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Biliary Decompression in Patients with Obstructive Jaundice

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Brief Summary

Background: Benign and malignant diseases of bile ducts usually cause mechanical jaundice.

The aim of the study: To determine the optimal duration of percutaneous transhepatic biliary drainage (PTBD) depending on the duration of mechanical jaundice and the initial level of total bilirubin in the serum.

Methods: This paper presents the experience of using PTBD in 88 patients with benign and malignant diseases of bile ducts complicated by mechanical jaundice, who were hospitalized at the State Institution “V. T. Zaitsev Institute of General and Urgent Surgery of the National Academy of Medical Sciences of Ukraine” from 2011 to 2017 years. Patients were divided into three groups. The first group consisted of 15 (17.1%) patients with benign diseases of the biliary tract. The second group consisted of 11 (12.5%) patients with resectable cholangiocarcinomas. The third group – 62 (70.4%) patients with unresectable cholangiocarcinomas.

Results: For patients of group 1, the process is somewhat slower, but the end result is also quite strongly influenced by the initial level of total bilirubin. The duration of biliary decompression in this category of patients



averages 10-12 days. For patients in group 2, biliary decompression requires at least 12 days, but the result is not significantly affected by the initial level of total bilirubin and the duration of obstructive jaundice.

Conclusions: Using the Poisson process, or more precisely the quasi-Poisson distribution, it was possible to determine the optimal duration of biliary decompression by using PTBD depending on the duration of obstructive jaundice and the initial level of total serum bilirubin.

Keywords:

bile duct diseases, obstructive jaundice, biliary decompression, percutaneous transhepatic biliary drainage, Poisson process.

Background:

Benign and malignant diseases of bile ducts usually cause mechanical jaundice (Renknimitr et al., 2013). The latest one should be eliminated in cases where the patient subsequently requires reconstructive surgery and in cases where biliary decompression is the only stage of treatment, especially in patients with high anesthesia risk and severe comorbidities (Moole et al., 2013; Oussoultzoglou & Jaeck, 2008). Difficulties in performing biliary decompression occur in patients with proximal bile duct block and in some cases with distal block. Percutaneous transhepatic methods of biliary decompression allow you to perform drainage of the bile ducts antegradely. However, there is no consensus on the duration of biliary drainage (Galperin et al., 2011; Momunova, 2011; Paik et al., 2014).

The aim of the study. To determine the optimal duration of percutaneous transhepatic biliary drainage (PTBD) depending on the duration of mechanical jaundice and the initial level of total bilirubin in the serum.

Methods:

This paper presents the experience of using PTBD in 88 patients with benign and malignant diseases of bile ducts complicated by mechanical jaundice, who were hospitalized at the State Institution “V. T. Zaitsev Institute of General and Urgent Surgery of the National Academy of Medical Sciences of Ukraine” from 2011 to 2017 years.

Patients were divided into three groups. The first (1) group consisted of 15 (17.1%) patients with benign diseases of the biliary tract. The causes of mechanical jaundice in patients of group 1 were choledocholithiasis in 6



(6.8%), strictures of the biliary tract in 2 (2.3%) and strictures of biliodigestive anastomoses in 7 (8.0%). The second (2) group consisted of 11 (12.5%) patients with resectable cholangiocarcinomas. The third (3) group – 62 (70.4%) patients with unresectable cholangiocarcinomas.

The level of total bilirubin when there ranged from 26.2 to 824 $\mu\text{mol/l}$. The median level of total bilirubin was 252 $\mu\text{mol/l}$. The average deviation was 15.6 $\mu\text{mol/l}$, the standard deviation was 169 $\mu\text{mol/l}$.

The duration of cholestasis was determined according to the Simonov's classification (Smirnov, 1974) – acute in 38 (43.2%), prolonged acute – 11 (12.5%), chronic – 39 (44.3%).

Patients were divided in terms of total bilirubin serum: <150 $\mu\text{mol/l}$ – 14 (15.9%) [150-250) $\mu\text{mol/l}$ – 20 (22.7%) [250-400) $\mu\text{mol/l}$ – 28 (31.8%) and more >= 400 $\mu\text{mol/l}$ – 26 (29.6%) patients.

