PCI has led Japanese surgeons to perform less invasive surgical procedures such as OPCAB.

Dr D. Taggart *(Oxford, United Kingdom)*: I think in many Asian countries it's very high. And India is probably even higher, somewhere in the region of 80% to 90%. In Japan the figures I saw were even higher than 60%. So in the Far East and South East Asia, off-pump surgery is the standard.

Could I just ask the audience, on this basis, not for redos but for a first time coronary, which of you five years ago would have been routinely using off-pump surgery in, say, at least 30% or 40% of patients?

(Show of hands.)

Who is still using off-pump surgery in at least 30% to 40% of patients?

(Show of hands.)

It's quite interesting, just looking at this audience indicates that most of the people who five years ago were doing a significant proportion of off-pump surgery are still doing it. In my own practice it was 90% 15 years ago and it's still 90% today. But I think what's happened with recent publications is that people who were a bit less sure about off-pump surgery have now dropped off, because we're seeing the figures for off-pump surgery in the United Kingdom have dropped from around 20% to 14% now in the last year. And I think the recent publications of Coronary and GOPCABE, the big German trial, have had a negative impact on off-pump surgery.

Dr Dohi: Japanese surgeons are familiar with the off-pump procedure. Therefore, even for redo CABG, Japanese surgeons perform the off-pump procedure quite well.

ORIGINAL ARTICLE

Total Gastrectomy Risk Model

Data From 20,011 Japanese Patients in a Nationwide Internet-Based Database

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Objective: To construct a risk model for total gastrectomy outcomes using a nationwide Internet-based database.

Background: Total gastrectomy is a very common procedure in Japan. This procedure is among the most invasive gastrointestinal procedures and is known to carry substantial surgical risks.

Methods: The National Clinical Database was used to retrieve records on more than 1,200,000 surgical cases from 3500 hospitals in 2011. After data cleanup, 20,011 records from 1623 hospitals were analyzed for procedures performed between January 1, 2011, and December 31, 2011.

Results: The average patient age was 68.9 years; 73.7% were male. The overall morbidity was 26.2%, with a 30-day mortality rate of 0.9%, in-hospital mortality rate of 2.2%, and overall operative mortality rate of 2.3%. The odds ratios for 30-day mortality were as follows: ASA (American Society of Anesthesiologists) grade 4 or 5, 9.4; preoperative dialysis requirement, 3.9; and platelet count less than 50,000 per microliter, 3.1. The odds ratios for operative mortality were as follows: ASA grade 4 or 5, 5.2; disseminated cancer, 3.5; and alkaline phosphatase level of more than 600 IU/L, 3.1. The C-index of 30-day mortality and operative mortality was 0.811 (95% confidence interval [CI], 0.744–0.879) and 0.824 (95% CI, 0.781–0.866), respectively.

Conclusions: We have performed the first reported risk stratification study for total gastrectomy, using a nationwide Internet-based database. The total gastrectomy outcomes in the nationwide population were satisfactory. The risk models that we have created will help improve the quality of surgical practice.

Keywords: National Clinical Database, risk factors of mortality, total gastrectomy, 30-day mortality, risk model

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Gastric cancer is currently the fourth most common malignancy worldwide[1] and is among the most prevalent types of cancer in Eastern Asia, including Japan, Korea, and China.[2] Surgical resection is often the only curative treatment, although some early gastric cancers limited to the mucosa may be treated endoscopically.[3] Total gastrectomy is usually indicated for tumors located in the upper third of the stomach or advanced gastric cancer extending to the cardia.

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Total gastrectomy is among the most invasive gastrointestinal procedures and is known to carry substantial surgical risks. Patients with gastric cancer frequently have anemia, malnutrition, or organ dysfunction due to tumor extension.[4] Major complications of total gastrectomy can be fatal; these complications include esophagojejunal anastomotic leakage, duodenal stump leakage, and pancreatic fistula related to suprapancreatic lymphadenectomy.[5] In addition, the proportion of patients with gastric cancer who are elderly is increasing.[6] Although all of these factors may affect mortality, and several additional factors influence the incidence of gastric cancer itself, there are few studies that have used a large patient cohort to describe a risk model of mortality for total gastrectomy.

The National Clinical Database (NCD), which commenced patient registration in January 2011, is a nationwide project that is linked to the surgical board certification system in Japan. In this study, we focused on the NCD division of gastrointestinal surgery that uses patient variables and definitions almost identical to those used by the American College of Surgeons National Surgical Quality Improvement Program.[7] Using this database, we created a risk model of mortality for Japanese patients undergoing total gastrectomy.

METHODS

Data Collection

In 2011, the NCD collected data on more than 1,200,000 surgical cases from 3500 hospitals. In the gastroenterological surgery section, the database registered all surgical cases that fell into this category; in addition, it required detailed input items for the 8 procedures, including total gastrectomy, that were determined to represent the performance of surgery in each specialty. Patients who declined to have their records entered in the NCD were excluded from our analysis. Records with missing data on patient age, sex, or status, 30 days after surgery were also excluded. A total of 20,011 patients who underwent total gastrectomy at 1623 institutions between January 1, 2011, and December 31, 2011, were eligible for analysis.

The NCD constructed software for an Internet-based data collection system, and the data managers of participating hospitals were responsible for forwarding their data to the NCD office. The NCD ensures traceability of its data by maintaining continuity in the staff who approve data, the staff of the departments in charge of annual cases, and the data-entry personnel. It also validates data consistency via random inspections by participating institutions. All variables, definitions, and inclusion criteria for the NCD are accessible to participating institutions on its Web site (http://www.ncd.or.jp); the database administrators also provide e-learning systems to teach participants how to input consistent data. The administrators answer all inquiries regarding data entry, answering approximately 80,000 inquiries in 2011, and Frequently Asked Questions are displayed on the Web site.

Endpoint

The primary outcome measure of this study was 30-day mortality and overall operative mortality. The calculation of operative mortality included all patients who died during the index hospitalization, including hospital stays up to 90 days, and any patient who died after hospital discharge within 30 days of the operation date.

Statistical Analysis

Data were randomly assigned to 2 subsets, with 80% allocated for model development and 20% for validation testing. The development data set comprised 16,036 records, and the validation data set comprised 3975 records. The 2 sets of logistic models, 30-day mortality and operative mortality, were constructed for the development data set using a stepwise selection of predictors, with the *P* value for inclusion set at 0.05. A goodness-of-fit test was performed to assess how well the model could discriminate between survivors and deceased patients. Model calibration, the degree to which the observed outcomes were similar to the predicted outcomes, was examined by comparing the observed with the predicted average within each of the 10 equal-sized subgroups, arranged in increasing order of patient risk.

RESULTS

Study Population Risk Profile

The total gastrectomy patient population represented in the NCD had an average age of 68.9 years; 73.7% of the population was male. The mean body mass index of the study population was 22.4 kg/m^2. Only 2.0% required emergency surgery. Furthermore, 4.6% of the patients needed assistance in activities of daily life. Weight loss of more than 10% was observed in 8.7% of patients. American Society of Anesthesiologists (ASA) scores of grade 3 and grade 4/5 were seen in 8.9% and 0.6% of patients, respectively. Preoperative comorbidities included diabetes mellitus in 8.9% of patients, preoperative respiratory distress in 2.4% of patients, disseminated cancer in 3.7% of patients, and ascites in 2.0% of patients. An abbreviated demographic and risk profile of the study population is shown in Table 1.

Morbidity

The overall morbidity in the total gastrectomy NCD population was 26.2%; grade II or higher complications, as defined by the Clavien-Dindo Classification of Surgical Complications system,[8] were observed in 18.3% of patients. Surgical complications included surgical site infection in 8.4% of patients, anastomotic leakage in 4.4% of patients, and pancreatic fistula (grades B, C) in 2.6% of patients. Nonsurgical complications included pneumonia in 3.6% of patients, renal failure in 1.3% of patients, central nervous system events in 0.7% of patients, and cardiac events in 0.6% of patients. The postoperative morbidities are presented in Table 2.

TABLE 1. Key Descriptive Data

Variables	N = 20,011
Age, mean, yr	68.9
Males, %	73.7
Body mass index, mean, kg/m^2	22.4
Status (emergent), %	2.0
ADL (any assistance), %	4.6
Weight loss, >10%, %	8.7
ASA score, %	
Grade 3	8.9
Grade 4 or 5	0.6
Diabetes, %	15.7
Previous cardiac surgery, %	1.1
Preoperative respiratory distress, %	2.4
Preoperative dialysis, %	0.5
Cerebrovascular accident, %	2.2
Disseminated cancer, %	3.7
Ascites, %	2.0

ADL indicates activities of daily life.

Outcomes

Total gastrectomy outcomes are presented in Table 3. The 30-day mortality was 0.9%, the in-hospital mortality was 2.2%, and the overall operative mortality was 2.3%.

Model Results

Risk models for 30-day mortality and operative mortality were developed; the final logistic models with the odds ratios and 95% confidence intervals are presented in Tables 4 and 5. The ASA score (grade 4 or 5) was the most significant factor in both models. In addition, there were 11 variables that appeared in both models: a preoperative dialysis requirement; a total bilirubin level of more than 2 mg/dL; the presence of disseminated cancer; an alkaline phosphatase level of more than 600 IU/L; an aspartate aminotransferase level of more than 35 IU/L; a prothrombin time–international normalized ratio of more than 1.25; any assistance needed for preoperative activities of daily living; the presence of ascites; a serum albumin level of less than 3.5 g/dL; and the patient's age category (see Tables 4 and 5 for the definition of age category).

