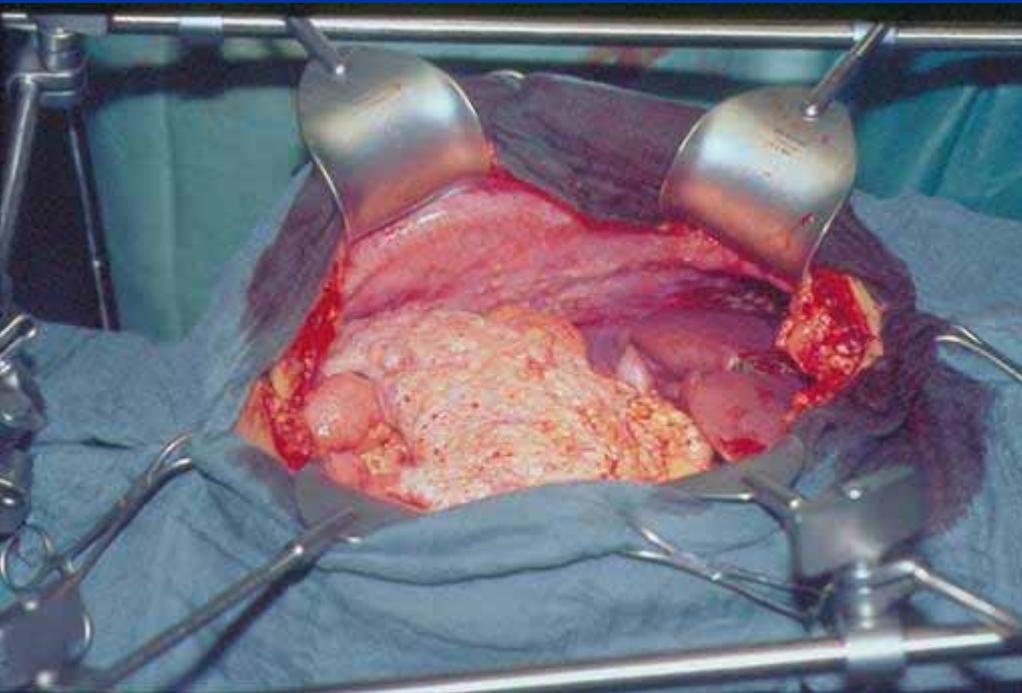


Peritonectomy plus hyperthermic peritoneal perfusion for the treatment of peritoneal carcinosis



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cytoreduction

Cytoreductive surgery means a complete removal of all visible tumors into the peritoneal cavity. It requires peritonectomy procedures eventually associated with multiple intestinal and/or organ resection.

The present knowledge of cell-kill kinetics with cytotoxic drugs indicates that, due to a larger proportion of cell growth fraction, micrometastases are more susceptible to chemotherapy than macroscopic ones, so that cancer cells free in the peritoneal cavity represent an ideal target of a locoregional treatment consisting in a high concentrated administration of cytotoxic drugs under hyperthermic conditions.

Operative steps of cytoreductive surgery

- electrosurgery for tumor resection
- peritonectomy
- hyperthermic intraperitoneal chemotherapy
- reconstruction
- early postoperative intraperitoneal chemotherapy

prerequisites for cytoreductive surgery

apparatus

- perfusion unit
- hyperthermia unit
- Thompson- Retractor
- smoke evacuator
- electrosurgical device
- effective intraoperative warming management
- trained intensive care unit

