

Shoulder Pain is a Common Problem Following Laparoscopic Adjustable Gastric Band Surgery

John B. Dixon, MBBS, PhD; Yigal Reuben, MBBS; Christine Halket, RN; Paul E. O'Brien, MD

Australian Centre for Obesity Research and Education, Monash Medical School, The Alfred Hospital, Melbourne, Australia

Background: Shoulder-tip pain is commonly reported following laparoscopic adjustable gastric band (LAGB) placement. The incidence, nature and factors that may increase the risk of pain have not been explored.

Methods: A prospective extensive collection of patient characteristics and operative details was obtained from consecutive patients having band placement for severe obesity. Postoperatively, the presence and characteristics of shoulder pain were obtained using a structured interview at discharge from hospital, and at 1 and 5 weeks after placement.

Results: 66% and 21% of patients at 1 and 5 weeks respectively following surgery reported pain predominantly in the left shoulder. At 5 weeks, only 7% found the pain of concern and 5% required analgesics. There were no factors found that predicted the presence and severity of pain at 1 week. Injury to the crus of the diaphragm (OR 4.2, 1.4-12.6, $P=0.01$) and a past history of any upper abdominal surgery (OR 4.2, 1.5-11.7, $P=0.007$) independently predicted an increased risk of pain at 5 weeks.

Conclusion: Shoulder pain following LAGB surgery is common, usually affects the left shoulder, and can in some cases last 5 weeks or more. Avoiding injury to the crura during the procedure may prevent more prolonged pain.

Key words: Pain, postoperative, morbid obesity, laparoscopy, gastric band, shoulder, diaphragm, bleeding, analgesia

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Reprint requests to: Dr. John Dixon, Australian Centre for Obesity Research and Education, Monash Medical School, The Alfred Hospital, Melbourne, Victoria, Australia 3004. Fax: 61 3 9510 3365; e-mail: john.dixon@med.monash.edu.au

Introduction

Shoulder pain is a common complaint following laparoscopic surgery, initially being recognized by gynecologists during early experience with laparoscopic sterilization.¹ The incidence varies, but is common, being experienced in approximately one-third of patients following laparoscopic cholecystectomy,^{2,3} while it is more frequent following Nissen fundoplication.⁴ The pain usually lasts 2-3 days and is relieved by simple analgesics such as paracetamol and codeine.⁵ Several causes of shoulder pain following laparoscopic surgery have been suggested: the effect of CO₂ gas,⁶ peritoneal stretching, diaphragmatic irritation, diaphragmatic injury, and even shoulder abduction during surgery.⁷

A number of studies have looked at methods to reduce the incidence and severity of shoulder pain following laparoscopic surgery. Methods investigated include: low-pressure insufflation,³ slow rate of insufflation,⁸ no CO₂ insufflation,^{9,10} warmed gas,^{11,12} pre-emptive anti-inflammatory medication,¹³ pre-emptive diaphragmatic local anesthetic irrigation,^{4,14-16} postoperative sub-diaphragmatic suction,¹⁷ and regional anesthesia to peritoneal surfaces in the operative area.^{14,18,19} Unfortunately, studies have often found quite varied and sometimes conflicting results regarding the effectiveness of these interventions. This may be related to the variety of procedures performed and a wide variety of study methodologies used.

Laparoscopic bariatric surgery is being performed frequently as a response to the obesity epidemic and

improved safety and efficacy of surgery,^{20,21} and is now the commonest laparoscopic procedure performed by the luminal upper GI surgeon. Laparoscopic adjustable gastric banding (LAGB) surgery has rapidly become one of the most utilized forms of bariatric surgery and has proven to be effective and very safe.²² This surgery has been shown to achieve between 50 and 60% excess weight loss at 3 years and thereafter following surgery, a result comparable with Roux-en-Y gastric bypass, but with approximately one-tenth the peri-operative mortality.²³ We have noted that while peri-operative problems are uncommon,²² shoulder pain following surgery is common and at times presented a significant problem in the weeks following surgery. The problem of shoulder pain following LAGB surgery has not to our knowledge been explored. Indeed, we have been unable to find any report directly addressing the problem of shoulder pain after any form of laparoscopic bariatric surgery.

The aim of this prospective study was to examine incidence, nature, severity and impact of shoulder pain following LAGB surgery. In addition, we have undertaken an extensive prospective collection of anesthetic and operative data to look for factors that may predispose to more severe or prolonged shoulder pain.