Model Performance

To assess the performance of the models, both the C-index and the model calibration across risk groups were evaluated. The receiver operating characteristic curves of both models are shown in Figure 1. The C-index, a measure of model discrimination represented by the area under the receiver operating characteristic curve, was 0.811 for 30-day mortality (95% confidence interval, 0.744–0.879) (Fig. 1A) and 0.824 for overall operative mortality (95% confidence interval, 0.781–0.866) (Fig. 1B). Figure 2 demonstrates the calibration of the models or how well the rates for the predicted event matched those of observed event among patient risk subgroups. (Figure 2A, 30-day mortality risk model; and Figure 2B, operative mortality risk model)

DISCUSSION

Although mortality due to gastric cancer has been steadily decreasing in recent years,[9] the incidence of this cancer in Japan is still the highest of all solid tumors,[10] probably due to the high incidence of *Helicobacter pylori* infection in the Japanese population.[11] Gastric cancer is one of the most commonly encountered diseases in Japanese surgical units; Japanese surgeons are therefore very familiar with gastric cancer surgery, which explains why our study cases were collected from such a large number of institutes.

Although numerous studies have reported the morbidity and mortality rates for gastrectomy in general, few have described these rates for total gastrectomy alone. Moreover, it is still unknown whether total gastrectomy should be considered a more invasive procedure than distal gastrectomy. A randomized controlled trial comparing D1 subtotal gastrectomy with D3 total gastrectomy for cancers located in the gastric antrum revealed that significantly more abdominal abscesses are observed in patients undergoing total gastrectomy; this is attributed to the extended lymphadenectomy involved in the latter procedure.[12] In contrast, an Italian study demonstrated that postoperative morbidity rates are comparable between subtotal gastrectomy and total gastrectomy,[13] although postoperative quality of life is significantly better after subtotal gastrectomy.[14] Both studies

TABLE 2. Morbidities in the NCD Total Gastrectomy Population

Complications	Test Set (n = 16,036)	Validation Set (n = 3975)	Overall Incidence (N = 20,011)
Overall complications	4216 (26.3)	1033 (26.0)	5249 (26.2)
Grade II or higher*	2965 (18.5)	708 (17.8)	3668 (18.3)
Surgical complications			
Surgical site infection	1355 (8.4)	331 (8.3)	1686 (8.4)
Superficial incisional	503 (3.1)	128 (3.2)	631 (3.2)
Deep incisional	244 (1.5)	66 (1.7)	310 (1.5)
Organ space	1024 (6.4)	251 (6.3)	1275 (6.4)
Anastomotic leak	711 (4.4)	170 (4.3)	881 (4.4)
Pancreatic fistula (grade B, C)	419 (2.6)	110 (2.8)	529 (2.6)
Bile leak	81 (0.5)	15 (0.4)	96 (0.5)
Wound dehiscence	161 (1.0)	37 (0.9)	198 (1.0)
Nonsurgical complications			
Pneumonia	589 (3.7)	137 (3.4)	726 (3.6)
Unplanned intubation	282 (1.8)	57 (1.4)	339 (1.7)
Prolonged ventilation >48 h	308 (1.9)	70 (1.8)	378 (1.9)
Pulmonary embolism	25 (0.2)	3 (0.1)	28 (0.1)
Renal failure	213 (1.3)	46 (1.2)	259 (1.3)
CNS events	121 (0.8)	28 (0.7)	149 (0.7)
Cardiac events	90 (0.6)	23 (0.6)	113 (0.6)
Sepsis	138 (0.9)	24 (0.6)	162 (0.8)

The values given are number (percentage).
*Clavien-Dindo classification.
CNS indicates central nervous system.

TABLE 3. Outcome Rates in the NCD Total Gastrectomy Population

Outcomes	Test Set (n = 16,036)	Validation Set (n = 3975)	Overall Incidence (N = 20,011)
30-d mortality	153 (1.0)	34 (0.9)	187 (0.9)
In-hospital mortality	358 (2.2)	89 (2.2)	447 (2.2)
Operative mortality	367 (2.3)	90 (2.3)	457 (2.3)
Reoperation within 30 d	542 (3.4)	122 (3.1)	664 (3.3)
Readmission within 30 d	311 (1.9)	86 (2.2)	397 (2.0)

The values given are number (percentage).

TABLE 4. Risk Model of 30-Day Mortality

Variables	Status	Hazard Ratio	95% Confidence Interval
ASA score	Grade 4 or 5	9.383	4.85–18.152
Preoperative dialysis	Present	3.906	1.546–9.867
Platelet count	<50,000/μL	3.064	1.256–7.473
Total bilirubin	>2.0 mg/dL	2.919	1.189–7.17
Disseminated cancer	Present	2.641	1.603–4.35
Alkaline phosphatase	>600 IU/L	2.457	1.153–5.232
Previous cardiac surgery	Present	2.346	0.997–5.518
Aspartate aminotransferase	>35 IU/L	2.340	1.549–3.537
Diabetes	Insulin use	2.182	1.116–4.266
PT-INR	>1.25	2.182	1.318–3.613
Preoperative ADL	Any assistance	2.086	1.329–3.272
Ascites	Present	2.018	1.11–3.669
Preoperative transfusion	Present	1.936	1.208–3.102
Blood urea nitrogen	>25 mg/dL	1.886	1.201–2.961
Albumin	<3.5 g/dL	1.714	1.167–2.517
Alkaline phosphatase	>340	1.682	1.032–2.739
Hemoglobin	Male, <13.5 g/dL; female, <12.5 g/dL	1.659	1.03–2.675
Age category		1.194	1.067–1.337

Age category is defined as follows: category 1, <60 years; category 2, ≤60 to <65 years; category 3, ≤65 to <70 years; category 4, ≤70 to <75 years; category 5, ≤75 years.
ADL indicates activities of daily living; PT-INR, prothrombin time–international normalized ratio.

TABLE 5. Risk Model of Operative Mortality

Variables	Status	Hazard Ratio	95% Confidence Interval
ASA score	Grade 4 or 5	5.248	2.735–10.07
Disseminated cancer	Present	3.458	2.514–4.757
Alkaline phosphatase	>600 IU/L	3.116	1.812–5.356
Total bilirubin	>2.0 mg/dL	2.751	1.355–5.587
Preoperative dialysis	Present	2.583	1.146–5.819
Pancreaticosplenectomy	Present	2.219	1.177–4.185
White blood cell count	>11,000/μL	2.037	1.368–3.033
Preoperative ADL	Any assistance	2.015	1.469–2.764
PT-INR	>1.25	1.880	1.292–2.737
Cerebrovascular accident	Present	1.858	1.136–3.037
ASA score	Grade 3	1.819	1.37–2.417
Ascites	Present	1.752	1.133–2.71
Respiratory distress	Present	1.719	1.139–2.594
Aspartate aminotransferase	>35 IU/L	1.685	1.252–2.266
Status	Emergent	1.656	1.031–2.662
White blood cell count	<3500/μL	1.629	1.172–2.265
Weight loss	>10%	1.584	1.185–2.119
Sodium	<138 mEq/L	1.429	1.104–1.85
Albumin	<3.5 g/dL	1.411	1.045–1.905
Albumin	<3.0 g/dL	1.353	0.974–1.88
Hematocrit	<30%	1.339	1.025–1.75
Age category		1.294	1.199–1.396

Age category is defined as follows: category 1, <60 years; category 2, ≤60 to <65 years; category 3, ≤65 to <70 years; category 4, ≤70 to <75 years; category 5, ≤75 years.

ADL indicates activities of daily living; PT-INR, prothrombin time–international normalized ratio.

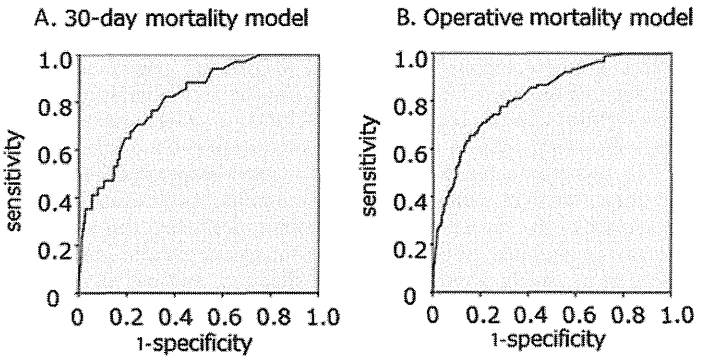

FIGURE 1. Receiver operating characteristic curves of each model. The C-index, a measure of model discrimination represented by the area under the receiver operating characteristic curve, was (A) 0.811 for 30-day mortality (95% CI, 0.744–0.879) and (B) 0.824 for overall operative mortality (95% CI, 0.781–0.866). CI indicates confidence interval.

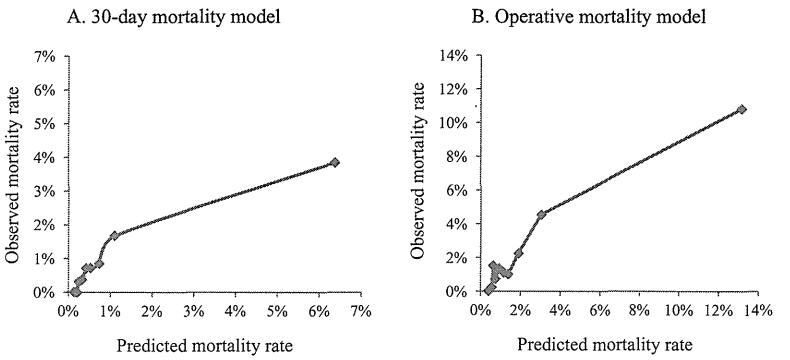

FIGURE 2. The calibration of (A) 30-day mortality model, and (B) operative mortality model.

report that mortality is similar between subtotal gastrectomy and total gastrectomy.[12,13] These results suggest that morbidity experienced after gastrectomy may depend on the extent of lymphadenectomy rather than the extent of gastrectomy. Several randomized controlled trials performed in Western countries have demonstrated that morbidity is significantly higher after D2 or greater lymphadenectomy than after D1 dissection.[15–17]

Although the operative outcomes for gastrectomy have been reported from several high-volume centers,[18] the nationwide outcomes in Japan remain unknown. The advent of the NCD enables the analysis

of these nationwide outcomes for several operative procedures, including total gastrectomy. In addition, the database allows researchers to determine interinstitutional differences in the outcomes and factors affecting these differences. Most importantly, development of a risk model using this database is expected to contribute to improved quality control for several procedures.