surgery

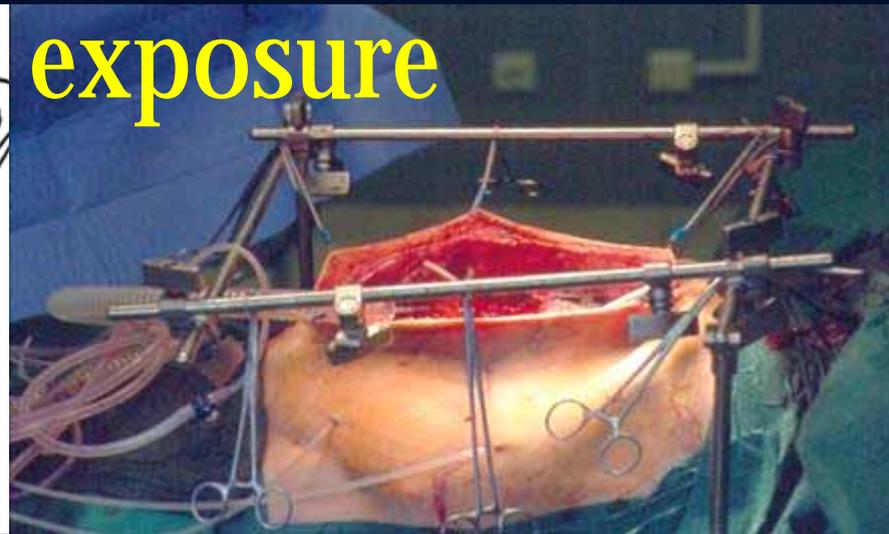
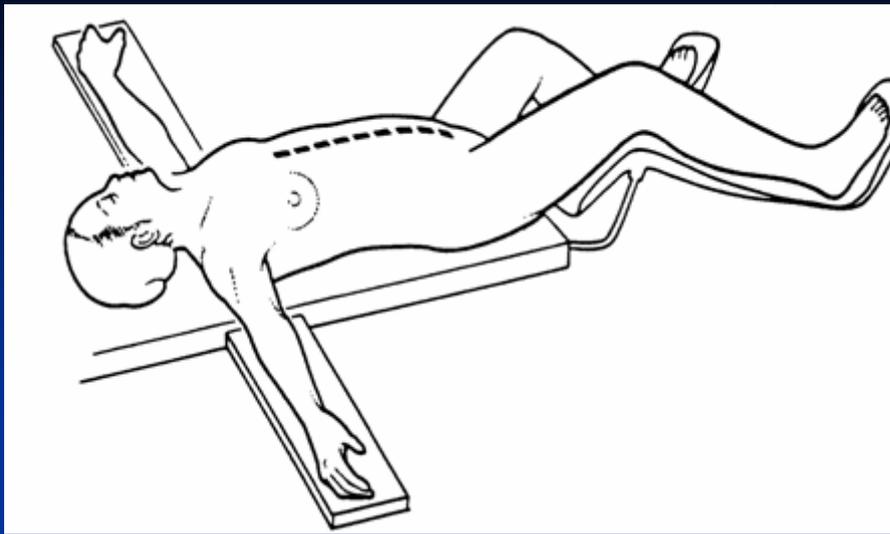
- anatomical correct preparation
- centripetal surgery
- strategy to prevent blood loss (splenectomy first)
- liberal use of anus præter
- no pre-operative heparinization

peritonectomy

- This fundamental technique requires the removal and stripping of all tumor involving the parietal and visceral peritoneum.
- Small cancer deposits found on the visceral peritoneum, especially the surface of tubular structures, are individually electroevaporated.
- Large tumor nodules on the small bowel must be resected and all visible tumors must be removed to maximize the benefits of perioperative intraperitoneal chemotherapy.

electrosurgical dissection

- Intra-abdominal dissection is facilitated by electro-evaporative surgery using a 0.3 cm ball-tipped diathermy.
- The electrosurgical generator is set at very high voltage between 200-250 MW.
- A maximal pure cut that evaporates the tissues on contact is used for dissection; it minimizes blood loss from small vessels up to 1.5 mm in diameter.
- Larger vessels are electrocoagulated or ligated in continuity and divided.
- Heat damage can be reduced by a frequent intermittent saline irrigation at the site of dissection.
- Heat necrosis at the tumor' s margin of resection could reduce the likelihood of cancer dissemination and local recurrence.

