INTRODUCTION

The obesity prevalence in the Brazilian population has increased over the years; it has changed from 9.3% in 1989 to 14.8% in 2009. WHO estimates that 500 million people were obese in 2008, it means 100 million more than the number for 2006. Another estimate, also made by WHO, says that in 2015 there will be 700 million.1,2 This indicates that an increasing percentage of people are subject to the comorbidities related to obesity, which 5.7% are believed to be morbid obese, in other words, they have a BMI ≥ to 40 kg/m² and need surgical treatment.12,22

Some publications about bariatric surgery patients started to come out on 2005; they pointed reduction on the prevalence of diabetes mellitus, hypertension, cardiovascular diseases and death, but also enhancement on nephrolithiasis’ risk, hypothesizing that the procedure could be a risk factor for lithogenesis, which has been confirmed.16,18 The relation between bariatric surgery and nephrolithiasis has been pointed as an important matter to be explored, since research remains scarce.

This article is a systematic review about the nephrolithiasis prevalence in patients who underwent different types of weight loss surgery, trying to establish its influence on this comorbidity.

METHODS

Search strategy

The literature review was performed during November 2013. Search was conducted in the PubMed electronic database using the following search phrase: (“Obesity”) AND (“Nephrolithiasis”) as title words or MeSH terms. The main goal was to identify relevant studies describing the prevalence of nephrolithiasis in obese patients. Among these, were searched articles that showed correlation of different bariatric surgery techniques to the theme.
Study selection
Initially, titles and abstracts were analyzed, and original studies that seemed to report obesity and nephrolithiasis as main subject were pre-selected, it means 112 articles. The studies that described the incidence of nephrolithiasis or its relation to different bariatric surgeries were selected, reaching 10 studies. Three researchers examined the full texts of the selected studies.

Studies that met the following criteria were selected: original article, English language, published between 2005 and 2013, full text available at Capes periodical, reports the occurrence of nephrolithiasis or its supporting emergence factors. Review articles, commentary, editorials, duplicate articles or sample size smaller than nine patients were excluded.

All potential differences in interpretation between the reviewers were discussed, to ensure that all the articles reviewed presented a satisfactory level of evidence.

Identified studies and handling of missing data
The literature search described above yielded 341 studies. A total of 10 articles were abstracted and included in the systematic review. Figure 1 shows the results of initial searches for inclusion.

If a study failed to report any of the variables, this was classified as “not reported.” It was then analyzed the results comparing only the available data.

FIGURE 1 - Flow diagram for this systematic review

TABLE 1 - Data extracted from each selected study

| Autor             | Number of patients | Kind of study | Comparison/kind of surgery | Following period (months) | Nephrolithiasis prevalence | Supporting evidences |
|-------------------|--------------------|---------------|----------------------------|--------------------------|---------------------------|----------------------|
| Froeder et al., 2012 | 61                | Prospective   | RYGB(58)/BPD-DS(3)         | 12 (months)              | 3 of 61 (4,9%) forming stones de novo after surgery | ↑ excretion of CaC2O4 and Citrate |
| Alexander J et al. 2008 | 18            | Prospective   | GB(14/4/VG)               | 6 (urine analysis)       | NR                        | No alteration |
| Nasr et al., 2008   | 11                | Prospective   | RYGB(8)/3 Total Gastrectomy (Roux-en-Y esophagojejunostomy) | mean and median follow-up of 19.4 and 11.0 mo, respectively (range 2.5 to 58.0 mo) | Not Mentioned | NR |
| Patel N et al. 2009 | 9                 | Prospective   | RYGB (6) Bypass Jejunioileal(2)/BPD-DS (1) | Different kind of study, 7 days with controlled diet | 66,67% | Urine volume, pH and citrate, contributing for calcui formation |
| Kumar R et al. 2010 | 58                | Prospective   | RYGB(52)/BPD-DS(6)        | 6 (urine analysis)       | NR                        | ↑ excretion of CaC2O4 |
| Matlaga B et al. 2010 | 11            | Prospective   | RYGB(9)/BPD-DS(2)         | 6 e 12 (urine analysis)  | NR                        | ↑ excretion of CaC2O4 |
| Duffey G et al. 2010 | 21               | Prospective   | RYGB                      | 3,12 e 24 (urine analysis) | NR                        | ↑ excretion of CaC2O4(52%) |
| Chen T et al. 2013  | 417               | Retrospective | AGB(332)/VG(85)           | 54 (search for nephrolithiasis) | AGB (4/1,000 year)       | NR |
| Matlaga B et al. 2009 | 9278            | Retrospective | RYGB(4639)/Obesos controle(4639) | 60 (at least 30[search for nephrolithiasis] | RYGB 7,65% = 355/Obese 4,63% = 215 | NR |
| Whitson et al. 2010 - Review: 5/60 - BS  | Retrospective   | RYGB | Not Mentioned              | 3,2%                      | ↑ excretion of CaC2O4 and Citrate |

NR = Not reported; RYGB = Roux en Y Gastric Bypass; AGB = Adjustable gastric band; VG = Vertical Gastrectomy; BPD-DS = Bilipancreatic diversion with Duodenal Switch; CaC2O4 = Calcium Oxalate
RYGB, due to the progressive rising amount of oxalate after surgery. A hyperoxaluria is a characteristic factor post-bariatric surgery and is maintained even on a restrict oxalate diet in patients submitted to the procedure, in spite of the overall calcium oxalate supersaturation decrement as Pang et al. found in their study. Nelson WK et al. in 2005 already pointed enteric hyperoxaluria, nephropathy and nephrolithiasis caused by oxalate as additional risks for RYGB.