In this study, we observed an overall morbidity of 26.2% in NCD patients undergoing total gastrectomy. Morbidity in the aforementioned randomized trials ranged from 16.8% to 28% in the D1 groups and 33% to 46% in the D2 or greater groups.[15–17] The 30-day mortality and overall postoperative mortality rates in the NCD total gastrectomy population were 0.9% and 2.3%, respectively. Mortality rates in the other trials ranged from 1.8% to 6.5% in the D1 groups and 3.7% to 13% in the D2 or greater groups. According to a recent report conducted by the Japanese Gastric Cancer Association using a nationwide registry, D2 lymph node dissection is performed in 49.2% of patients and extended D1 dissection is performed in 20.9% of patients whereas D0 or D1 lymphadenectomy is performed in 27.2% of patients.[18] When we consider the fact that such a high percentage of patients undergo D2 lymph node dissection at many institutions, the morbidity and mortality rates for total gastrectomy are satisfactorily low in Japan.

According to our risk models, the most important variable affecting both 30-day and overall operative mortality rates is the ASA score. The ASA classification is among the most commonly used scoring systems, although it is subjective and prone to interobserver variability.[19] The ASA grade has the advantages of simplicity and of universal use[20] and is known to be an effective risk indicator when used either alone[21] or in combination with other parameters.[22,23] Other factors affecting mortality can be divided into 2 groups, with the first group including factors related to patients' general condition such as the need for preoperative dialysis and laboratory test abnormalities and the second group including variables related to tumor extension such as the presence of disseminated cancer and ascites. It is reasonable to presume that a poor preoperative general condition correlates with postoperative mortality. As an example of the impact of the second group of variables, peritoneal dissemination is a progression pattern distinctive for gastric cancer; curative resection is usually impossible in this situation, and palliative resection is often performed for symptom relief. High morbidity and mortality rates have been reported for noncurative gastric cancer surgery.[24]

In our risk model, body mass index was not a significant factor affecting the mortality. Overweight is a well-known risk of postoperative complications after gastrectomy. Tsujinaka et al[25] investigated influence of overweight on surgical complications after gastrectomy using data from Japan Clinical Oncology Group study 9501, which explored survival benefit of para-aortic D3 dissection over standard D2 dissection. They revealed that being overweight increased the risk for surgical complications in patients who underwent D2 dissection.[25] Kulig et al[26] conducted a multicenter study to evaluate the effects of overweight on surgical outcomes in a Western patient population and demonstrated that higher body mass index was associated with a higher rate of cardiopulmonary complications and intra-abdominal abscess. Despite the increase in postoperative complications in overweight patients, obesity did not affect the mortality in both studies, as observed in this study.

Preoperative treatment may also affect the occurrence of mortality after total gastrectomy. In the European countries, perioperative chemotherapy is the standard treatment approach for patients with resectable gastroesophagel cancer.[27] In contrast, postoperative chemotherapy using S-1 is the standard therapy for patients with stage II/III gastric cancer in Japan.[28] Only 4.3% and 0.1% of the NCD total gastrectomy population underwent neoadjuvant chemotherapy and radiotherapy, respectively, and therefore neoadjuvant therapy was not a significant factor affecting the mortality.

The C-indices of the models for 30-day mortality and operative mortality indicate that our models are reliable. Although the usefulness of several scoring systems, such as the Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (POSSUM)[29] and the Estimation of Physiologic Ability and Surgical Stress (E-PASS),[30,31] in predicting the risks associated with gastrectomy has been reported, these systems are not specific to Japanese patients undergoing total gastrectomy. Using our risk model results, we may be able to create a novel scoring system suitable for total gastrectomy in Japanese patients.

It is unclear whether all total gastrectomy cases all over Japan are really enrolled in the NCD. Basically, the data manager in each participating hospital is responsible for the data enrollment. However, as the NCD is linked to the surgical board certification system, we assume that almost all cases are enrolled in this system. Indeed, the number of cases in this study is almost 5 times higher than that of the nationwide registry maintained by the Japan Gastric Cancer Association.[18]

CONCLUSIONS

We have reported the first risk stratification study on total gastrectomy in Japan by using a nationwide Internet-based database. The nationwide mortality rates after total gastrectomy are quite satisfactory. We have developed risk models for total gastrectomy that will contribute to improving the quality of this procedure.

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REFERENCES

1. Siegel R, Naishadham D, Jemal A. Cancer statics, 2012. *CA Cancer J Clin.* 2012;62:10–29.
2. Bray F, Ren JS, Masuyer E, et al. Global estimates of cancer prevalence for 27 sites in the adult population in 2008. *Int J Cancer* 2013;132:1133–1145.
3. Ott K, Lordick F, Blank S, et al. Gastric Cancer: surgery in 2011. *Langenbecks Arch Surg.* 2011;396:743–758.
4. Nitenberg G, Raynard B. Nutritional support of the cancer patient: issues and dilemmas. *Crit Rev Oncol Hematol.* 2000;34:137–168.
5. Kim KM, An JY, Kim HI, et al. Major early complications following open, laparoscopic and robotic gastrectomy. *Br J Surg.* 2012;99:1681–1687.
6. Benhamiche AM, Faivre J, Tazi AM, et al. Time trends in diagnostic strategy, treatment, and prognosis of gastric cancer in the elderly: a population based study. *Eur J Cancer Prev.* 1997;6:71–77.
7. Shiloach M, Frencher SK, Jr, Steeger JE, et al. Toward robust information: data quality and inter-rater reliability in the American College of Surgeons National Surgical Quality Improvement Program. *J Am Coll Surg.* 2010;210:6–16.
8. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg.* 2004;240:205–213.
9. Roder DM. The epidemiology of gastric cancer. *Gastric Cancer.* 2002;5:5–11.
10. National Cancer Center, Center for Cancer Control and Information Services. Monitoring of cancer incidence in Japan. 2007. Available at http://ganjoho.jp/data/professional/statistics/odjrh3000000hwsa-att/mcij2007_report.pdf. Accessed November 20, 2012.
11. Feldman RA. Epidemiologic observations and open questions about disease and infection caused by *Helicobacter pylori*. In: Achtman M, Suerbaum S, eds.

Helicobacter pylori: Molecular and Cellular Biology. Wymondham, England: Horizon Scientific Press; 2001:29–51.

12. Robertson CS, Chung SC, Woods SD, et al. A prospective randomized trial comparing R1 subtotal gastrectomy with R3 total gastrectomy for antral cancer. *Ann Surg*. 1994;220:176–182.
13. Bozzetti F, Marubini E, Bonfanti G, et al. Total versus subtotal gastrectomy: surgical morbidity and mortality rates in a multicenter Italian randomized trial. The Italian Gastrointestinal Tumor Study Group. *Ann Surg*. 1997;226:613–620.
14. Davies J, Johnston D, Sue-Ling H, et al. Total or subtotal gastrectomy for gastric carcinoma? A study of quality of life. *World J Surg*. 1998;22:1048–1055.
15. Hartgrink HH, van de Velde CJ, Putter H, et al. Extended lymph node dissection for gastric cancer: who may benefit? Final results of the randomized Dutch Gastric Cancer Group trial. *J Clin Oncol*. 2004;22:2069–2077.
16. Bonnenkamp JJ, Hermans J, Sasako M, et al. Dutch Gastric Cancer Group. Extended lymph-node dissection for gastric cancer. *N Engl J Med*. 1999;340:908–914.
17. Cuschieri A, Fayers P, Fielding J, et al. Postoperative morbidity and mortality after D1 and D2 resections for gastric cancer: preliminary results of the MRC randomised controlled surgical trial. The Surgical Cooperative Group. *Lancet*. 1996;347:995–999.
18. Nashimoto A, Akazawa K, Isobe Y, et al. Gastric cancer treated in 2002 in Japan: 2009 annual report of the JGCA nationwide registry. *Gastric Cancer*. 2013;16:1–27.
19. Viste A. Predicted morbidity and mortality in major gastroenterological surgery. *Gastric Cancer*. 2012;15:1–2.
20. Sutton R, Bann S, Brooks M, et al. The Surgical Risk Scale as an improved tool for risk analysis in comparative surgical audit. *Br J Surg*. 2002;89:763–768.
21. Vacanti CJ, van Houton RJ, Hill RC. A statistical analysis of the relationship of physical status to postoperative mortality in 68,388 cases. *Anesth Analg*. 1970;49:564–566.
22. Klotz HP, Candinas D, Platz H, et al. Preoperative risk assessment in elective general surgery. *Br J Surg*. 1996;83:1788–1791.
23. Hall JC, Hall JL. ASA status and age predict adverse events after abdominal surgery. *J Qual Clin Pract*. 1996;16:103–108.
24. Mahar AL, Coburn NG, Singh S, et al. A systematic review of surgery for non-curative gastric cancer. *Gastric Cancer*. 2012;15:S125–S137.
25. Tsujinaka T, Sasako M, Yamamoto S, et al. Influence of overweight on surgical complications for gastric cancer: results from a randomized control trial comparing D2 and extended para-aortic D3 lymphadenectomy (JCOG9501). *Ann Surg Oncol*. 2007;14:355–361.
26. Kulig J, Sierzega M, Kolodziejczyk P, et al. Implications of overweight in gastric cancer: a multicenter study in a Western patient population. *Eur J Surg Oncol*. 2010;36:969–976.
27. Cunningham D, Allum WH, Stenning SP, et al. Perioperative chemotherapy versus surgery alone for resectable gastroesophageal cancer. *N Engl J Med*. 2006;355:11–20.
28. Sakuramoto S, Sasako M, Yamaguchi T, et al. Adjuvant chemotherapy for gastric cancer with S-1, an oral fluoropyrimidine. *N Engl J Med*. 2007;357:1810–1820.
29. Dutta S, Al-Mrabt NM, Fullarton GM, et al. A comparison of POSSUM and GPS models in the prediction of post-operative outcome in patients undergoing oesophago-gastric cancer. *Ann Surg Oncol*. 2011;18:2808–2817.
30. Haga Y, Ikei S, Ogawa M. Estimation of Physiologic Ability and Surgical Stress (E-PASS) as a new prediction scoring system for postoperative morbidity and mortality following elective gastrointestinal surgery. *Surg Today*. 1999;29:219–225.
31. Haga Y, Wada Y, Takeuchi H, et al. Evaluation of modified Estimation of Physiologic Ability and Surgical Stress in gastric carcinoma surgery. *Gastric Cancer*. 2012;15:7–14.

