Introduction
Health and life of Asian is threatened by gastric cancer seriously (Atrkar-Roushan et al., 2013; Unal et al., 2014). Technique of laparoscopy-assisted gastric cancer resection was reported by Kitano et al in 1994 firstly (Kitano et al., 1994). From then on, this technique has been accepted by surgeons and patients gradually and the advantages of this approach have been confirmed by several centers (Kim et al., 2012; Shimohara et al., 2013; Sakuramoto et al., 2013; Haverkamp et al., 2013; Liao et al., 2013). While emphasis too much on the advantages of laparoscopic resection, learning itself usually be ignored. Whether every surgeon can perform this approach perfectly? Whether laparoscopic operation performed by inexperienced junior surgeons can get satisfactory results? Aimed at finding answers for these questions, a study was designed by us to compare the different outcomes of laparoscopy-assisted gastric cancer resection performed by inexperienced junior surgeons under the supervision of expert laparoscopic surgeons and open resection completed by the same surgeons.

Materials and Methods
Population
Data of patients underwent gastric cancer operation completed by six junior surgeons from May 2011 to March 2013 in cancer hospital, Chinese academy of medical sciences were collected and analyzed retrospectively. Preoperative definite diagnosis for each patient was confirmed by gastroscope with biopsy. Upper gastrointestinal radiography, abdominal computed tomography scan and abdominal ultrasound were routinely used for evaluation. Distance metastasis was excluded by imaging examination.

All these 6 junior surgeons who had no enough laparoscopic experience were surgical oncologists.

Keywords: Junior surgeon - laparoscopy-assisted resection - open resection - gastric cancer - short-term outcome

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Before launching laparoscopic-assisted gastric cancer resection, 2 surgeons had no experience of laparoscopy-related operation and 4 surgeons had experienced a few laparoscopic operations such as laparoscopic-assisted colorectal cancer resection. All of them had open surgery experience for about 5 years and each surgeon had completed about 30 gastric cancer operations independently.

Choice of the surgical procedure (laparoscopic versus open) was strictly based on the patient’s individual decision after providing informed consent concerning the methods and risks of each procedure. The protocol was approved by the ethics committee of our hospital. According to the Japanese Classification of Gastric Carcinoma (Hwang et al., 2009), extended lymph node dissection (D2) was the preferred procedure in both laparoscopic resection and open resection (Table 1). We were used to performing D1+ lymphadenectomy for older and high-risk patients aimed at reducing intra-operative risk and postoperative complications.

In our study, consecutive patients received laparoscopy-assisted gastric cancer resection successfully were assigned to laparoscopic group and patients received open surgery concurrently were assigned to open group. Short-term outcomes including operative time, intra-operative blood loss, conversion rate, number of lymph nodes harvested, time to first flatus, time to first defecation, intra- and postoperative complications were compared between the two groups.

Laparoscopic technique

All patients were placed in lithotomy position. Five trocars were used in all patients, a 12mm port below the umbilicus was created to introduce the laparoscope, another 12 mm trocar was introduced into the left anterior axillary line 2cm below arch of rib, a 5mm trocar was insert in the port of parambibal中期clavicular line, another two 5mm trocars were placed in the corresponding position of right abdomen. The operator stood on the left side of the patient.

A routine exploration of the abdominal and pelvic cavity was performed, separation of the greater omentum from the transverse colon was created to introduce the laparoscope, and the superior leaf of the mesocolon was resected. According to the tumor location combined with tumor size and pathologic type, selective ligation of peripheral vascular of stomach including the right gastroepiploic vessel, left gastroepiploic vessel, left gastric vessel, right gastric vessel and vasa brevia and dissection of lymph nodes of draining area were performed in proper sequence under laparoscopy, then the duodenum or and distal esophagus was transected through the small incision which was done when laparoscopic procedure was completed, and the stomach was transected or total stomach was removed. Soon afterwards, Billroth I, BillrothII, esophago-gastrostomy, double “S” or Roux-en-Y anastomosis was performed according to the extent of resection. Gastrointestinal decompression tube and abdominal cavity drainage tube were indwelled routinely.

All laparoscopic-assisted operations were completed under supervision of expert laparoscopic surgeons and all open operations were completed by junior surgeons independently in this study.

Statistical analysis

Statistical analyses were performed using statistical software package SPSS version 16.0. A P-value less than 0.05 was considered to be statistically significant. Categorical variables were analyzed by Chi-square test, and continuous variables were analyzed by the Student’s t test.

Results

A total of 137 patients were attempted to deliver laparoscopy-assisted gastric cancer resection. 118 patients underwent this approach successfully were assigned to laparoscopic group. 19 patients were converted to open surgery and they were excluded from analysis. 95 patients underwent open surgery were assigned to open group.

Clinical and pathological findings

Age, gender, concomitant diseases, BMI, ASA, abdominal operation history and operation type were matched between the two groups (Table 1). The mean tumor size was 4.8±2.4 cm in laparoscopic group and 4.1±2.2 cm in open group (p=0.060). In laparoscopic group, 75 patients underwent distal gastrectomy with Billroth I anastomosis, 17 patients underwent distal gastrectomy with BillrothII anastomosis.

