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ORIGINAL ARTICLE

Complications in patients undergoing ultrasound-guided percutaneous nephrostomy and associated factors

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Abstract

Introduction: *For the treatment of obstructive hydronephrosis that compromises renal function, procedures are required to decrease pressure such as intrarenal ultrasound-guided percutaneous nephrostomy, which leads to complications like any procedure.* **General objective:** *To determine the complications of patients undergoing ultrasound-guided percutaneous nephrostomy and factors associated with their development.* **Material and methods:** *Cross-analytical, observational, retrospective study that included patients undergoing ultrasound-guided percutaneous nephrostomy in UMAE 25 IMSS, from 1 March, 2013 to 1 March, 2014. Electronic medical records were obtained: age, gender, history of diabetes mellitus, hypertension, smoking, and alcoholism, and whether or not there was the development of post-procedure complications. The association was analyzed by chi square test and Student's t test, taking as significant a value of p = 0.05 and the magnitude of association was measured with 95% confidence interval with SPSS v.18.0.* **Results:** *A total of 84 patients aged 31-79 years were analyzed, corresponding to 64.3% of women. Nephrostomy subsequent complications occurred in 19.0% of cases, of which diabetes mellitus comorbidities occurred in 56.2%, hypertension in 62.5%, obesity 75.0%, smoking 31.2%, and alcoholism 43.7%, with a statistically significant association (p = 0.019), with the presence of obesity hematuria being the most commonly observed complication.* **Conclusion:** *Despite the presence of several comorbidities in our population, only the influence of obesity was associated with the development of complications in patients who underwent ultrasound-guided nephrostomy.*
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KEY WORDS: *Associated factors. Percutaneous nephrostomy. Complications.*

Introduction

Hydronephrosis consists in dilation of the urinary tract without this being necessarily pathological in nature. However, visualization of the ureter (> 7 mm) and calyceal dilatation are usually of pathological origin. Giant hydronephrosis has been defined as dilatation of the pyelocalycial system with more than 1,000 cc urine retained, as well as when the size of the kidney occupies more than half the abdominal cavity and, generally, the degree of involvement is directly proportional to the time of obstruction evolution[1,2].

Urinary obstruction relief is the most common indication for percutaneous nephrostomy; in several series of studies, it accounts for 85-90% of patients. The three

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most common causes of renal obstruction in adults are urinary calculi and benign and malignant iatrogenic stenosis. In a study of a large series of patients, 26% of all nephrostomy tubes placed were observed to be owing to lithiasis and 61% to malignant tumors[3].

Percutaneous nephrostomy consists in placing, guided by some imaging method (ultrasound, computed tomography, fluoroscopy), a catheter into the renal collecting system by means of a puncture though the skin. This is intended not only to obtain an accurate diagnostic method, but also to place a catheter of adequate caliber to drain the collecting system or to extract lithiasis. Some of the most important aspects of the procedure include adequate patient selection, technique and performance of the procedure, as well as follow-up[4].

There are four general indications to perform a percutaneous nephrostomy:

- To relief urinary obstruction.
- As a diagnostic test.
- To be used as therapeutic intervention access.
- Urinary bypass.

To determine the suitability of nephrostomy, familiarity with the clinical presentation, a working diagnosis and typical management of each specific indication are essential[5].

In our hospital unit, approximately 8-10 ultrasound-guided nephrostomy procedures are performed every month. A strict patient selection is always made, with criteria such as absence of clotting times abnormalities, in order to prevent hemorrhagic complications, and preserved renal function. Although the ultrasound-guided percutaneous nephrostomy procedure technique has become widespread and has been refined, complications continue to occur, although its rate has decreased.

Our main purpose was to assess which complications occurred in patients undergoing ultrasound-guided percutaneous nephrostomy and which the associated factors were; whether age older than 50 years, smoking, alcoholism, diabetes mellitus (DM), high blood pressure (HBP) and obesity were factors associated with the development of complications, was assessed.