The optimal duration of decompression of the biliary tract by PTBD was determined using the Poisson process, and more precisely – the distribution of quasi-Poisson, which reflects the process of reducing total bilirubin level in time (Ponarin et al., 2013; Shitikov & Mastickij, 2017; Warner, 2015).

Statistical processing of digital data was performed on a personal computer using Excel 2010, SPSS and free software for statistical calculations R (Kabacoff, 2011).

Results:

For patients with benign bile duct disease complicated by obstructive jaundice (1 group) who underwent antegrade endobiliary interventions as biliary decompression, total bilirubin decreased in time as follows: the average value of total bilirubin before biliary decompression was 267.9 $\mu\text{mol/l}$, after treatment – 139 $\mu\text{mol/l}$. The arithmetic mean of the difference is 128.7 $\mu\text{mol/l}$ ($p = 0.001$). Direct bilirubin decreased from 182.84 $\mu\text{mol/l}$ to 87.55 $\mu\text{mol/l}$ and the arithmetic mean difference is 95.3 $\mu\text{mol/l}$ ($p = 0.001$). But the rate of decrease in total and direct bilirubin is not linear, because on the first day in most cases the level of bilirubin decreases significantly, and then the process slows down.

In this case, the rate of decrease depends on the duration of obstructive jaundice: the rate is higher if obstructive jaundice is acute, while obstructive jaundice is prolonged acute - the rate of decrease in bilirubin is lower, as well as the initial level of total bilirubin: at the level of bilirubin [250-400) $\mu\text{mol/l}$ rate of decrease greater than at its level <150 $\mu\text{mol/l}$. Therefore, to determine the dependence of the value of total bilirubin after biliary decompression on the number of days, the duration of obstructive



jaundice and the initial level of total bilirubin used a nonlinear and logarithmic function.

On average, patients in group 1 with chronic obstructive jaundice with a total bilirubin level $<150 \mu\text{mol/l}$, the final level is $25.4 \mu\text{mol/l}$. Every day the total bilirubin will decrease by 10% compared to the previous one. That is, the reduction of total bilirubin to this value, if at the beginning it was $<150 \mu\text{mol/l}$, occurs in about 14 days.

If the patient's total bilirubin level is $(150-250) \mu\text{mol/l}$ in chronic obstructive jaundice, the final total bilirubin will be $38.13 \mu\text{mol/l}$ for the same period as for patients with a level of $<150 \mu\text{mol/l}$. If the level of total bilirubin in patients is $(250-400) \mu\text{mol/l}$, the average value at the end of the same period after PTBD will be $63.55 \mu\text{mol/l}$, and at its level $\geq 400 \mu\text{mol/l} - 101.68 \mu\text{mol/l}$.

For patients with acute obstructive jaundice, total bilirubin after PTBD is slightly higher than for patients with its level $<150 \mu\text{mol/l}$ ($26.18 \mu\text{mol/l}$), while for patients with acute obstructive jaundice is slightly lower ($16.12 \mu\text{mol/l}$). But in principle, the rate of decline depending on the duration of the obstructive jaundice does not differ. The process of reducing direct bilirubin is the same as the total. Thus, based on the analysis, the duration of biliary decompression was calculated, which is optimal for patients with benign bile duct diseases complicated by obstructive jaundice using PTBD (group 1). For such patients, the average duration of biliary decompression is 10-12 days, because regardless of the initial level of total bilirubin, the latter is reduced by an average of 10% per day.

Total bilirubin in patients of group 2, with resectable cholangiocarcinomas, during biliary decompression, decreased in time as follows: the average value of total bilirubin before treatment was $243 \mu\text{mol/l}$, after treatment – $78.56 \mu\text{mol/l}$. The arithmetic mean of the difference is $164.26 \mu\text{mol/l}$ and the difference are significant at the level ($p = 0.001$). Direct bilirubin decreased from $172.76 \mu\text{mol/l}$ to $44.22 \mu\text{mol/l}$ and the arithmetic mean difference is $128.55 \mu\text{mol/l}$ ($p = 0.001$).