### Table 1. Comparisons of Two Groups for General Parameters

| Parameters                        | Laparoscopic group (n=118) | Open group (n=95) | p value |
|-----------------------------------|---------------------------|------------------|--------|
| Gender                            |                           |                  | 0.268  |
| Male                              | 80                        | 71               |        |
| Female                            | 38                        | 24               |        |
| Age, year (mean±SD)               | 55.2±12.6                 | 54.0±10.1        | 0.47   |
| BMI, kg/m²(mean±SD)               | 23.4±3.5                  | 24.0±3.4         | 0.226  |
| ASA                               |                           |                  | 0.096  |
| I                                 | 17                        | 6                |        |
| II                                | 83                        | 78               |        |
| III                               | 18                        | 11               |        |
| Concomitant diseases              |                           |                  | 0.942  |
| Yes                               | 33                        | 27               |        |
| No                                | 85                        | 68               |        |
| Abdominal operation history       |                           |                  | 0.208  |
| Yes                               | 18                        | 9                |        |
| No                                | 100                       | 86               |        |
| Tumor size, cm(mean±SD)           | 4.8±2.4                   | 4.1±2.2          | 0.06   |
| Resection                         |                           |                  | 0.914  |
| Distal gastrectomy                | 92                        | 74               |        |
| Proximal gastrectomy              | 12                        | 11               |        |
| Total gastrectomy                 | 14                        | 10               |        |
| Lymphadenectomy                   |                           |                  | 0.753  |
| D1+                               | 18                        | 16               |        |
| D2                                | 100                       | 79               |        |
| Reconstruction                    |                           |                  | 0.514  |
| Billroth I                        | 75                        | 59               |        |
| BillrothII                        | 17                        | 15               |        |
| Esophago-gastrostomy              | 12                        | 11               |        |
| Double “S”                        | 14                        | 8                |        |
| Roux-en-Y                         | 0                         | 2                |        |
gastrectomy with Billroth II anastomosis, 12 patients underwent proximal gastrectomy with esophago-gastrostomy anastomosis, 14 patients underwent total gastrectomy with Double “S” anastomosis; In open group, 59 patients underwent distal gastrectomy with Billroth II anastomosis, 15 patients underwent distal gastrectomy with Billroth III anastomosis, 11 patients underwent proximal gastrectomy with esophago-gastrostomy anastomosis and 8 patients underwent total gastrectomy with Double “S” anastomosis and and 2 patients underwent total gastrectomy with Roux-en-Y anastomosis (Table 1). 18 patients underwent D1+ lymphadenectomy and 100 patients experienced D2 lymphadenectomy in laparoscopic group, and 16 patients received D1+ lymphadenectomy and 79 patients received D2 lymphadenectomy in open group, the difference was not obvious.

Comparisons of pathological outcomes including T-classification, number of lymph node harvested, tumor differentiation, pathological type of tumor, length of distal or/and proximal margin between the two groups were shown in Table 2.

Operative results and recovery of intestinal function

The mean operative time was 215.9±32.2min in laparoscopic group and 220.1±34.6min in open group (p=0.866), and the mean blood loss in laparoscopic group was obviously less than that in open group (200.9±197.0ml vs 291.1±194.4ml; p=0.001). Time to passing of first flatus was similar between the two groups (Laparoscopic group vs Open group: 4.0±1.0 days vs 4.3±1.2 days; p=0.135), and the same result could be found for the time to passing of first defecation (Laparoscopic group vs Open group: 4.7±1.6 days vs 4.8±1.6 days; p=0.586). Time to resumed soft diet in laparoscopic group was a little earlier than in open group although no statistical significance (7.2±1.3 days vs 7.4±1.5 days; p=0.454). The hospital stay in laparoscopic group was significantly shorter than that in open group (10.2±2.3 days vs 11.0±2.9 days; p=0.025), all of results were shown in Table 3.

Complication and conversion

The complication rate in laparoscopic group was lower than that in open group (9.3% vs 20.0%, p=0.026). In laparoscopic group, six patients had complications including fat liquefaction (n=4) and infection (n=2); two patients had anastomosis leakage: one had gastroduodenal anastomosis leakage and one had gastrojejunostomy anastomosis leakage, both of them were cured by indwelling drainage tube and washout; two patients had intraperitoneal hemorrhage which was cured by using hemostatic and transfusion; one patients had gastroparesis and it was cured by indwelling jejunum nutrition tube and jejunal infusion of nutrition. In open group, fourteen patients had incision complication including fat liquefaction (n=11) and infection (n=3); one patient had gastroduodenal anastomosis leakage; two patients had intraperitoneal hemorrhage; two patients had gastroparesis. Treatments of these complications were similar to what mentioned in laparoscopic group (Table 3). The conversion rate was 13.9% (19/137) for laparoscopy-assisted resection in our study. Reasons for conversion showed in table 4 including unclear anatomy, intra-operative bleeding, abdominal

