Masaki Kitajima

OECD- APEC-WASEDA UNIVERSITY JOINT CONFERENCE

PART I
12-13 SEP, 2012
OECD WORKSHOP
ANTICIPATING THE SPECIAL NEEDS OF THE 21ST CENTURY SILVER ECONOMY: FROM SMART TECHNOLOGIES TO SERVICES INNOVATION
Critical factors for a Healthy Ageing Society in Japan

Future Strategies of Minimally Invasive and Individualized Surgery for GI Tract Cancer

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International University of Health and Welfare (IUHW)

Professor Emeritus
Keio University School of Medicine
Population pyramids of Japan

1950

2000

2050
Gastric cancer treated in 1991 in Japan: data analysis of nationwide registry

8851 patients with primary gastric cancer treated in 1991

Early gastric cancer: 48.8%

Table 12. Depth of invasion (resected cases)

<table>
<thead>
<tr>
<th>categories</th>
<th>total number</th>
<th>direct death</th>
<th>lost f.u.</th>
<th>1 yr (%)</th>
<th>2 yr (%)</th>
<th>3 yr (%)</th>
<th>4 yr (%)</th>
<th>5 yr (%)</th>
<th>5% s.d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mucosa (M)</td>
<td>2209</td>
<td>4</td>
<td>118</td>
<td>98.0</td>
<td>96.6</td>
<td>95.2</td>
<td>94.0</td>
<td>92.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Submucosa (SM)</td>
<td>1662</td>
<td>11</td>
<td>118</td>
<td>96.0</td>
<td>93.7</td>
<td>90.8</td>
<td>89.3</td>
<td>87.6</td>
<td>1.7</td>
</tr>
<tr>
<td>Muscularis (MP)</td>
<td>817</td>
<td>6</td>
<td>58</td>
<td>93.9</td>
<td>87.8</td>
<td>83.7</td>
<td>81.2</td>
<td>78.4</td>
<td>2.9</td>
</tr>
<tr>
<td>Subserosa (SS)</td>
<td>1136</td>
<td>21</td>
<td>86</td>
<td>84.2</td>
<td>71.0</td>
<td>62.5</td>
<td>58.4</td>
<td>55.4</td>
<td>3.0</td>
</tr>
<tr>
<td>Serosa (SE)</td>
<td>1590</td>
<td>29</td>
<td>129</td>
<td>70.0</td>
<td>50.6</td>
<td>41.7</td>
<td>36.1</td>
<td>33.2</td>
<td>2.5</td>
</tr>
<tr>
<td>Adjacent structures (SI)</td>
<td>520</td>
<td>10</td>
<td>39</td>
<td>48.3</td>
<td>27.6</td>
<td>21.0</td>
<td>17.7</td>
<td>15.9</td>
<td>3.4</td>
</tr>
</tbody>
</table>
Gastric cancer treatment in Japan: 2008 annual report of the JGCA nationwide registry

12004 patients with primary gastric cancer treated in 2001

Early gastric cancer: 51.2%

<table>
<thead>
<tr>
<th>Table 13</th>
<th>Survival outcomes by depth of invasion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of patients</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>pt1(M)</td>
<td>3071</td>
</tr>
<tr>
<td>pt1(SM)</td>
<td>2662</td>
</tr>
<tr>
<td>pt2(MP)</td>
<td>1071</td>
</tr>
<tr>
<td>pt2(SS)</td>
<td>1695</td>
</tr>
<tr>
<td>pt3(SE)</td>
<td>2278</td>
</tr>
<tr>
<td>pt4(SI)</td>
<td>417</td>
</tr>
</tbody>
</table>
Trends of surgical management

• The 20th Century
  Radical surgery for locally advanced disease
  Establishment of standard procedures

• The 21st Century
  Individualized management
  Less invasive approach
Keywords in Surgical Treatment

Minimally invasiveness

Individualization
Surgical Treatment of Esophageal Cancer —
The Advent of the Era of Individualization ... 1705