If a patient has chronic obstructive jaundice with a total bilirubin level of $[150-250) \mu\text{mol/l}$, his figure will be $59.95 \mu\text{mol/l}$ for the same period (12 days) as for patients with a bilirubin level $<150 \mu\text{mol/l}$. If patients have a total bilirubin level $(250-400) \mu\text{mol/l}$, the average value after drainage will be $99.9 \mu\text{mol/l}$, and for patients with a bilirubin level greater than $\geq 400 \mu\text{mol/l} - 159.9 \mu\text{mol/l}$ for the same period. Therefore, the latter requires more days for drainage.

For patients with acute obstructive jaundice, the total bilirubin after PTBD is slightly higher than for patients with bilirubin up to $150 \mu\text{mol/l}$ ($8.76 \mu\text{mol/l}$), for patients with prolonged acute obstructive jaundice is



twice as high (16.03 $\mu\text{mol/l}$), The rate of decline for obstructive jaundice depending on its duration does not differ significantly. Therefore, when performing biliary decompression, the total bilirubin levels for each patient should be individually monitored. The process of reducing direct bilirubin is the same as the total, but its reduction is somewhat faster, but it is determined that the effect of the duration of obstructive jaundice and the initial level of total bilirubin is insignificant.

In patients of group 3, total bilirubin decreased in time as follows: the average value of total bilirubin before treatment was 324.17 $\mu\text{mol/l}$, after treatment – 240.42 $\mu\text{mol/l}$. The arithmetic mean of the difference is 83.75 $\mu\text{mol/l}$ and the difference are significant at the level ($p = 0.001$). Direct bilirubin decreased from 219.45 $\mu\text{mol/l}$ to 161.76 $\mu\text{mol/l}$ and the arithmetic mean difference is 62.67 $\mu\text{mol/l}$ ($p = 0.001$).

On average, patients in group 3 with chronic obstructive jaundice with a total bilirubin level $<150 \mu\text{mol/l}$, the final level is 19.03 $\mu\text{mol/l}$. Every day the bilirubin level will be lower by 13-14% than in the previous one. That is, the reduction of total bilirubin to this value, if at the beginning its level was $<150 \mu\text{mol/l}$ occurs in about 12 days.

If a patient has chronic obstructive jaundice with a total bilirubin level of [150-250) $\mu\text{mol/l}$, the final total bilirubin level will be 28.56 $\mu\text{mol/l}$ for the same period as for patients with a level of $<150 \mu\text{mol/l}$. If the level of total bilirubin in patients is (250-400) $\mu\text{mol/l}$, the average value at the end of cholangiodrainage will be 47.58 $\mu\text{mol/l}$, and when its level is more $> = 400 \mu\text{mol/l} - 76.13 \mu\text{mol/l}$ per 12 days. That is, patients with higher bilirubin levels need more days to achieve lower bilirubin levels.

For patients with acute obstructive jaundice, total bilirubin after PTBD is slightly lower than for patients with $<150 \mu\text{mol/l}$ (17.92 $\mu\text{mol/l}$), as well as for patients with prolonged acute obstructive jaundice (18.66 $\mu\text{mol/l}$). But in principle, the rate of decline depending on the duration of the obstructive jaundice does not differ. The process of reducing direct bilirubin is the same as the total.

Thus, based on the analysis, the duration of biliary decompression was calculated to reduce the level of total bilirubin, which is optimal for patients with unresectable cholangiocarcinomas by using PTBD (3 group). For such patients, the average duration of biliary decompression is 7 days, because regardless of on average, its indicators decrease by 13-14% per day. Thus, we can conclude that the fastest process of reducing the level of total bilirubin occurs in patients of the 3rd group. For such patients, an average of 8 days is enough to reduce total bilirubin to the required level, but the duration of biliary decompression significantly depends on its initial level per day, its indicators decrease.



For patients of group 1, the process is somewhat slower, but the end result is also quite strongly influenced by the initial level of total bilirubin. The duration of biliary decompression in this category of patients averages 10-12 days.

For patients in group 2, biliary decompression requires at least 12 days, but the result is not significantly affected by the initial level of total bilirubin and the duration of obstructive jaundice. These patients require constant monitoring of direct bilirubin.

Conclusions:

Using the Poisson process, or more precisely the quasi-Poisson distribution, it was possible to determine the optimal duration of biliary decompression by using PTBD depending on the duration of obstructive jaundice and the initial level of total serum bilirubin.

Conflicts of interests:

The authors declare that there is no conflict of interests.

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