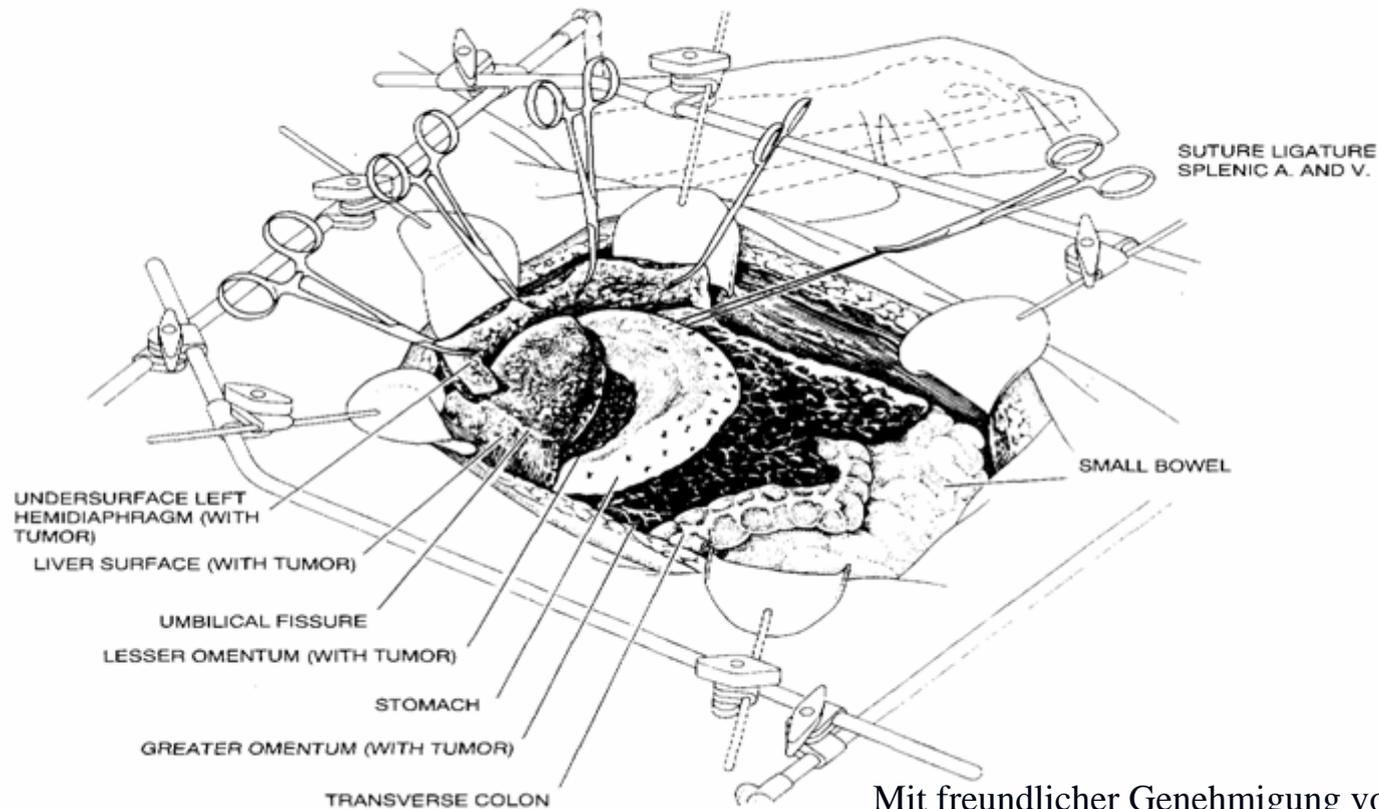


exposure

- A vertical incision is made from the xiphoid to the symphysis pubis to allow maximum exposure.
- The xiphoid is usually excised.
- During re-operation excision of old surgical scars from the skin to the peritoneum including the umbilicus, reduces the risk of recurrence at the sites of operation
- The Thompson self-retaining retractor improves the exposure, and multiple angles of retraction can be applied to gain maximum exposure for peritonectomy.