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REVIEW ARTICLE

Cancer registries in Japan: National Clinical Database and site-specific cancer registries

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Abstract The cancer registry is an essential part of any rational program of evidence-based cancer control. The cancer control program is required to strategize in a systematic and impartial manner and efficiently utilize limited resources. In Japan, the National Clinical Database (NCD) was launched in 2010. It is a nationwide prospective registry linked to various types of board certification systems regarding surgery. The NCD is a nationally validated database using web-based data collection software; it is risk adjusted and outcome based to improve the quality of surgical care. The NCD generalizes site-specific cancer registries by taking advantage of their excellent organizing ability. Some site-specific cancer registries, including pancreatic, breast, and liver cancer registries have already been combined with the NCD. Cooperation between the NCD and site-specific cancer registries can establish a valuable platform to develop a cancer care plan in Japan. Furthermore, the prognosis information of cancer patients arranged using population-based and hospital-based cancer registries can help in efficient data accumulation on the NCD. International collaboration between Japan and the USA has recently started and is expected to provide global benchmarking and to allow a valuable comparison of cancer treatment practices between countries using nationwide cancer registries in the future. Clinical research and evidence-based policy recommendation based on accurate data from the nationwide database may positively impact the public.

Keywords Cancer registry · Nationwide database · Risk factor · Risk model

Introduction

The cancer registry is an essential part of any rational program of evidence-based cancer control [1, 2]. This information can be used to monitor cancer patterns in certain regions and to formulate an effective cancer control plan [2]. In Japan, the government started promoting and supporting a cancer control plan based on the Cancer Control Act of 2006. Cancer registries in Japan are classified into three types—population-based, hospital-based, and site-specific cancer registries. Each registry plays an important role in the epidemiology, evaluation of patient care quality, and in providing clinically detailed information (Table 1); however, all three types have problems with poor standardization or incomplete follow-up [2].

The cancer control program is required to strategize in a systematic and impartial manner and efficiently utilize limited resources. The National Clinical Database (NCD) in Japan, which was launched in 2010 and commenced patient registration in January 2011, is a nationwide prospective registry linked to the surgical board certification system. The NCD systematically collects accurate data to develop a standardized surgery database for quality improvement and healthcare quality evaluation, considering the structure, process, and outcome [3]. Moreover, submitting cases to the NCD is a prerequisite for all member institutions of the surgical society, and only registered cases can be used for board certification. The NCD contains >1,200,000 surgical

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Table 1 Types of cancer registries in Japan

	Organization	Primary purpose	End point
			Epidemiological
Population-based cancer registries	Prefecture	Cancer surveillance at population level	Morbidity rate Survival rate
Hospital-based cancer registries	Hospital	Evaluation of cancer care quality	Survival rate
Site-specific cancer registries	Academic society	Collecting in-depth information	Survival rate
			Clinical

cases collected in 2011, and approximately 4,000 institutions were participating at the end of 2013. Detailed information on cancer, such as gastrointestinal, liver, pancreas, thyroid, and breast cancer is also collected in the NCD. The NCD generalizes site-specific cancer registries by taking advantage of their excellent organizing ability [4]. Some site-specific cancer registries, including pancreatic, breast, and liver cancer registries have already been combined with the NCD. Furthermore, it has also been promoted to cooperate with non-surgical fields.

Here, we summarize the current status of the NCD and site-specific cancer registries in conjunction with future perspectives for developing a cancer registration system.

Current status of the NCD

There was no nationwide clinical database for gastroenterological surgery for cancer treatment in Japan before 2006. The Japanese Society of Gastroenterological Surgery organized preliminary nationwide surveys in gastroenterological surgery in 2006 and 2007. These surveys, without using risk-adjustment techniques, indicated that hospital volume may influence the mortality rate after major gastroenterological surgery [5]. However, it was considered that upgraded analysis using risk-adjustment techniques should have been conducted to reveal the specific contribution of the variables. The NCD was established in 2010 as a general incorporated association in partnership with several clinical societies. The activities of the NCD primarily focus on providing the highest quality healthcare possible to patients and to the general public with the clinical setting serving as the driving force behind improvements [3, 4]. The NCD was developed in collaboration with the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP). The ACS-NSQIP is the first nationally validated database using web-based data collection software. It is risk adjusted and outcome based to improve the quality of surgical care [6]. Development of the NCD allows risk-adjusted analysis in Japan.

The NCD continuously recruits individuals to approve the input data from members of several departments in charge of annual cases as well as data entry officers, through a web-based data management system to assure the traceability of the data. Furthermore, the project managers consecutively and consistently validate the data by inspecting randomly chosen institutions. All variables, definitions, and inclusion criteria regarding the NCD are accessible to all the participating institutions from the website (http://www.ncd.or.jp/) and are also intended to support an e-learning system in order for participants to input consistent data. The NCD also provides answers to all queries regarding data entry (approximately 80,000 inquiries in 2011) and regularly includes some of the queries as frequently asked questions on the website.

In the gastrointestinal surgery section, all surgical cases are registered and require detailed input items for eight procedures representing the performance of surgery in each specialty (low anterior resection, right hemicolectomy, hepatectomy, total gastrectomy, partial gastrectomy, pancreatoduodenectomy, esophagectomy, and surgery for acute diffuse peritonitis). Risk models for predicting surgical outcome have been created for the mortality of each procedure [7–13]. A total of 120,000 cases collected from the eight procedures in 2011 were then analyzed in each procedure. Data were randomly assigned into two subsets that were split as follows—80 % for model development and 20 % for validation. The two sets of logistic models (30-day mortality and operative mortality) were constructed for dataset development using a step-wise selection of predictors. Potential independent variables included patient demographics, pre-existing comorbidities, preoperative laboratory values, and operative data. Furthermore, multiple significant risk factors were identified in each

procedure—age, American Society of Anesthesiologists class, respiratory distress, body mass index, platelet count, Brinkman index, etc. As a performance parameter of the risk model, the C-indices of the 30-day and operative mortality calculated from all models were >0.7; in particular, the indices of total gastrectomy [11], right hemicolectomy [9], and surgery for acute diffuse peritonitis [13] were >0.8, suggesting that the area under the receiver operating characteristics curves results were good. This is considered as proof of the efficacy and reliability of these risk models. These models could be available for participating institutes and would be useful for benchmark performance and decision making by surgeons as well as informed consent for patients. The NCD is currently planning to provide feedback on severity-adjusted clinical performance through a web-based program. Real-time feedback through the web provides an opportunity to observe changes within facilities and shifts in clinical performance [3].

The benefits of the NCD for patients include their ability to receive high-quality healthcare through the improvement of the medical service—fewer complications, shorter hospital stay, and better outcomes. Patients can also select hospitals that suit their preferences by choosing among board-certified surgeons in a relevant field. The benefits for surgeons who use the NCD include receiving better data for more targeted decision-making and disciplined reports that provide performance information useful for surgery and the ability to identify one's position among peers to allow strategic planning.

Current activities of site-specific cancer registries

The site-specific cancer registries in Japan are conducted by academic societies or research organizations specializing in cancers of different origin. Many institutes nationwide are included and collect detailed clinical information based on the general rules of the Japanese classification of cancer [2]. The first site-specific cancer registry was launched in 1952 to collect data about gynecological cancer. In the field of gastroenterological surgery, gastric cancer (1963), esophageal cancer (1965), and hepatic cancer (1965) registries were launched as pioneers in developing site-specific cancer registries; colorectal, pancreatic, and biliary cancer registries were established in the 1980s. Each registry has released the original investigation report based on the specificity of each site. In the Japan pancreatic cancer registry, >350 leading institutions voluntarily contributed their information and periodic follow-up. Several reports on the overall survival and prognostic factors of pancreatic cancer in Japan have been published. A continuous survey on pancreatic cancer could indicate that the improvement of the survival of patients with invasive cancer can be attributed to the introduction of effective chemotherapies, regionalization, and earlier diagnosis and treatment [14–16]. For instance, the Japanese Society for Cancer of the Colon and Rectum (JSCCR), a nationwide database, covers approximately 10 % of all patients with colorectal cancer in Japan [17]. The JSCCR provided important information in establishing general rules for the Japanese classification of colorectal cancer and published clinical guidelines for the treatment of colorectal cancer. It has been evaluated that the publication of the guidelines has accelerated the spread of surgical standards [18]. As described, site-specific cancer registries, which register in-depth information in contrast to population-based and hospital-based cancer registries, have played a major role in the development of the cancer treatment program.