M. Kitajima and Y. Kitagawa
The prediction by Yukichi Fukuzawa
Laparoscopic surgery for gastric cancer developed in 1992

1 mucosal cancer
2 IIa \leq 25\text{mm}
3 IIc \leq 15\text{mm, ul(—)}

Lesion Lifting (Ohgami’s method)

Intragastric Mucosal Resection
Laparoscopic wedge resection of the stomach (Ohgami’s method)
Laparoscopy-Assisted pylorus preserving Gastrectomy - Presevation of the infra-pyloric vessels -
Two major factors of minimally invasive surgery for gastric cancer

- Early phase recovery
  - Laparoscopic surgery

- Late phase QOL
  - Organ and function preserving surgery
How to reduce the extent of lymph node dissection and extent of resection.

- To establish sensitive method to detect lymph node micro-metastasis

Sentinel node navigation surgery
Sentinel Node Concept in Esophageal Cancer
Radio-guided method

Hand-held gamma probe

Cancer Cell

Technetium tin colloid
500 nm
Sentinel Node Navigation Surgery for cN0 Esophageal Cancer
Sentinel Node Navigation Surgery for cN0 Esophageal Cancer
Sentinel Node Navigation Surgery for cN0 Esophageal Cancer
Robotics in Surgery
Harmonization of Medicine and Engineering in Boston
Obstacles in Laparoscopic Surgery

- Lack of degree of freedom (DOF)
- Lack of tactile sensation
Development of Head Mount Display

3-Dimensional Laparoscope
Solution for lack of DOF

-Surgical Robot-

Master–slave manipulator
(da Vinci)

March 2000: Keio University School of Medicine

International University of Health & Welfare
Solution for lack of DOF

-Surgical Robot-

Master–slave manipulator (da Vinci)

March 2000: Keio University School of Medicine

International University of Health & Welfare
Problems and limitations of master–slave manipulator

1. Huge and complicated
2. Conflict of robotic arm
3. Limited operative field
4. Cost
5. Lack of tactile sensation
Robotics – Manipulator type
Problems and limitations of master–slave manipulator

1. Huge and complicated
2. Conflict of robotic arm
3. Limited operative field
4. Cost
5. Lack of tactile sensation
A problem caused by lack of tactile sensation
Overview of Haptic Forceps in Bilateral Control
Haptic Forceps in Bilateral Control
The surgeons said “This is something hard, like a metal.”
Bilateral teleoperation experiment over internet communication
(Japan – Slovenia)

10000 km

Protocol: TCP/IP

Master manipulator

Slave manipulator

“telesensation”

Open experiment of haptic forceps

Keio Univ.
Sch. of Med.

Faculty of Tech. K2

2004. 9.25
Cooperative Telesurgery System

- Teleoperation of Laparoscope
- Telementoring with annotation

Wide-Ether®
70 Mbps

High Quality Video Transportation (DVTS*)

Keio University Hospital

ImagTrac®

National Tokyo Medical Center

*DVTS: Digital Video Transport System
Cooperative Telesurgery
Keio Univ. ——— Tokyo Med. Ctr.
March 25, 2004
Japan commons for manufacturing by medicine-engineering collaboration

The platform that enable people from medical fields, industrial circles and government service encounter with each other.
Japan commons for manufacturing by medicine-engineering collaboration

The Japan Society of Mechanical Engineers
The Institute of Electrical Engineers of Japan
The Japan Society for Precision Engineering
Japanese Society for Medical and Biological Engineering
Japan Society of Computer Aided Surgery
Japan Society for Endoscopic Surgery
Japanese Society for Artificial Organs
The Society of Instrument and Control Engineers
The Robotics Society of Japan
The Society of Life Support Engineering
NPO Japanese Society of Biorheology
REDEEM
Medical Engineering Technology Industrial Strategy Consortium
The Japan Federation of Engineering Societies
Science Council of Japan
American College of Surgeons
Thank you for kind attention!!