centripetal surgery

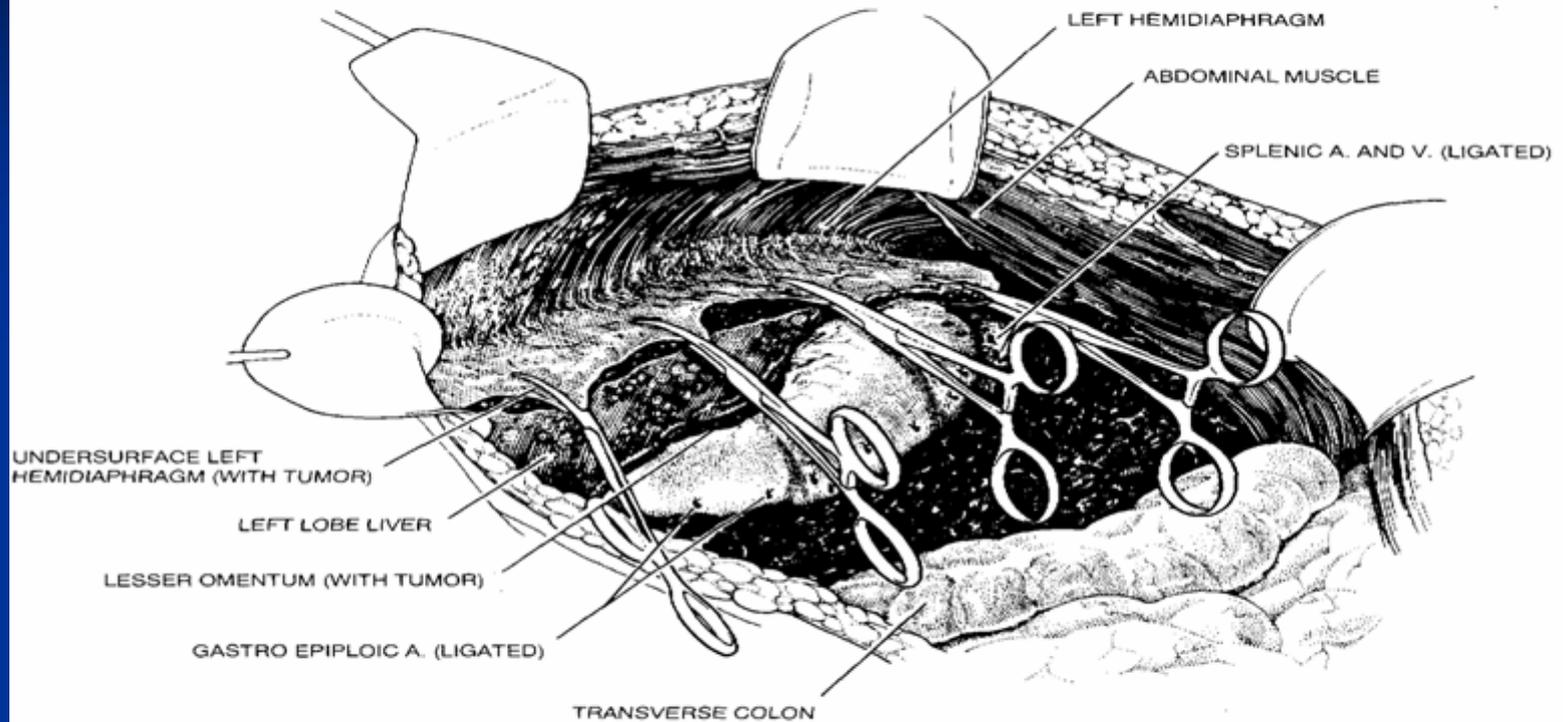
- Peritoneal stripping begins at the furthest extent of the tumor and proceeds towards the deepest extent of the tumor and the major vessels.
- This centripetal surgery combines as many as six peritonectomy procedures into a single coordinated effort.
- It is necessary to allow optimum clearance and containment of the tumor with minimal bleeding and no damage to vital structures.
- Care is taken to preserve the abdominal rectus muscle during peritonectomy but the posterior rectus sheath may be sacrificed.