In contrast, there are several limitations to site-specific cancer registries. First, incomplete follow-up data is a serious issue; the data collection system at the institute needs to be improved. Second, management infrastructure systems are unstable as a whole in site-specific cancer registries. Third, inadequate standardization in the registration procedure is present in these registries. Furthermore, the registration forms of each registry and even the basic parameters for cancer registration are different. As a whole, in site-specific cancer registries, the databases have a lower cover rate (number of registration/estimated morbidity) that is not a complete enumeration.

Cooperation with the NCD and site-specific cancer registries

In order to solve several problems with site-specific cancer registries, it has been planned that the NCD generalizes site-specific cancer registries. Approximately 610,000 surgical cases were registered in the NCD in one year, including approximately 220,000 cases for the treatment of malignant tumors. The cover rate (number of registration/estimated morbidity) of the NCD is higher than that of site-specific cancer registries and glanularity is higher compared with that of other registries (Fig. 1). Breast cancer registration of the Japanese Breast Cancer Society was combined with the NCD in 2012. The Japan pancreatic cancer registry was also combined with the NCD in 2012. In addition, the liver cancer study group of Japan has just transferred its registration system into the NCD. Information required for the Japanese lung cancer registry is now mostly input into the NCD. At present, the NCD not only has the role of being a surgical database but also of being a database for several cancer registries. With cooperation between the NCD and high-precision site-specific cancer registries, it should be possible to build the basic framework to evaluate healthcare quality in the cancer control plan. Moreover, by assessing the performance

of board-certified physicians for cancer treatment according to a guideline, it would be possible to identify the strategy towards the standardization of cancer treatment in Japan.

To assure the success of this cooperation, several issues should be solved. Data should be appropriately collected and should follow an exact baseline assessment. In particular, exhaustive and reliable information and a follow-up survey of a long-term prognosis are indispensable for the survival rate of cancer patients. The lack of long-term prognosis information has been an issue in site-specific cancer registries. The deviation of a participating institution and a registration case and the defect of a follow-up survey serve as bias; therefore, their influence on the interpretation of a result represents a major problem. The collection of the prognosis information in the NCD could allow the evaluation of a short-term prognosis on the basis of a 30-day postoperative outcome. A follow-up survey at 1, 5, and 10 years, based on the clinical feature of each cancer will be designed in the near future. The data quality and compatibility of the NCD are also continuously verified.

In contrast, several cancer registries and case registration systems are processed in parallel for a follow-up survey of cancer prognosis. Furthermore, the efficiency of data collection is also an important issue. Cooperation with the NCD and other cancer registries is essential to avoid inaccurate follow-up data. The government has started promoting and supporting the cancer registration plan based on the Cancer Registration Act of 2013. With this promotion and mandatory feedback to each department, prognosis information of cancer patients arranged by population- and hospital-based cancer registries can help in efficient data accumulation for the NCD. Fig. 2 shows the cooperation and integration of cancer registration systems.

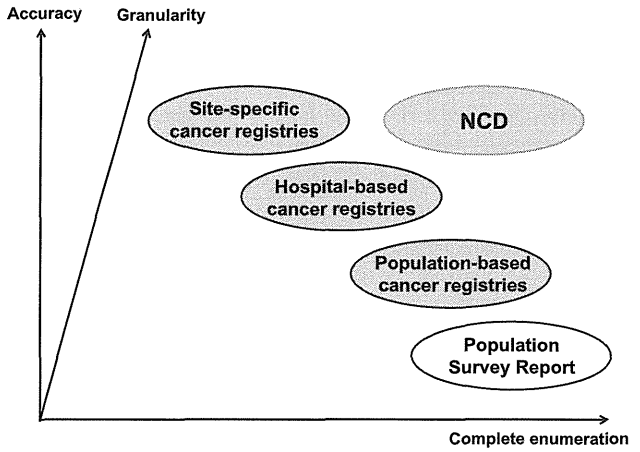

Fig. 1 Characteristics of cancer registries. Granularity and degree of complete enumeration are different among registries

Future direction of the NCD and site-specific cancer registries

The coordination of a nationwide and advanced cancer registry, such as the combination between the NCD and site-specific cancer registry could positively impact society through their activities. In order to accomplish the same, the NCD needs to make progress by continuously evaluating this database. As mentioned above, the NCD is now planning to give feedback based on a rich store of clinical data. Similarly, in the cardiac surgery field, a web-based program provides feedback on severity-adjusted clinical performance [19]. The report is prepared by highlighting the patient characteristics. By utilizing the risk model, users would be able to predict the estimated mortality through entering the system on the web. 'Surgical Risk Calculator' developed by ACS-NSQIP

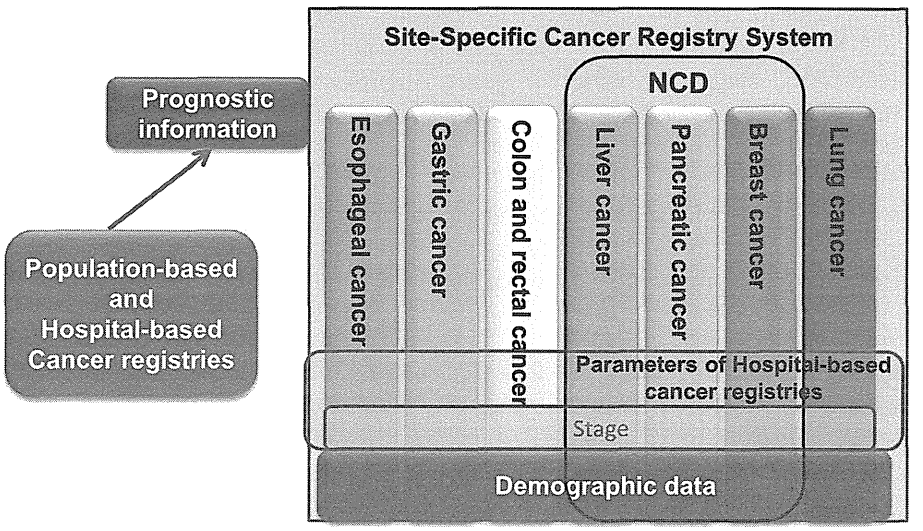

Fig. 2 Cooperation and integration of cancer registration systems. The prognostic information arranged by population-based and hospital based cancer registries are returned to the hospital which offered information. The information is then reflected through each hospital to the NCD and site-specific cancer registries

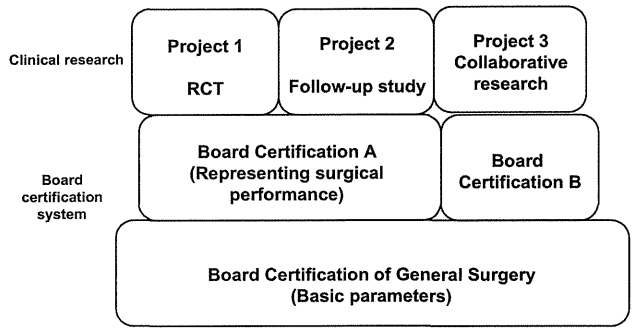

Fig. 3 Utilization possibilities for the NCD. The basic society (Japan Surgical Society) supports the basic case registration system for board certification in the NCD. It is also constituted by an individual clinical research project representing each specialized society

(http://riskcalculator.facs.org/) is a similar feedback system. Furthermore, real-time and useful feedback is essential in developing a large-scale database. For instance, ACS-NSQIP indicates that surgical outcomes improve in participating hospitals; 66 % of hospitals showed improved risk-adjusted mortality and 82 % showed improved risk-adjusted complication rates. NSQIP hospitals appear to be avoiding substantial numbers of complications, improving care, and reducing costs [20]. The NCD is a platform of databases which would allow collaboration among institutes in Japan to provide an opportunity for clinical research based on a large-scale database and to produce novel evidence (Fig. 3).

International collaboration is important to evaluate the quality of medical care and to provide meaningful improvement. However, international comparisons of general surgery and outcomes using nationwide clinical registry data have not been accomplished. There is little information on the outcomes of Japanese patients undergoing gastroenterological surgery and its comparison with those of other countries. Furthermore, the application of predictive models for clinical risk stratification has not been internationally evaluated. The NCD in Japan collaborates with the ACS-NSQIP, which shares a similar goal of developing a standardized surgery database for quality improvement. The NCD implemented the same variables used by the ACS-NSQIP to facilitate international cooperative studies, which have recently started [21]. This collaboration is expected to provide a global benchmark and to evaluate and improve clinical care by comparing the treatment practices among countries using nationwide cancer registries.

Conclusions

Cooperation between the NCD and site-specific cancer registries can establish a valuable platform to develop a cancer care plan in Japan. Studies are in progress to improve the quality control of surgical procedures using the NCD. Furthermore, clinical research and evidence-based policy recommendations from accurate data of a nationwide database may positively impact the public.

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Conflict of interest The authors declare that they have no conflict of interest.