Material and methods

At the *Centro Médico Nacional del Noroeste* No. 25 of the IMSS, a retrospective, cross-sectional, observational, analytical study was conducted, with support of the Department of Diagnostic and Therapeutic Imaging. All patients undergoing ultrasound-guided percutaneous nephrostomy in the period encompassed between March 1, 2013 and March 1, 2014 were included; patients with blood dyscrasias were excluded and those with incomplete or lost medical records were eliminated. The sampling technique used was of the non-probabilistic, convenience type. Once the patient names were collected by date, the following data were obtained from the electronic medical records: age, gender, body mass index, history of DM, HBP, smoking and alcoholism, and whether in the patients' progress notes was there or not development of complications referred after the procedure. All the obtained data were captured with the SPSS statistical pack (version 18.0). For the descriptive analysis, absolute frequencies, percentages, means or medians and standard deviation or minimum and maximum were measured. The chi-square test or Fisher's exact probability test were used for inferential analysis, and Student's t-test or Mann-Whitney's U-test were used for independent samples. To assess the magnitude of association, the odds ratio (OR) was measured with a 95% confidence interval (CI) and a p-value < 0.05 was considered to be significant.

Results

Ninety six medical records of the period encompassed between March 1, 2013 and March 1, 2014 were analyzed; 12 records were excluded for not meeting the established selection criteria. The remaining 84 patients had ages ranging from 31 to 79 years (average: 50.7 ± 13.2 years). There were 30 males (35.7%) and 54 females (64.3%). Thirty two patients (38.0%) had DM; 45 (53.5%), HBP, 41 (48.8%), obesity; 33 (39.2%), alcoholism and 24 (28.5%), were smokers. The causes of the obstructive uropathy that led for nephrostomy to be requested were, in order of frequency, the following: cervical cancer in 26 cases (30.9%), colon cancer in 23 (27.3%), prostate cancer in 18 (21.4%), bladder cancer in 11 (13.0%) and ureteral lithiasis in 6 (7.1%).

Complications after ultrasound-guided percutaneous nephrostomy occurred in 16 patients (19.0%) who had a mean of 51.2 ± 12.4 years of age; there were 7 males (43.7%) and 9 (56.3%) females, and 7 patients (43.7%) were older than 50 years. There were 9 patients (56.2%) with diabetes; 10 (62.5%) with high blood pressure; 12 (75.0%) with obesity; 5 (31.2%) with a smoking history, and 7 (43.7%) with alcoholism. A statistically significant difference was observed with the presence of obesity ($p = 0.019$) with regard to the development of

Table 1. Clinical and demographic characteristics of 84 patients undergoing ultrasound-guided percutaneous nephrostomy, classified according to whether they had complications or not

	Total (n = 84)	With complications (n = 16)	Without complications (n = 68)	OR (95% CI)	p
Age (years)	50.7 ± 13.2	51.2 ± 12.4	49.6 ± 11.3	–	0.621
Age > 50 years	29 (34.5%)	7 (43.7%)	22 (32.3%)	1.6 (0.3-2.5)	0.388
Gender					
Male	30 (35.7%)	7 (43.7%)	22 (33.8%)	–	0.455
Female	54 (64.3%)	9 (56.3%)	45 (66.1%)		
DM	32 (38.0%)	9 (56.2%)	23 (33.8%)	2.5 (1.0-4.2)	0.096
HBP	45 (53.5%)	10 (62.5%)	35 (51.4%)	1.5 (0.6-2.8)	0.426
Obesity	41 (48.8%)	12 (75.0%)	29 (42.6%)	4.0 (1.8-6.3)	0.019
Alcoholism	33 (39.2%)	7 (43.7%)	26 (38.2%)	1.2 (0.4-2.1)	0.684
Smoking	24 (28.5%)	5 (31.2%)	19 (27.9%)	1.1 (0.5-1.9)	0.792

complications in patients undergoing ultrasound-guided percutaneous nephrostomy (Table 1).