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peritonectomy procedures

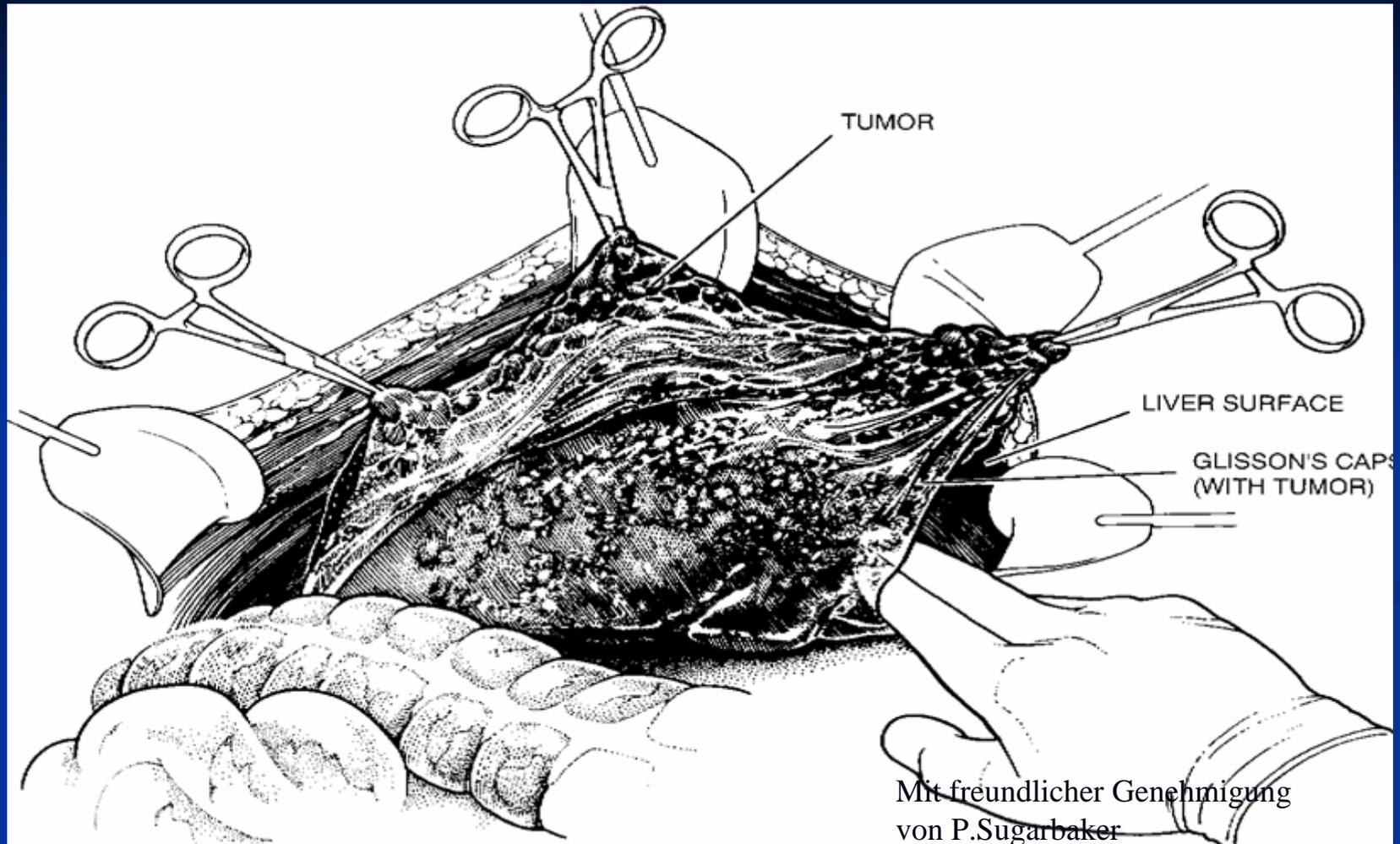
- omentectomy plus splenectomy



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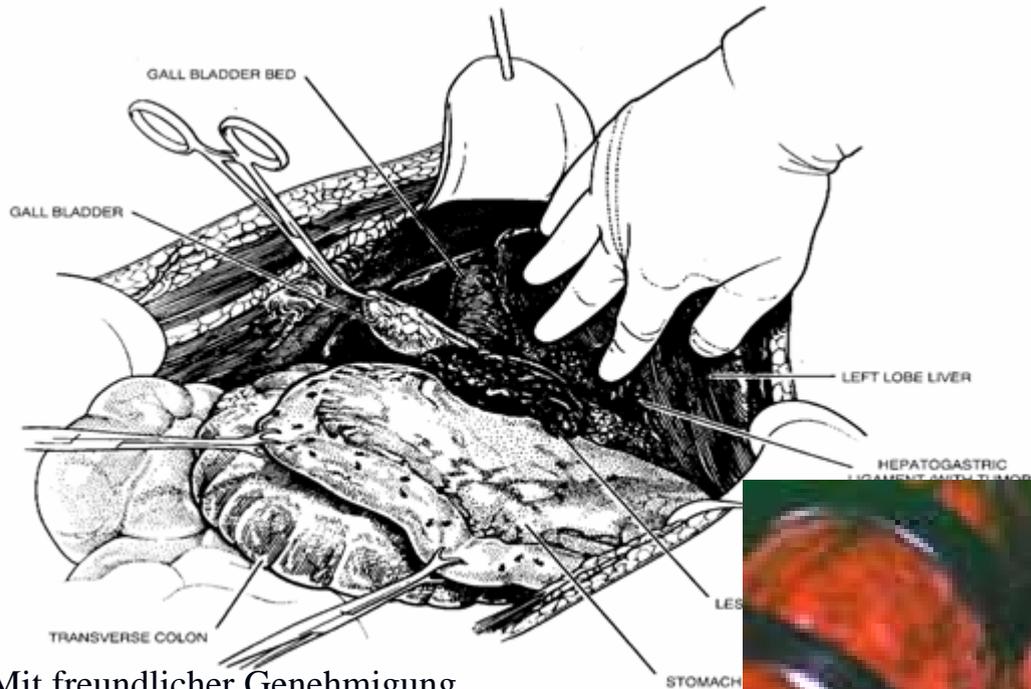