References

1. Muir CS (1985) The International Association of Cancer Registries. The benefits of a worldwide network of tumor registries. Conn Med 49(11):713–717
2. Sobue T (2008) Current activities and future directions of the cancer registration system in Japan. Int J Clin Oncol 13(2):97–101
3. Miyata H, Gotoh M, Hashimoto H et al (2014) Challenges and prospects of a clinical database linked to the board certification system. Surg Today. doi:10.1007/s00595-013-0802-3
4. Gotoh M, Miyata H, Konno H (2014) Evolution and future of the National Clinical Database: feedback for surgical quality improvement. Nihon Geka Gakkai Zasshi 115(1):8–12
5. Suzuki H, Gotoh M, Sugihara K et al (2011) Nationwide survey and establishment of a clinical database for gastrointestinal surgery in Japan: Targeting integration of a cancer registration system and improving the outcome of cancer treatment. Cancer Sci 102(1):226–230
6. Cohen ME, Dimick JB, Bilimoria KY et al (2009) Risk adjustment in the American College of Surgeons National Surgical Quality Improvement Program: a comparison of logistic versus hierarchical modeling. J Am Coll Surg 209(6):687–693
7. Kenjo A, Miyata H, Gotoh M et al (2014) Risk stratification of 7,732 hepatectomy cases in 2011 from the National Clinical Database for Japan. J Am Coll Surg 218(3):412–422
8. Kimura W, Miyata H, Gotoh M et al (2014) A pancreaticoduodenectomy risk model derived from 8575 cases from a national single-race population (Japanese) using a web-based data entry system: the 30-day and in-hospital mortality rates for pancreaticoduodenectomy. Ann Surg 259(4):773–780
9. Kobayashi H, Miyata H, Gotoh M et al (2014) Risk model for right hemicolectomy based on 19,070 Japanese patients in the National Clinical Database. J Gastroenterol 49(6):1047–1055
10. Takeuchi H, Miyata H, Gotoh M, et al. (2014) A Risk Model for Esophagectomy Using Data of 5354 Patients Included in a Japanese Nationwide Web-Based Database. Ann Surg [Epub ahead of print]
11. Watanabe M, Miyata H, Gotoh M, et al. (2014) Total Gastrectomy Risk Model: Data From 20,011 Japanese Patients in a Nationwide Internet-Based Database. Ann Surg [Epub ahead of print]
12. Matsubara N, Miyata H, Gotoh M et al (2014) Mortality after common rectal surgery in Japan: a study on low anterior resection from a newly established nationwide large-scale clinical database. Dis Colon Rectum 57(9):1075–1081
13. Nakagoe T, Miyata H, Gotoh M, et al. (2014) Surgical risk model for acute diffuse peritonitis based on a Japanese nationwide database: an initial report of 30-day and operative mortality. Surg Today 2014 Sep 18 [Epub ahead of print]

14. Egawa S, Toma H, Ohigashi H et al (2012) Japan Pancreatic Cancer Registry; 30th year anniversary: Japan Pancreas Society. Pancreas 41(7):985–992
15. Matsuno S, Egawa S, Fukuyama S et al (2004) Pancreatic Cancer Registry in Japan: 20 years of experience. Pancreas 28(3):219–230
16. Yamamoto M, Ohashi O, Saitoh Y (1998) Japan Pancreatic Cancer Registry: current status. Pancreas 16(3):238–242
17. Konishi T, Watanabe T, Kishimoto J et al (2007) Prognosis and risk factors of metastasis in colorectal carcinoids: results of a nationwide registry over 15 years. Gut 56(6):863–868
18. Ishiguro M, Higashi T, Watanabe T, et al. (2014) Changes in colorectal cancer care in japan before and after guideline publication: a nationwide survey about D3 lymph node dissection and adjuvant chemotherapy. J Am Coll Surg 218(5):969–977.e961
19. Miyata H, Motomura N, Murakami A et al (2012) Effect of benchmarking projects on outcomes of coronary artery bypass graft surgery: challenges and prospects regarding the quality improvement initiative. J Thorac Cardiovasc Surg 143(6):1364–1369
20. Hall BL, Hamilton BH, Richards K et al (2009) Does surgical quality improve in the American College of Surgeons National Surgical Quality Improvement Program: an evaluation of all participating hospitals. Ann Surg 250(3):363–376
21. The 69th General Meeting of the Japanese Society of Gastroenterological Surgery, Special Program (2014)

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特集2　がん登録の歴史・現状・将来展望

NCDとがん登録

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National Clinical Database and cancer registry

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医療の質向上を目的とした臨床データベース事業として，2011年から外科専門医制度と連携したNational Clinical Database（NCD）が始動した。NCDは開始当初より，一部の臓器がんに対してはがんの詳細情報が登録され，2012年からは乳癌登録・膵癌登録も開始された。NCDデータは，がん診療の質を評価する指標の開発やがん医療の均てん化の取り組みなど，様々な活用が期待される。一方，がん情報の症例登録では，登録の悉皆性や予後情報の追跡調査などデータの質の担保が重要である。個人情報保護や倫理的側面に配慮したうえで，他のがん登録との連携も見据えたデータ収集の効率化を検討している。さらに，医療現場にリアルタイムで直接情報をフィードバックする仕組みを構築し，患者の術後死亡や合併症の予測率を計算する機能の開発や，NCDデータを基盤とした臨床研究などにも取り組んでいる。NCDは患者視点に立ち，医療従事者が理解・納得して参加できる事業として，さらに発展を目指している。

***Key words*：** National Clinical Database（National Clinical Database），がん登録（cancer registry），医療の質（quality improvement initiatives）

はじめに

医療の質向上を目的とした臨床データベース事業として，2011年から外科専門医制度と連携したNational Clinical Database（以下，NCD）が始動した。NCDでは，症例登録の開始当初より，一部の臓器がんに対してはがんの詳細情報が登録され，2012年からは乳癌登録・膵癌登録も開始された。とくにがん患者の症例登録においては，症例登録の悉皆性や予後情報の追跡調査が重要である。これらの情報を用いて，医療の均てん化や治療成績の比較など，臨床へ有用な情報として可視化することができる。またNCDでは，臨床現場に直接情報をフィードバックする仕組み作りに取り組んでいる。本稿では，NCDとがん登録の概略，症例登録の悉皆性や追跡調査について，NCDにおけるデータの活用事例を紹介する。

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1．NCDとがん登録

（1）　NCDとは

患者の視点に基づいた良質な医療を根拠に基づいて提供するため，医療の質向上を目的として，2011年から外科専門医制度と連携したNCDが開始された（http://www.ncd.

表1． NCDに参加している専門領域と主体組織（2013年12月時点）

専門領域	がん情報を収集しているがん	主体組織
外科		日本外科学会
消化器外科／肝胆膵	食道癌，胃癌，膵癌，肝癌，大腸癌，胆嚢癌など	消化器外科領域については，次の学会が「消化器外科データベース関連学会協議会」を組織して，NCDと連携する：日本消化器外科学会，日本肝胆膵外科学会，日本食道学会，日本胃癌学会，大腸癌研究会，日本肝癌研究会，日本膵臓学会，日本内視鏡外科学会，日本腹部救急医学会
乳腺	乳癌	日本乳癌学会
小児外科		日本小児外科学会
心臓血管外科		日本胸部外科学会，日本心臓血管外科学会，日本血管外科学会
内分泌・甲状腺外科	甲状腺癌，副甲状腺癌など	日本内分泌外科学会，日本甲状腺外科学会
呼吸器外科		日本胸部外科学会，日本呼吸器外科学会
膵癌登録	膵癌	日本膵癌学会
CVIT*1		一般社団法人 日本心血管インターベンション治療学会
JPIC*2		日本 Pediatric Interventional Cardiology 学会

*1 CVIT：Japanese Association of Cardiovascular Intervention and Therapeutics
*2 JPIC：Japanese Society of Pediatric Interventional Cardiology

or.jp/)[1]。NCDは，臨床現場が主体となって運営する臨床データベース事業としてはじまり，参加施設は約4,000施設で（2013年11月現在），年間約120万件のデータが蓄積されている。NCDは外科共通項目を基本として，専門領域ごとに詳細な入力項目が設計されている。

がんの詳細な情報は，NCD開始当初より，消化器外科，乳腺，内分泌・甲状腺外科領域で蓄積されている。また臓器がん登録は，2012年より乳癌登録・膵癌登録がNCDへシステムを移行し，現在，内科領域の連携も行っている(**表1**)。さらに消化器外科領域でも，NCDでの臓器がん登録の構築について検討中である[2]。

（2） がん患者の症例登録

がん対策については，WHOも国家的ながん対策プログラムの推進を提唱しており，根拠に基づいた戦略を系統的，かつ，公平に実行し，限られた資源を効率よく最大限に活用することが求められている。詳細な臨床情報をベースにした症例登録では，症例の臨床病理学的な特徴や治療法，治療成績，および，これらの推移など，診療実態を正確に把握することが可能で，重要な基礎情報となる。このような情報を用いて，がん診療の質を評価する指標の開発やがん医療の均てん化の取り組みも可能となる。例えば，患者背景の違いや診断治療方針について全国平均と各施設の差異を把握し，それによって全体としての医療の質向上につながると期待される。また，診療ガイドラインの基礎情報，臨床研究や医療政策などの基礎データとして，様々な活用が期待されている[3～5]。

本節では，NCDで行われている取り組みの1例を紹介する。

内分泌・甲状腺外科領域では，甲状腺・副甲状腺・副腎の腫瘍に対する手術症例について，詳細情報の登録が可能である。例えば甲状腺癌では，腫瘤の大きさやTNM分類，Stage，切除範囲などである。消化器外科領域では，食道・胃・膵臓・肝臓・大腸・胆嚢など腫瘍に対して詳細情報が登録されており，後述するリスクモデルの開発や海外との連携が進んでいる。

乳癌登録は，日本乳癌学会で2004年から行われている臓器がん登録で，従来のデータベースからNCDへ移行する形でデータベースを構築した。乳癌登録の追跡調査は5年後・10年後・15年後の予後調査で行われ，これまでの蓄積データに対する患者追跡調査を継続して行うため，NCDへ従来のデータを移行する準備も進んでいる。膵癌登録は，日本膵癌学会で1981年から行われている臓器がん登録で，乳癌登録と同様に，従来のデータベースからNCDへの移行により，継続したデータ収集を行っている。