Methods

Data regarding demographics, anthropometry, past abdominal surgery and co-morbidity were obtained during a preoperative assessment period. Extensive information was collected for the purposes of this study at the time of LAGB placement, to look for associations with postoperative shoulder pain. There was no specific intervention or change in usual practice during the duration of the study. Informed written consent was obtained from all patients, and the study was conducted in conformance with the Helsinki Declaration.

Surgical Procedure

One surgeon placed all LAGBs (PEO) using the pars flaccida dissection pathway. Data regarding putative operative factors that may influence pain were collected using standard data collection sheets. These factors included: primary or revisional procedure,

associated procedure, length of procedure, duration of insufflation, CO₂ volume insufflated, the extent and site of any bleeding, type of Lap-Band® (Inamed Health, Santa Barbara, CA, USA) placed, tightness of the band when closed, dissection to reduce fat along the band pathway, injury to the left crus during greater curve dissection in the area of the angle of His, injury to the right crus during lesser curve pars flaccida dissection, difficulty in passage of the Lap-Band® placer behind the stomach, and whether a liver biopsy was taken. Insufflation rate, temperature and pressures were not altered throughout the study.

Anesthetic

Standard data collected included ASA classification, premedication, all agents used during the procedure including nature and dose of intra-operative analgesics. Non-steroidal anti-inflammatory or cyclooxygenase II inhibitor medications were given to all subjects for pre-emptive analgesia unless there was a contraindication.

Shoulder Pain

Data regarding shoulder pain was collected on 3 occasions: first, on discharge from hospital when data regarding pain during the hospital stay and use of postoperative analgesic usage was obtained from the patient and the patient's chart. In addition, information on current pain status at the time of discharge was obtained. A nurse facilitator (CH) collected this information from the patient in a standard way during a structured interview.

Second, all patients were phoned and interviewed by a physician (YR) at 1 and 5 weeks following band placement. Details of the pain site(s), frequency, severity, aggravating factors, relieving factors and analgesic usage were obtained using a standardized structured interview technique.

Pain of interest was in the region of the shoulders – right, left or both. Pain frequency was occasional, intermittent (<50% of time), often (>50% of time) or constant (0-4). Severity was mild when no analgesics were required, mild with occasional use of analgesics, moderate requiring regular analgesics, severe but relieved by analgesics, and severe not adequately relieved by analgesics (0-5).

Aggravating factors specifically questioned included:

deep breathing, eating, drinking, generalized movement, and specific shoulder movement. Relieving factors specifically questioned included: simple analgesics, lying down, standing, movement, local application of heat and peppermint. Additional factors aggravating or relieving the pain were also sought.

Data Analysis

Patient characteristics were described as mean \pm standard deviation. The prevalence, type and duration of pain were expressed in percentages of the total patient group. The study was planned to include at least 80 subjects, because this allowed us to detect clinically relevant associations explaining up to 4% of variance, $r=0.2$ at 0.05 level and 10% variance, $r=0.32$ at 0.001.

Spearman correlation coefficients were used to assess correlation between patient, anesthetic, and operative factors, and the duration and severity of pain at 1 week and the presence of pain at 5 weeks. Ordinal and binary logistic regression was used to assess the effect and independence of multiple variables on pain at 1 and 5 weeks. Odds ratios (OR) and 95% confidence limits (CI) are provided for factors found to be associated with shoulder pain. A P -value of <0.05 is considered significant, and no correction has been made for multiple factors assessed simultaneously because we may lower the opportunity to find potentially clinically relevant associations.

Results

Eighty-seven consecutive patients (24M, 63F) having primary ($n=75$) or revisional LAGB ($n=12$) surgery were followed for 5 weeks after band placement. The mean age, weight and BMI of this group were 43.6 ± 10 years, 123.1 ± 21 kg and 44.3 ± 8 kg/m² respectively.

Incidence and Nature of Shoulder Pain

The majority of patients experienced pain in one or both shoulders during the week following LAGB surgery. Pain was most commonly experienced in the left shoulder alone, less frequently in both, and rarely in the right only (Table 1).

Factors that aggravated or relieved the pain are shown in Table 2. Pain was sometimes aggravated by eating, drinking or was associated with breathing, and most commonly relieved by simple analgesics, lying down or placing a hot pack on the affected shoulder. Pain was still experienced by 21% of patients at 5 weeks, but only 7% found it a concern and only 4 patients (5%) required occasional oral analgesics.