| Outcomes                              | Laparoscopic group (n=118) | Open group (n=95) | P-value |
|---------------------------------------|---------------------------|-------------------|---------|
| T-classification                      |                           |                   | 0.32    |
| T1                                    | 21                        | 18                |         |
| T2                                    | 27                        | 13                |         |
| T3                                    | 45                        | 45                |         |
| T4                                    | 25                        | 19                |         |
| Number of lymph node harvested(mean±SD) | 21.1±9.6                  | 18.2±9.7          | 0.029   |
| Tumor differentiation                 |                           |                   | 0.899   |
| Well                                  | 6                         | 4                 |         |
| Moderate                              | 18                        | 13                |         |
| Poor                                  | 94                        | 78                |         |
| Pathology                             |                           |                   | 0.287   |
| adenocarcinoma                        | 85                        | 74                |         |
| Signet ring cell                      | 33                        | 21                |         |
| Length of margin for distal gastrectomy | 3.0±0.4                   | 2.9±0.4           | 0.236   |
| Distal margin, cm(mean±SD)            |                           |                   |         |
| Proximal margin, cm(mean±SD)          | 5.3±0.5                   | 5.3±0.6           | 0.828   |
| Length of margin for proximal gastrectomy | 5.2±0.5                   | 5.1±0.6           | 0.545   |
| Distal margin, cm(mean±SD)            |                           |                   |         |
| Proximal margin, cm(mean±SD)          | 3.2±0.4                   | 3.1±0.4           | 0.258   |

Table 4. Reasons for Conversion

| Reasons for conversion | Number of patients (n=19) |
|------------------------|--------------------------|
| Bleeding (%)           | 4 (21.0%)                |
| Adhesion (%)           | 4 (21.0%)                |
| Adjacent structure invasion (%) | 3 (15.8%) |
| Bulky mass (%)         | 3 (15.8%)                |
| Unclear anatomy (%)    | 3 (15.8%)                |
| Obesity (%)            | 2 (10.5%)                |

| Outcomes                              | Laparoscopic group (n=118) | Open group (n=95) | P-value |
|---------------------------------------|---------------------------|-------------------|---------|
| Operative time, min (mean±SD)         | 215.9±32.2                | 220.1±34.6        | 0.866   |
| Blood loss, ml (mean±SD)              | 200.9±197.0               | 291.1±194.4       | 0.001   |
| Time to first flatus, day (mean±SD)   | 4.0±1.0                   | 4.3±1.2           | 0.135   |
| Time to first defecation, day (mean±SD)| 4.7±1.6                     | 4.8±1.6           | 0.586   |
| Time to resumed soft diet, days (mean±SD)| 7.2±1.3                     | 7.4±1.5           | 0.454   |
| Hospital stay, day (mean±SD)          | 10.2±2.3                  | 11.0±2.9          | 0.025   |
| Peri-operative complication           | 11                        | 19                | 0.026   |
| Incision complication                 | 6                         | 14                | 0.016   |
| Anastomosis leakage                   | 2                         | 1                 | 0.693   |
| Intraperitoneal hemorrhage            | 2                         | 2                 | 0.826   |
| Gastroparesis                         | 1                         | 2                 | 0.439   |
| Length of incision, cm (mean±SD)      | 6.9±0.8                   | 14.0±1.0          | <0.001  |

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that the disturbance for internal environment of patients was slight. Second, gastrointestinal tract was pulled slightly during the procedure of laparoscopic operation (Akiyoshi et al., 2009). Compared with open surgery, earlier intestinal function recovery had been found in our study.

Conversion rate in our study was a little higher than results which had reported previously by some centers (Chen et al., 2012; Wan et al., 2012). For example, a study designed by Toshihiko Shinohara et al (2013) showed that the conversion rate in their laparoscopic group was 2.2% (4/186). The most common reasons for conversion in our study were bleeding and adhesion. Unskilled operation and the lack of experience might be the main reasons although under supervision of expert laparoscopic surgeons.

Results including the similar operative time, less intra-operative blood loss, lower complication rate and rapider intestinal function recovery in our study had confirmed the advantages of laparoscopic resection performed by junior surgeon under supervision of expert laparoscopic surgeons. Patients benefited from laparoscopic resection in our study. We thought that junior surgeons who have no enough laparoscopic experience could perform laparoscopic gastric cancer resection satisfactorily under the supervision of expert laparoscopic surgeons.

Laparoscopic surgery requires specialized dexterity that is different from that for open surgery due to the translation of a three-dimensional working area into a two-dimensional video image, decreased tactile feedback, and the need for good eye-hand coordination (Ahn et al. 2013). We think that experience of open surgery is the basic of laparoscopic approach, accurate anatomy under laparoscopy and dexterous operation is the guarantee of success. More training should be proceeded before performing laparoscopic surgery for patients with gastric cancer and the supervision of expert laparoscopic surgeons may play a very important role.

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Laparoscopy-assisted Gastric Cancer Resection by Inexperienced Junior Surgeons

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