2．データの質の担保（登録の悉皆性，予後情報の追跡調査）とデータ収集の効率化への取り組み

医療の質向上には的確な現状把握が必要で，そのためには正確にデータを収集しなくてはならない。とくに，がん患者の生存率の推定には，登録症例の悉皆性と長期予後の追跡調査が必須となる。長期予後情報の追跡漏れは臓器がん登録としても課題となっており，各臓器によって追跡のばらつきが指摘されている[6]。参加施設の偏りや登録症例の偏り，追跡調査の不備はバイアスとなり，結果の解釈への影響が大きい。

NCDにおける予後情報の収集は，まず術後30日時点までの術後評価を基本とし，これにより，短期的な予後のアウトカム評価が可能となっている。さらに，専門領域ごと

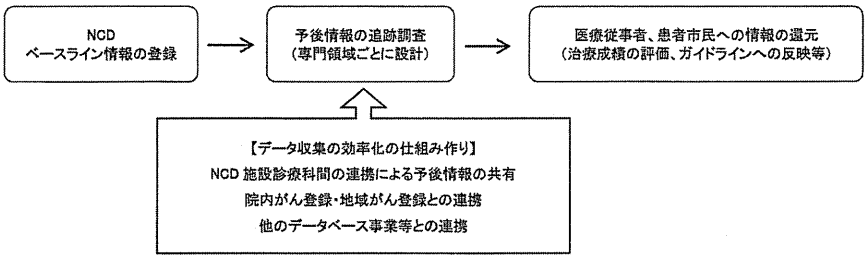

図1． 予後情報の追跡調査とデータ収集の効率化

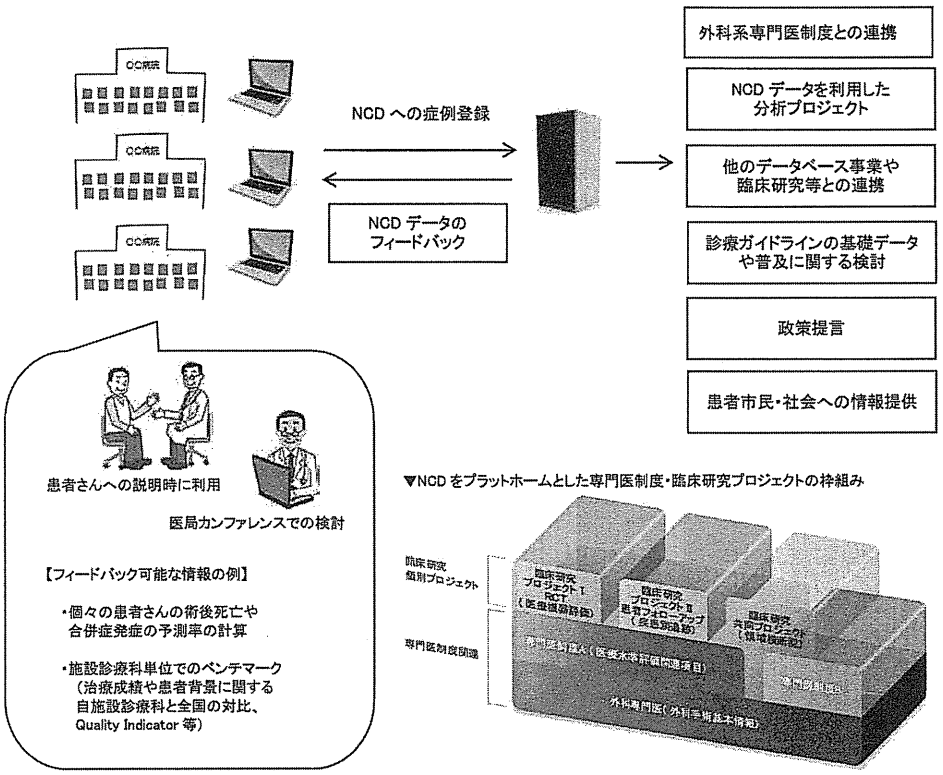

図2． NCDデータの活用事例

に各がんの臨床的な特徴をふまえた追跡調査が設計され，1年後・5年後・10年後といった長期的な予後情報の収集が計画されている。またNCDは，施設のカバー率・症例のカバー率ともに，高い水準で，悉皆性の高いデータベースであることが期待されているが，本来期待される母集団と，実際の登録症例の乖離がどのように・どの程度あるかは，結果の一般化可能性に直接影響する。NCDではデータの質や整合性の検証にも取り組んでおり，今後も継続した検証が必要である。

一方で，予後情報の追跡調査に関しては，複数のがん登録や症例登録事業が並行して行われているため，データ収集の効率化への取り組みも重要な課題である。NCDはオプトアウトで予後情報の収集も行うこととなるが，データ収集の効率化のためには，施設間連携や行政データとの連携，地域がん登録・院内がん登録との連携が今後重要となる(**図1**)[7]。個人情報保護や倫理的側面に十分配慮したうえで，がん登録法やマイナンバー制度の導入など，昨今の社会の動きにも対応した形で，今後も発展的にシステム開発や運用面での検討を行う予定である。

3．NCDにおける臨床現場へのフィードバックの取り組みとデータの利活用(図2)

NCDでは，蓄積されたデータを活用した臨床現場へのフィードバックに取り組んでいる。NCDはインターネットを介した登録を行っており，同じインフラを利用して，次のような情報を臨床現場に直接フィードバックする仕組みを構築中である。

① 術後死亡や合併症発症の予測値の計算機能

臨床データベースでは，患者さんの背景情報以外に，アウトカム情報（例：生存状況，術後合併症，がんの再発・

転移など）も蓄積される。これらの情報から，患者さんの予後に影響するリスク因子の特定と，それに基づくリスクモデルの開発が可能となる。術前情報を用いて，臨床的・統計的観点から死亡や合併症の発症に影響するリスク因子を検討する。そして，各リスク因子が死亡や合併症の発症に寄与する大きさを推定し，術式ごと・アウトカムごとにリスクモデルを開発する。例えば消化器外科領域では，胃全摘術や肝切除術など，８つの医療水準評価対象手術でリスクモデルが検討されている[８]。このようなリスクモデルは，がんの部位別に構築することが可能であるが，リスクモデルの構築にはnational-wideのデータが必要となる。そのためには，NCDのような全国規模での詳細な患者情報・アウトカム情報の収集が不可欠である。

リスクモデルを活用した臨床へのフィードバックの例としては，NCD症例登録画面から術前情報などを入力すると，患者さんの死亡率などの予測値を計算して表示することができる。この情報は，患者さん・家族への説明や医局カンファレンスで利用することができる。また同様の機能は，例えば海外では，米国外科学会のAmerican College of Surgeons National Surgical Quality Improvement Program（ACS NSQIP）で，“Surgical Risk Calculator”としてwebsiteで公開されている（http://riskcalculator.facs.org/）。

② 施設診療科ごとのベンチマーキング

大規模臨床データベースの特徴として，治療成績や症例数を自施設と全国で比較しながら，自施設の特徴を把握することが可能となる。全体としての均てん化のためにも，まずは医療現場で，医療従事者が自ら，継続的に，現状を直接把握することは重要である。臨床データベース事業に医療機関が参加することで，医療の質向上が期待されることも明らかとなっている[９]。ただし，単純な比較ではバイアスが生じるため，前項のリスクモデルを用いたリスク調整済の死亡率をフィードバックするなどを考慮している。その他にも，Quality Indicator（QI）を施設診療科ごとに算出し，各医療機関で自施設の傾向を把握することも可能である。とくにQIによるリアルタイムなモニタリングは米国で普及しており[10]，日本でもがん登録のさらなる活用が期待される。

またNCDは，データベースのプラットホームとしての役割も有している。データを利用したデータ分析や，臨床データベースを基盤とした臨床研究も可能で，エビデンスの創出にも取り組んでいる[11]。さらに，海外の臨床データベース事業との連携も行われており，例えば，日本心臓血管外科データベースでは胸部外科学会，消化器外科領域ではACS NSQIPが連携している。このような連携によって国際比較が可能となるよう，データベースの設計段階から入力項目や定義が検討されている。国際比較によって，治療成績の比較のみならず，治療対象患者の背景の違いや治療法の適応の違いなども検討が可能となる。

おわりに

NCDは，医療の質向上のための臨床データベースとして，患者視点に立ち，医師をはじめとした医療従事者が理解・納得して参加できる事業を目指して取り組んでいる。とくにがん領域では，がん対策推進計画でもアウトカム評価の検討がはじまっており，NCDをプラットホームとしたデータの蓄積は，ますます重要になると考えられる。一方で，データ集積には，NCD全参加施設の医療従事者の協力なくしては成り立たず，データ入力の効率化に今後も継続的に取り組む必要がある。そのうえで，臨床データベース事業を通じて，さらに医療現場へのフィードバックや社会への情報還元をより強化し，がん医療の質をさらに高めていくことが期待される。