Pain at 1 Week Following Surgery

Two-thirds of all patients experienced pain at 1 week after surgery. Each patient's score for frequency (0-4) and severity of pain (0-5) were added to give a combined pain score (0-9). The median score was 1 (interquartile range =3). The subjects were

Table 1. Prevalence, frequency and site of pain following LAGB surgery

	In hospital	On Discharge	At 1 week	At 5 weeks
Some pain	68%	53%	66%	21%
Constant	10%	14%	15%	0
Often	28%	15%	15%	2%
Intermittent	13%	17%	23%	7%
Occasional	15%	7%	13%	11%
Of concern to patient			39%	7%
R-shoulder Only	6%	2%	2%	1%
L-Shoulder Only	45%	37%	57%	17%
Both shoulders	17%	14%	6%	2%

Often >50% of the time; *Intermittent* <50% of the time.

Table 2. Number of patients reporting factors that aggravate and relieve pain, and simple analgesic usage at 1 and 5 weeks following surgery

		Pain at 1 week (n=57)	Pain at 5 weeks (n=18)
Aggravated by	Nothing noted	27	7
	Breathing	8	5
	Eating	15	2
	Drinking	7	0
Relieved by	Nil	4	7
	Oral analgesics	28	2
	Lying down	14	3
	Standing	2	0
	Hot packs	24	2
	Movement	8	0
	Peppermint	7	2
Others	Raise arms	2	0
	Massage	5	3
	Eating food	1	1
Analgesics usage	Nil	19	14
	Occasional	23	4
	Regularly	14	0
	Not controlled by analgesics	1	0

divided into 3 groups; no pain (n=35), a score of 1-3 (n=34) and a score >3 (n=18). Using ordinal logistic regression, there were no predictors of the pain score at 1 week following surgery. There were no features directly related to the surgery that were associated with pain at 1 week. In a similar way, the subjects were divided into two groups: those with a score of 0 and 1, which is at or below the median score (n=47), and those scoring >1 (n=40). Binary logistic regression was used and again no predictors could be found. Those with pain at 1 week were more likely to continue to have pain at 5 weeks. Shoulder pain score at 1 week was not associated with an increased length of hospital stay.

The complaint of right-sided pain was unusual. Only 8 patients (9%) reported right-sided shoulder pain at 1 week following surgery: 2 reported pain in the right shoulder alone and in 6 in both shoulders. There were 2 factors found to increase the risk of R-sided or bilateral pain. First, these 8 patients were more likely to have had more than trivial bleeding during the procedure although the site of bleeding was not a significant influence; 23% of those who had some blood removed during the procedure (24%

of all patients) either by simple swabbing or suction, had R-shoulder pain, while only 4.5% of the remainder had R-shoulder pain ($P=0.008$, OR 6.6, 95%CI 1.4-30). In this series, there were no cases of bleeding that were a significant surgical problem.

Second, a history of previous upper abdominal surgery, cholecystectomy (n=17) and Nissen fundoplication (n=1), also appeared to increase the risk of right shoulder pain ($P=0.032$, OR 4.6 95%CI 1.04-20). However, it was not seen more often in those having revisional Lap-Band® surgery.

These had combined effects with an R^2 of 0.114 (Cox and Snell), $P=0.005$. Two percent of those with no risk factor, 16% of those with one risk factor, and 50% of those with both risk factors experienced right shoulder pain at 1 week.

Factors Associated with Persistent Pain at 5 Weeks

Of the extensive preoperative and peri-operative data collected, there were few factors that were associated with the persistence of pain at 5 weeks after surgery (n=18 of 87). There was no significant

association between persistent pain and the patient's age, sex, weight and BMI. Using binary logistic regression, two factors were found:

- 1) A history of previous upper abdominal surgery: 14 patients had a history of previous surgery in the area of the gastroesophageal junction – 13 LAGB revisions for slippage and one Nissen fundoplication. Six (36%) had pain at 5 weeks (OR 4.0, 95%CI 1.1-14.3, $P=0.03$) when compared with those who had never had previous abdominal surgery. However, 14 patients having primary LAGB surgery had a history of open or laparoscopic cholecystectomy, and 7 (50%) experienced pain at 5 weeks (OR 5.7, 95%CI 1.6-20.0, $P=0.007$). Those with any history of previous upper abdominal surgery have an increased likelihood of pain at 5 weeks (OR 4.2, 95%CI 1.5-11.7, $P=0.007$).
- 2) Injury to the crus of the diaphragm during dissection near the angle of His: 7 of 42 (16.2%) with no observed injury, 5 of 26 (19.7%) with a minor pull, tug or bleeding, and 9 of 19 (47.4%) with a significant injury as a result of bleeding, muscle tear or concurrent crural repair for hiatal hernia experienced pain at 5 weeks. The odds ratio for pain with significant crural injury on the left hand side is OR 4.2, 95%CI 1.4-12.6, $P=0.01$.