The main complication observed in patients undergoing ultrasound-guided percutaneous nephrostomy was hematuria, which occurred in 11 patients (13.0%), with a mean age of 51.3 ± 14.5 years; there were 3 males (27.2%) and 8 females (72.8%), and 5 (45.4%) were older than 50 years; 5 (45.4%) of these patients were diabetic; 7 (63.6%), hypertensive; 9 (81.8%), obese; 3 (27.2%) had a history of smoking and 5 (45.4%), of alcoholism. Statistically significant difference was only observed with the presence of obesity (p = 0.018) with regard to the development of hematuria in patients undergoing ultrasound-guided percutaneous nephrostomy (Table 2).

Other complications found in patients undergoing ultrasound-guided percutaneous nephrostomy were: pain and subcapsular hematoma in 3 patients and nephrostomy-site skin infection in 2; the majority were obese, diabetic and hypertensive females. No complications such as arteriovenous fistula, renal function worsening and damage to other organs were observed.

Table 2. Clinical characteristics of 84 patients undergoing ultrasound-guided percutaneous nephrostomy with regard to the development of hematuria

	Hematuria			
	Yes (n = 11)	No (n = 73)	OR (95% CI)	p
Age, mean (years)	51.3 ± 14.5	50.1 ± 13.4	–	0.765
Age > 50 years	5 (45.4%)	24 (32.8%)	1.7 (0.5-2.9)	0.413
Gender				
Male	3 (27.2%)	27 (36.9%)	–	0.530
Female	8 (72.8%)	46 (63.1%)		
DM	5 (45.4%)	27 (36.9%)	1.4 (0.4-2.3)	0.589
HBP	7 (63.6%)	38 (52.0%)	1.6 (0.8-2.9)	0.472
Obesity	9 (81.8%)	32 (43.8%)	5.7 (1.4-7.8)	0.018
Alcoholism	5 (45.4%)	28 (38.3%)	1.3 (0.4-2.7)	0.653
Smoking	3 (27.2%)	21 (28.7%)	0.9 (0.2-1.4)	0.918

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Discussion

In the past few decades, ultrasound-guided percutaneous nephrostomy, followed by fluoroscopic study, has been widely used for the relief of upper urinary tract obstruction, regardless of the cause that produced it[6].

Usually, in tertiary care hospitals, ultrasound-guided percutaneous nephrostomy is part of the treatment of many patients with neoplastic conditions and, therefore, it is our duty to know and assess the patients' status, since a poor health status could be associated with different types of complications. However, improvement of the technique, which is important and essential, should not be overlooked and has to be taken into account. Currently, timing of the procedure, comorbidities and patient health status are subjects under debate, as well as the required experience of the executor and possible complications resulting from the procedure[7].

Due to the confluence and diversity of the population it receives, at the IMSS UMAE No. 25 of northwestern Mexican Republic, at least 2-3 ultrasound-guided percutaneous nephrostomy are practiced every week, and patients undergoing this type of procedure usually are bearers of different comorbidities and addictions.

The diagnoses referred by the patients who underwent ultrasound-guided percutaneous nephrostomy for the relief of urinary tract obstruction were, in decreasing order of frequency, the following: cervical cancer, colon cancer, prostate cancer, bladder cancer and ureteral lithiasis. These are very similar findings to those in other publications[8]. The most common presenting complications (occurred in a very low percentage) were, on its vast majority, minor complications such as hematuria (subsided in less than 48 h), pain at the puncture site, subcapsular hematoma and skin infection at the percutaneous nephrostomy site, with no major complications occurring, as reported in some recent studies.

Owing to the lifestyle and poorly balanced diet commonly observed in our country, many of these patients usually have comorbidities, such as DM and HBP. In these patients, the presence of substance addictions such as smoking and alcoholism is generally rare, but it entails much higher risk for the occurrence of systemic disorders than in the general population, which adds to the already existing renal damage due to the obstructive uropathy evolution time[9].