謝　辞

NCDの全参加医療機関ならびに医療従事者の皆様に感謝申し上げます。

【文　献】

1. 岩中　督：厚生労働科学研究費補助金　厚生労働科学特別研究事業．外科全手術症例登録とその解析のための学会間ネットワーク構築に関する研究　平成22年度～23年度　総合研究報告書．厚生労働省，東京，2012
2. 後藤満一：厚生労働科学研究費補助金　がん臨床研究事業．精度の高い臓器がん登録による診療ガイドラインや専門医育成への活用に関する研究　平成24年度　総括・分担研究報告書．厚生労働省，福島，2013
3. 友滝　愛，宮田裕章，大久保豪他：臨床データベースを用いた研究　現状と方法　臨床データベースの利活用．胸部外科　66：919-924，2013
4. 猪飼伊和夫，工藤正俊：消化器癌治療成績のさらなる向上に向けて　臓器がん登録の現状と将来展望―臨床へのフィードバックを目指して―肝癌．外科治療　102：372-377，2010
5. 飯島耕太郎，岩瀬拓士：消化器癌治療成績のさらなる向上に向けて　臓器がん登録の現状と将来展望―臨床へのフィードバックを目指して―乳癌．外科治療　102：387-394，2010
6. 東　尚弘，祖父江友孝，西本　寛：臓器がん登録の現状―臓器がん登録の実態についての調査報告―．外科治療　104：169-176，2011
7. 国武健二郎，後藤満一：特集　がん関連データベース，その特徴と今後の展開．４．臓器がん登録の今後の展開．Surg Fronti 19：31-35，2012
8. 後藤満一，宮田裕章，杉原健一他：特集　がん関連データベース，その特徴と今後の展開．１．NCD登録データから

把握できる消化器がん外科治療成績. Surg Fronti 19：13-18, 2012
9. Hall BL, Hamilton BH, Richards K, et al.: Does Surgical Quality Improve in the American College of Surgeons National Surgical Quality Improvement Program: an evaluation of all participating hospitals. Ann Surg 205: 363-376, 2009
10. Schneider EC, Malin JL, Kahn KL, et al.: Developing a System to Assess the Quality of Cancer Care: ASCO's National Initiative on Cancer Care Quality. J Clin Oncol 22: 2985-2991, 2004
11. 友滝　愛, 宮田裕章, 大久保豪他：臨床試験のヒストリカルコントロール群として既存のデータベースを利用するためのプロセスとデータ収集効率化の検討：日本成人心臓血管外科手術データベースの利用. 日心臓血管外会誌　41：1-7, 2012

日外会誌 115 臨時増刊号 (3)：44-46, 2014

第114回日本外科学会定期学術集会記録
第12回臨床研究セミナー **第3部 外科臨床研究の実践**

NCDを用いた外科臨床研究の実践

(2014年4月5日受付)

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1. はじめに

2011年1月より各外科系学会が連携し「National Clinical Database (以下, NCD)」大規模データベースシステムが始動し, 全国で行われる外科治療の詳細が登録されるようになった. 現在, 登録開始から3年足らずであるが, すでにNCDには膨大な症例数が蓄積されており, 諸学会においてNCDデータを利用したいくつかの臨床研究やデータ解析が行われつつある. 日本外科学会臨床研究推進委員会は, 基盤学会としてNCDを用いた臨床研究として「肥満が手術に及ぼす影響に関する全国調査」に取り組むこととなった. 本研究は日本消化器外科学会ならびに日本心臓血管外科学会 (JCVSD) の協力をえることにより, 複数領域における検討が可能となった. 本稿ではその概要を報告する.

2. 目 的

肥満人口が増加した近年において, 肥満患者外科手術の現状把握とリスク評価を行う必要性は大きく, 全国規模での研究調査を行うことは重要な社会的意義を持つものと考えられる. そこで, 全国の外科治療情報が登録されるNCDのデータを用いて, 肥満が外科手術に与える影響を明らかにすることが本研究の目的である.

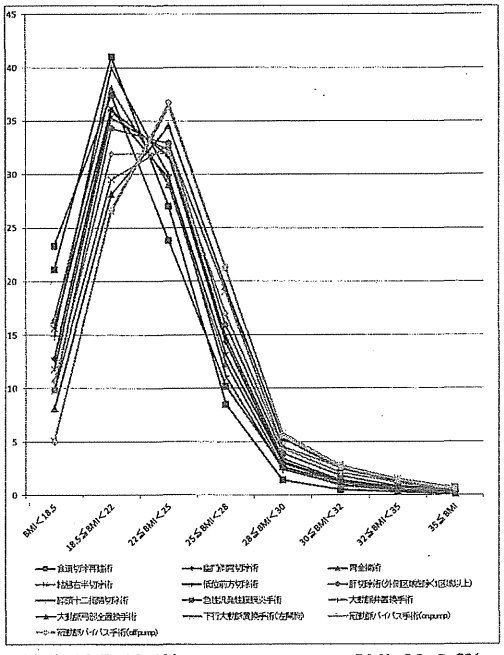
3. 研究方法

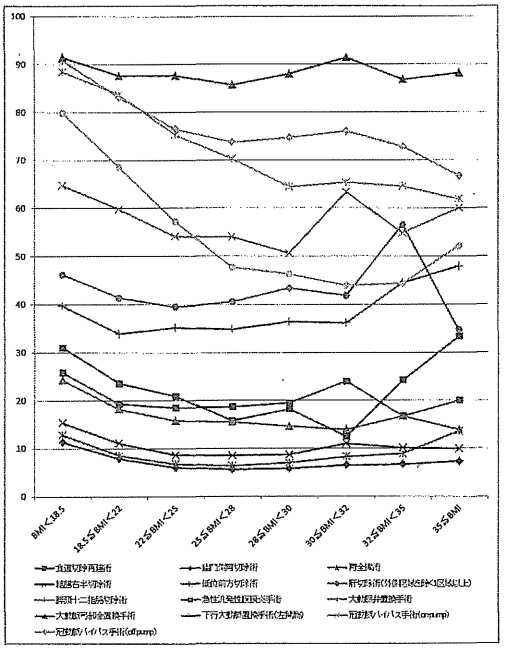
本研究は, 2011年1月より症例登録が開始されたNCDのデータを用いた後ろ向き検討である. 2011年1月～2012年12月までの2年分のデータを用い, 対象は患者体型情報を含んでいる消化器外科, 心臓血管外科の2領域の一部の術式とした. 消化器外科領域は食道切除再建術10,850例, 幽門側胃切除術63,878例, 胃全摘術37,913例, 結腸右半切除術37,903例, 低位前方切除術33,334例, 肝区域切除術 (外側区域を除く1区域以上) 14,945例, 膵頭十二指腸切除術17,544例, 急性汎発性腹膜炎手術16,706例, 心臓外科領域は大動脈弁置換手術14,835例, 大動脈弓部全置換手術10,595例, 下行大動脈置換手術 (左開胸) 5,606例, 冠動脈バイパス手術 (人工心肺有り) 9,224例, 冠動脈バイパス手術 (人工心肺無し) 15,979例の総計13術式, 289,312例に対して解析を行った.

NCDデータの使用項目は, 患者体型(身長・体重), 手術時間, 術中輸血の有無, 30日死亡, 周術期死亡を抽出データとして使用した. 肥満の指標としてBMIを用い, BMIを階層化し各術式において, BMIと手術時間, 術中輸血の有無, 30日死亡, 周術期死亡の関係を検討した.

4. 結 果

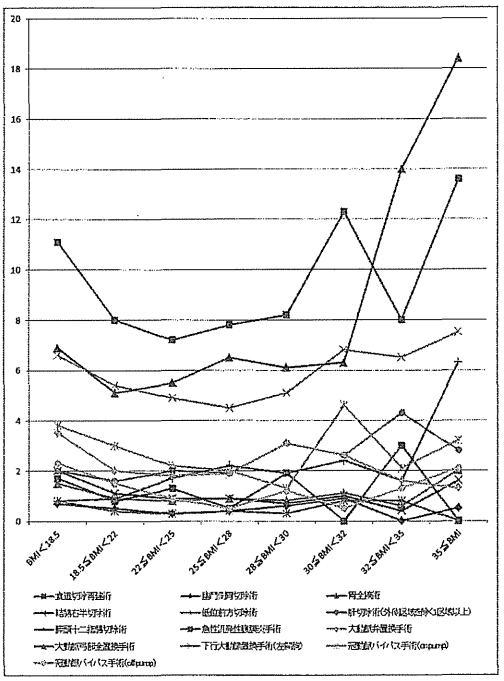
BMI分布, 輸血率, 30日死亡 (%), 手術時間 (分) をそれぞれ図1, 2に示す. BMI別の死亡率では, 総じて「痩せ」と「高度肥満」において高値を示すという, U字型の分布がみられた. 手術時間については, すべての術式においてBMIの上昇と共に延長する傾向がみられた. しかし,「痩せ」ではすべての術式で手術時間の短縮を認めたが, 食道切除再建術や胃全摘術等では, 超高度肥満症例で手術時間が逆に短くなるといった傾向を認めた. BMIのcut off値を30とすると, 食道切除再建術以外のすべての術式で手術時間は有意に延長していた (表1).





BMI<18.5: 13.4%　　BMI>30: 2.6%

図　1



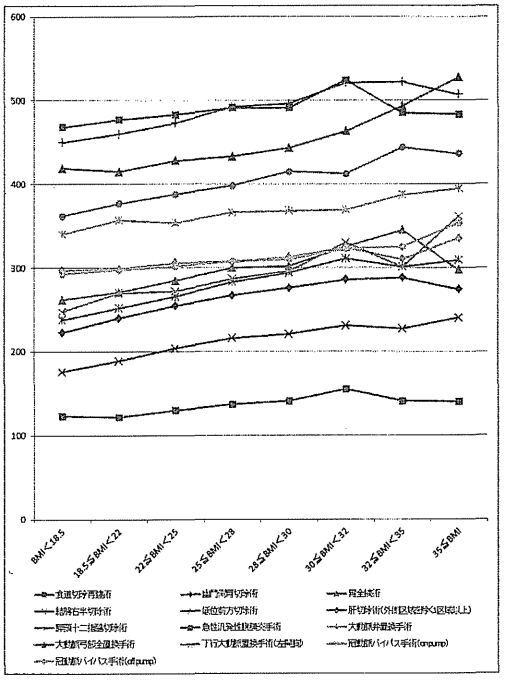


図　2