These two factors provided independent effect when modeled together (Cox and Snell $R^2=0.15$, $P=0.001$). Moreover, 11% of those with no risk factor, 33% of those with one risk factor, and 71% of those with both risk factors experienced pain at 5 weeks.

Discussion

This prospective study shows that shoulder pain predominantly on the left side occurs in the majority of patients following the laparoscopic placement of an adjustable gastric band. Importantly, most patients still experienced pain 1 week following placement, which contrasts with most reports indicating that the pain usually resolved within 2-3 days. Most studies, however, have only examined the immediate post-operative period and it is possible that a description of more prolonged discomfort has not been sought. Indeed, most studies of interventions designed to reduce shoulder pain have examined the first 24-48 hours only.^{2-4,15,16,23} A recent study by Bisgaard et

al²⁴ did examine a longer period and found that 38% and 25% of patients having a Nissen fundoplication had shoulder pain at 7 and 30 days following surgery respectively. These findings are consistent with ours; we found 66% and 21% experienced some shoulder pain at 1 and 5 weeks respectively. It would seem that surgery in the region of the gastroesophageal junction may be not only associated with a higher incidence of shoulder pain, but also in some cases a more prolonged period of pain.

It is interesting that the predominant shoulder where pain is experienced following LAGB surgery is the left; in contrast, following laparoscopic cholecystectomy it is the right. This difference suggests that the region of surgery has an important influence on the site of pain and that the development of the pneumoperitoneum is not the only factor producing shoulder pain immediately following surgery.^{14,25}

This study has found two factors associated with more prolonged pain (5 weeks) following LAGB placement. These are a history of previous upper abdominal surgery and injury to the crura during the procedure. While the first of these is unavoidable, the second can be potentially addressed by careful dissection techniques to reduce the risk of crural damage during LAGB placement. During dissection on the greater curvature side, care should be taken to avoid crural injury during exposure of the angle of His, while on the lesser curvature side using the pars flaccida technique the initial dissection should commence 2-3 mm to the left of the right crus to avoid crural damage. Placement of an instrument behind the stomach should be performed gently to avoid injury to both the esophagus and the crura.

Previous upper abdominal surgery including laparoscopic cholecystectomy appears to increase the risk of more prolonged pain and right shoulder pain following surgery. A weakness of the present study is the possibility that an error of association has been made because no adjustment was made for the multiple factors assessed. On the other hand, it would be important to find any factors that may provide an opportunity for intervention. Injury to the crura and its association with more prolonged pain, and bleeding during the procedure leading to a higher risk of right shoulder pain or bilateral pain, provide associations that may have both plausible explanations and provide useful information to the surgeon.

LAGB surgery has the potential to revolutionize

bariatric surgery. The operation is safe and effective, with a surgical technique that is standardized, reproducible and widely available. The procedure can be performed by well-trained upper GI surgeons and is not as technically demanding as Roux-en-Y gastric bypass. This procedure also provides the opportunity for day stay bariatric surgery.²⁶ Given these considerations, there is a real need to study ways to minimize the discomfort experienced by the patient following LAGB placement. We find that the shoulder pain is often more a concern than either visceral or wound pain following LAGB placement. There is a need to study ways of preventing this common problem: CO₂ insufflation rates,⁸ temperature^{11,12} and pressures,²⁷ pre-emptive anti-inflammatory or analgesic medications,¹³ and pre-emptive long-acting local anaesthesia to the operative area and diaphragm should all be assessed.^{4,15,16,28-30} These interventions should ideally be assessed using randomized controlled trials, and not be limited to an assessment of the 2-3 days following surgery, but should include the full duration of pain experienced. It would be important to see if successful pre-emptive measures influence pain following the first postoperative week.

In conclusion, shoulder pain following LAGB surgery is common, usually affects the left shoulder, and can in some cases last for 5 weeks or more. Avoiding injury to the crura during the procedure may prevent more prolonged pain. A series of studies is required to explore measures to prevent or minimize shoulder pain resulting from this now well-standardized bariatric surgical procedure.

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