peritonectomy procedures

- stripping of diaphragm



peritonectomy procedures

- resection of Glisson capsule

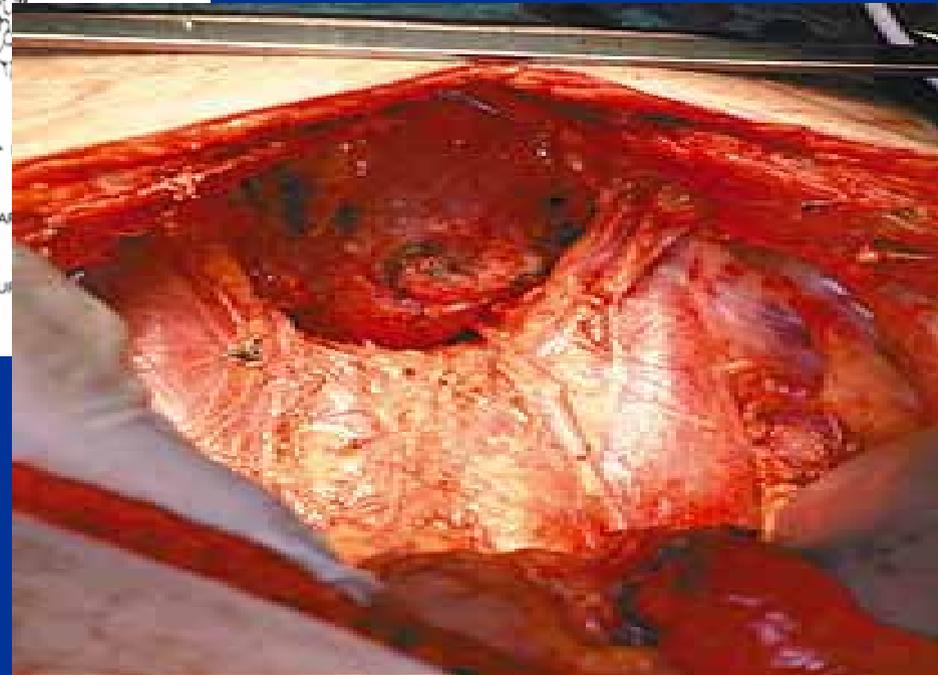
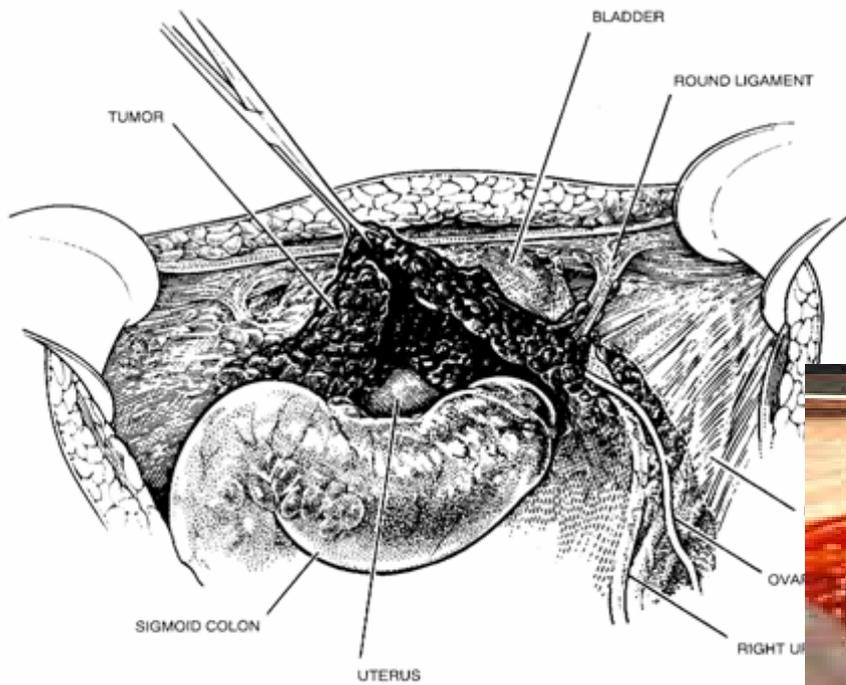