Among the non-operated obese patients, the nephrolithiasis prevalence is greater than in general population, and the composition of the calculi is predominantly uric acid. In this cohort of patients, the obesity itself promotes a biochemical condition that cooperates with the kidney stone formation such as pH reduction, raised excretion of calcium, oxalate, uric acid, and, as remembered by Dardamanis M, the crystallopasis of a salt does not rely only in its supersaturation, but in a group of conditions like pH alteration previously mentioned added to the ionic activity of soluble salts, existence of complex salts in the solvent and, finally, the salt concentration above the formation product (region of supersaturation or instability).

Prevalence of calcium oxalate in that group motivated the accomplishment of studies to clear the involved mechanism of lithogenesis. Evidences have shown that calcium oxalate accumulation may be caused by a already known mechanism (Figure 2) in which happens saponification of the calcium ions with free fat acids in the bowel, leaving more oxalate free in (Figure 2) in which happens saponification of the calcium ions with free fat acids in the bowel, leaving more oxalate free in

Exceptionally, in the obese patients that underwent bariatric surgery, several studies have shown hyperoxaluria as a determining lithogenic factor being it confirmed as the most significant abnormality of modern bariatric surgery.

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FIGURE 2 - Mechanism of saponification and hyperoxaluria due to RYGB

Regarding the mechanism prior described, Kumar et al. accompanied the urine and feces composition in intervals of six and 12 months of 11 patients who underwent bariatric surgery, being nine RYGB and two biliopancreatic diversion with duodenal switch, and they demonstrated that there was a raise in fecal fat as well as a raise in the oxalate levels after a overloaded ingestion of calcium oxalate. These findings confirmed the calcium saponification mechanism and the increased enteric absorption of oxalate. Without the overload, the oxalury levels didn’t demonstrate expressive growth. To explain the oxalury non-augmentation, differently from the preceding paper of his group, Kumar et al., evoke the calcium supplementation of 1,600 mg/day for a year post-surgery. And they justify that the calcium oxalate supersaturation growth as a consequence of the post-surgery reduced urinary volume and increasing of the urinary calcium levels.

Two other prospective studies demonstrated the occurrence of hyperoxaluria in the patients during post-operation period. Duffey et al. analyzed the urine of 21 patients who underwent RYGB in gaps of 3, 12 and 24 months. Patel N. et al. analyzed the urine of 58 patients being 52 RYGB, and six biliopancreatic diversion with duodenal switch, in six month interval post-surgery. Both found hyperoxaluria.

Other mechanism that has been proposed to explain the hyperoxaluria is the probable change in the intestinal flora after the surgery, with the reduction of Oxalobacter formigenes colonization in the bowel. This bacterium is naturally present in the intestinal flora, and it is responsible for oxalate degradation. This change contributes to increase oxalate absorption, because, as demonstrated by Kaufman DW et al., patients that present their gastrointestinal tract colonized by that bacterium have 70% less risk in becoming a recurrent calculi former. Also it is worth highlighting that the uric acid stones can be aggravated by three factors, such as the salt concentration above the formation product (region of supersaturation or instability).

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Figure 2 illustrates the mechanism of saponification and hyperoxaluria due to RYGB. The articles highlight that more prospective studies, with a compatible diet with the new condition (bariatric surgery operated patient), increase fluid consumption (average amount around 2,000 ml), reduce sodium, animal protein and foods that may contain oxalate consumption. All of that should be followed by calcium supplementation of 1,200-2,000 mg/day - preferably in the form of calcium citrate as indicated by Mechanik JI et al., as far as the restrictive diet alone doesn’t provide significant results. This consumption of calcium citrate is necessary since not only the calcium absorption decreases in RYGB patients but also there are large numbers of patients in whom hypocitraturia has been reported. Biochemically, it is known that the citrate binds with the calcium, thus forming a soluble salt and consequently preventing that ion to bind with the oxalate.

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longer follow-up time, that also evaluate the hyperoxaluria, are necessary for more efficient interventions.

Final considerations
There is an increased prevalence of obesity, its comorbidities and consequently, it is expected that more obesity surgeries will be performed. Recent studies show a relationship between obesity surgery and nephrolithiasis even in higher levels than those related only to obesity. More efforts are needed, such as prospective studies with greater population to define the most adequate procedure to achieve weight loss and decrease the risk of potential consequences not yet well considered, such as urinary calculi.

CONCLUSION
There is correlation between obesity surgery and nephrolithiasis.

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