08±0.01	0.05±0.01	735.43±15.16	8.45±2.64
t value		5.33	7.43	9.35	10.73
P value		<0.05	<0.05	<0.01	<0.01

disappearance of lung rales, the time of correction of heart failure and the length of hospital stay of children in the study group were significantly shorter than those in the control group (P<0.05). as shown in table 3.

Comparison of serum NT-proBNP, cTnI, PANP, and peptin levels between two groups of children after treatment. The levels of serum NT-proBNP, cTnI, PANP, and peptin in the observation group were lower than those in the control group, and the difference was statistically significant (P <0.05, as shown in table 4).

Comparison of adverse reactions in two groups of children

Except for individual children with irritability and tachycardia, there were no other serious adverse reactions in either group.

DISCUSSION

Pediatric pneumonia and heart failure is a common critical illness in pediatrics. Children's respiratory function will be damaged in the case of pneumonia, which will cause hypoxia easily (Killick *et al.,* 2014). Myocardial ischemia and hypoxia will affect cardiac function accordingly. In addition, the child's constant hypoxia, accompanied by CO2 retention, stimulates the pulmonary arterioles, causes their reflex contractions to occur, promotes increased pulmonary circulation pressure, triggers pulmonary hypertension, promotes an increase in the right heart load, and ultimately leads to cardiac effort The occurrence of exhaustion (Miloso *et al.,* 2008). The clinical routine treatment of pediatric pneumonia with heart failure includes: (1) Oxygen inhalation, anti-infection, asthma and other treatments are given to ensure that the respiratory tract of the child is unobstructed. (2) Patients with threatened heart failure should be given oxygen sedation immediately, and if the condition does not improve after 1 hour, digitalis preparation poisonous trilobatin K. 007 mg / kg rapid intravenous injection, 6-12 h/time; 12h. The maintenance dose is started. The

maintenance dose depends on the severity of the disease (Mensor *et al.,* 2001; Virginia *et al.,* 2018). The remission period of heart failure can be stopped, and the serum digoxin level should be closely monitored.

Dobutamine also has a certain effect on enhancing the myocardial contractility of children, and can expand the peripheral blood vessels of the lungs, thereby reducing the pulmonary circulation resistance of the children to a lower level, and making the children's blood loss higher (Kim *et al.,* 2004; Yasmina *et al.,* 2019). Is conducive to the absorption of pulmonary inflammation in children. It can be seen from the efficacy of the drug that dopamine and dobutamine are actually synergistic effects, both of which are beneficial for strengthening the heart, reducing the resistance to peripheral blood flow in the lung, and promoting the absorption of pulmonary inflammation, etc (Kim *et al.,* 2018). Combining the two drugs can achieve better results, and at the same time, can reduce multiple complications caused by excessive dopamine use. Trzeciak (2016) pointed out in Effective Observation on the Therapeutic Effect of Low-dose Dopamine Combined with Dobutamine in the Treatment of Pediatric Severe Pneumonia Produces a positive inotropic effect, which is the same as some of the views in this article (Trzeciak *et al.,* 2016).

The results of this study indicate that combined with dopamine and dobutamine for the treatment of pediatric pneumonia and heart failure on the basis of conventional treatment, the total effective rate is significantly higher than that of the conventionally treated control group ($P < 0.05$). The correction time and hospital stay were significantly shorter than those in the control group ($P < 0.05$), and both groups had significant adverse reactions. From a pharmacological analysis, dopamine is an endogenous catecholamine drug. Small doses of [2-5μg / (kg·min)] dopamine can effectively stimulate cardiac dopamine receptors without affecting heart rate to a great extent (Lazarevic *et al.,* 2017). And myocardium, which in turn significantly promotes myocardial contractility. In addition, low-dose dopamine can also act on dopamine receptors in coronary arteries, mesentery and other parts, dilate the blood vessels in the corresponding parts, promote the reduction of peripheral vascular resistance and increase the cardiac output (Li *et al.,* 2017). At the same time, children's urine volume will be increased accordingly, which will greatly reduce the heart load and effectively reduce myocardial oxygen consumption, and eventually correct the symptoms of heart failure (Singh *et al.,* 2016; Liu *et al.,* 2017). Dobutamine is a pulmonary vasodilator, which can selectively excite cardiac receptors and activate adenosine cyclase at the same time, thereby promoting the effective promotion of cyclic adenosine monophosphate levels in myocardial cells at a faster rate (Nabavi *et al.,* 2016). Provides good prerequisites for calcium ions to be transferred into myocardial cells, promotes the improvement of myocardial contractility, the increase of cardiac output and the improvement of cardiac function (Nordberg, 2006; Park *et al.,* 2011). In addition, dobutamine can also dilate the renal arterioles, promote the increase of renal blood flow, and thereby greatly increase the urine output of children.

Many studies have shown that the combined application of the two drugs can achieve a synergistic effect, thereby promoting the strengthening of the positive cardiac muscle effect and promoting the reduction of pulmonary arterial pressure (Lin *et al.,* 2006; Rodriguez *et al.,* 2019). The effect of dopamine on arterial vasoconstriction can also be controlled to a certain extent under the action of low-dose dobutamine, thereby effectively avoiding the occurrence of adverse symptoms in children under the action of excessive doses of dopamine, such as peripheral Increased resistance, arrhythmia, etc (Luo, 2001; Robson *et al.,* 2019). Therefore, this group chooses low-dose dobutamine to highlight its efficacy and effectively avoid its adverse effects under the synergistic effect of dopamine.

CONCLUSION

In short, dopamine and dobutamine have significant clinical effects in the treatment of pneumonia and heart failure, and can effectively shorten the disappearance of children's lung rales, the time to correct heart failure, and the length of hospital stay, which is worthy of clinical promotion and application. At the same time, after using dobutamine, receptor excitement effectively relaxes vascular smooth muscle, promotes the reduction of peripheral resistance, the contraction of reflective blood vessels during heart failure, the reduction of cardiac load, and the increase in cardiac output, thereby providing good prerequisites for the recovery of cardiac function. In addition, dobutamine can dilate the trachea and promote effective improvement of lung ventilation

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