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peritonectomy procedures

- cholecystectomy plus resection of lesser omentum



peritonectomy procedures

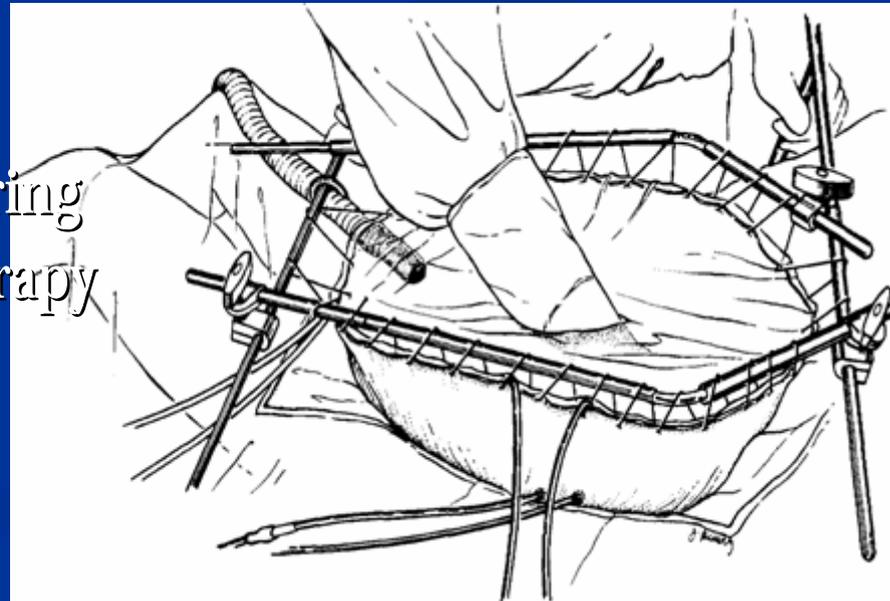
- peritonectomy of small pelvis

Reconstructive surgery

- All anastomoses are made after intraoperative intraperitoneal chemotherapy in order to reduce rate of anastomotic recurrences.
- Liberal use of anus praeter.
- After performing anastomoses thoracic tubes are inserted in the right and the left pleural cavities to evacuate fluid accumulating in the chest following subdiaphragmatic resection.
- In gastrectomy cases a duodenal exclusion operation is performed to protect the esophagojejunal anastomosis.