Recently, age has acquired considerable importance as a risk factor for many diseases and for the prognosis of many procedures. Progressive chronologic deterioration influences on many organs and systems of the human body, and has as a consequence its poor functioning. Unlike to what many authors refer on how age influences on the development of complications, in this study, no statistically significant association with the development of complications was observed, even when 7 of the 29 patients who were older than 50 years developed them; however, the presence of complications did imply an increased risk (a risk of 1.6 was observed)[10].

DM is regarded as one of the most common chronic degenerative diseases, with hemodynamic and systemic repercussions, which attracts health economic overspending in Western countries such as Mexico. The increased prevalence of diabetes has led to an increase in the number of patients with diabetic nephropathy, and in these patients, an added neoplastic condition that produces obstructive uropathy, kidney damage is more accelerated, which leads more rapidly to end-stage renal disease. Although DM was present in 32 patients undergoing ultrasound-guided percutaneous nephrostomy, only 9 developed complications, out of which 5 displayed hematuria, with no statistically significant difference being found that might suggest for it to be a factor associated with the development of complications, although an increased risk as high as 1.4 was observed in comparison with the rest of the population, probably owing to the damage that is extensively produced in different body systems, especially at the renal microvasculature level[11].

The influence of systemic hypertension on different capillary beds is very important, especially on renal vessels. In some publications, the association of HBP and an increase in bleeding time and in bleeding in surgical procedures has been observed[12]. In our study, we found that 45 patients undergoing ultrasound-guided percutaneous nephrostomy had systemic HBP and only 10 of these patients developed complications, with no statistically significant association being observed with the development of complications such as hematuria, although there was an increased risk as high as 1.5 for its occurrence.

Alcohol has a biphasic effect on the body, i.e., its effects change over time; at the vascular system, it usually produces peripheral vasodilatation, at high doses, it produces hypertension, inhibits the production of red and white blood cells, decreases the levels of complex B vitamins and alters kidney functioning by reducing the levels of anti-diuretic hormone, thus eliciting dehydration. We have not found publications that explain a possible association between alcoholism and the development of complications after percutaneous nephrostomy puncture. In our study, alcoholism was present in 33 patients, out of which only 7 developed complications and 5 of them experienced hematuria during the first 48 h after the procedure, with no statistically significant association being observed with the development of complications, although an increased risk as high as 1.2 for their occurrence was found.

In our country, obesity has been increasing and, consequently, also the rates of systemic and metabolic diseases. In some previously conducted investigations, an increase in complications has been observed in patients undergoing surgical procedures; especially an increase in infections, as well as longer in-hospital stay, resulting from the patient's elevated BMI, which also entails an increase in the complexity to perform the surgical act[13]. Although currently there are no studies that explain why complications occur in obese patients undergoing ultrasound-guided percutaneous nephrostomy, in our investigation we found that of the 41 patients undergoing ultrasound-guided percutaneous nephrostomy who were obese at the moment of the procedure, 12 developed complications (hematuria was the most common complication observed in this type of patients), and an increased risk of up to 5.2 should be noted, as well as a statistically significant association ($p = 0.019$) with the development of complications in this type of patients. Maybe a more difficult visualization of the renal anatomy by means of ultrasound in patients with obesity makes it harder for Brodel's line to be located, which is the zone of the kidney with less vascular contribution, located at the posterior and lateral border of the kidney, which would imply for the puncture of the nephrostomy procedure to likely be made in an very close area with more vascular contribution, and this might explain the development of complications such as hematuria.

In the future, it would be convenient to significantly increase the sample size, in order to establish more reliable association values, as well as to include other variables that may influence on the development of complications, such as the different kinds of medications these types of patients usually take.

Conclusion

In our hospital setting, there was no prevalence of major complications after the performance of ultrasound-guided percutaneous nephrostomy at the Department of Interventional Radiology. We can assure that, although their frequency was low, most complications were minor and had no clinical consequences and, therefore, they would not contraindicate the use of ultrasound-guided percutaneous nephrostomy in patients with any obstructive uropathy. The vast majority of clinical characteristics studied in patients undergoing percutaneous nephrostomy were not associated with the development of complications, except for obesity, which influenced as a factor associated with the development of complications, especially hematuria, in this type of patients.

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