Benefits of hyperthermic intraperitoneal chemotherapy

- Heat has anti-tumor effects by itself.
- Heat increases drug penetration into tissue.
- Heat increases the cytotoxicity of selected chemotherapy agents.
- Intraoperative chemotherapy allows manual distribution of drug and heat uniformly to all surfaces of the abdomen and pelvis.
- Renal toxicities of chemotherapy can be avoided by careful monitoring of urine output during chemotherapy perfusion.

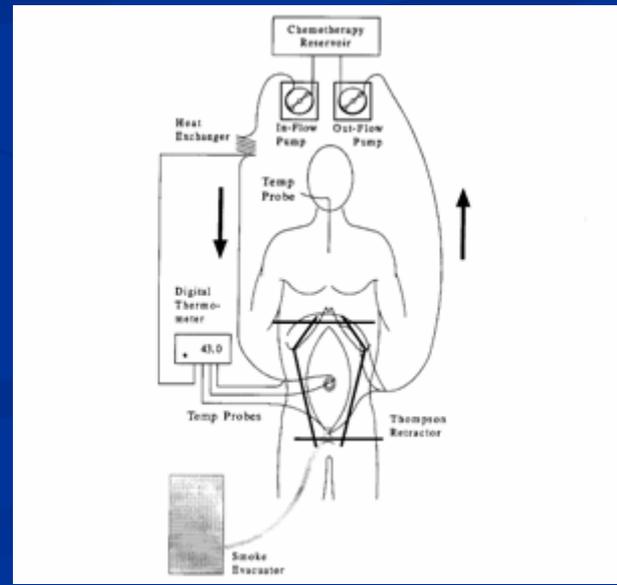
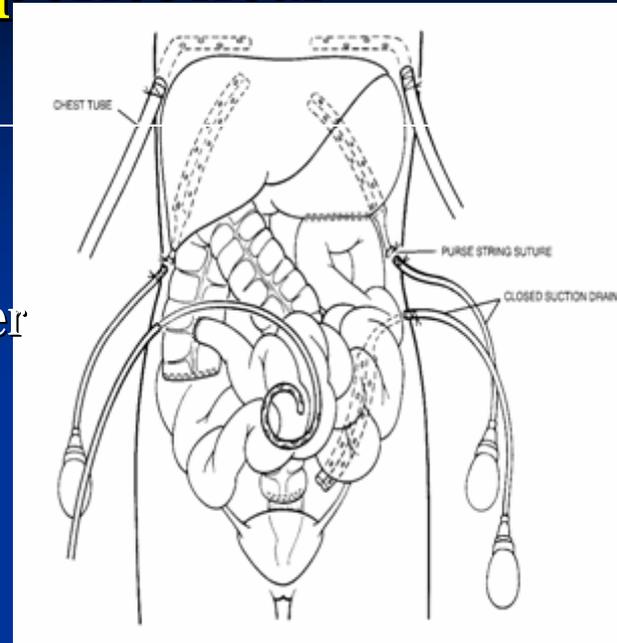


chemotherapy

cytostatic	Molekular weight	AUC
5-Fluorouracil	130	1 : 250
Cisplatin	300	1 : 20
Mitomycin	334	1 : 75
Doxorubicin	544	1 : 500
Mitoxantron	445	1 : 640
Paclitaxel	854	1 : 1000

intraoperative hyperthermic intraperitoneal chemotherapy - techniques

- A Tenckhoff inflow catheter and outflow drains are secured watertight with purse-string sutures on either side of the abdomen.
- After priming and testing for leakages with one liter of 1.5% dextrose peritoneal dialysis solution, a total of three liters of chemotherapy solution are used to wash in the abdomen and pelvis.
- Care is taken to avoid spillage.
- The perfusate is externally heated to 44-46°C to achieve a core intraperitoneal fluid temperature of 41-42°C.
- Hyperthermic chemo-perfusion is undertaken for a total of 60 min.



Early postoperative intraperitoneal chemotherapy

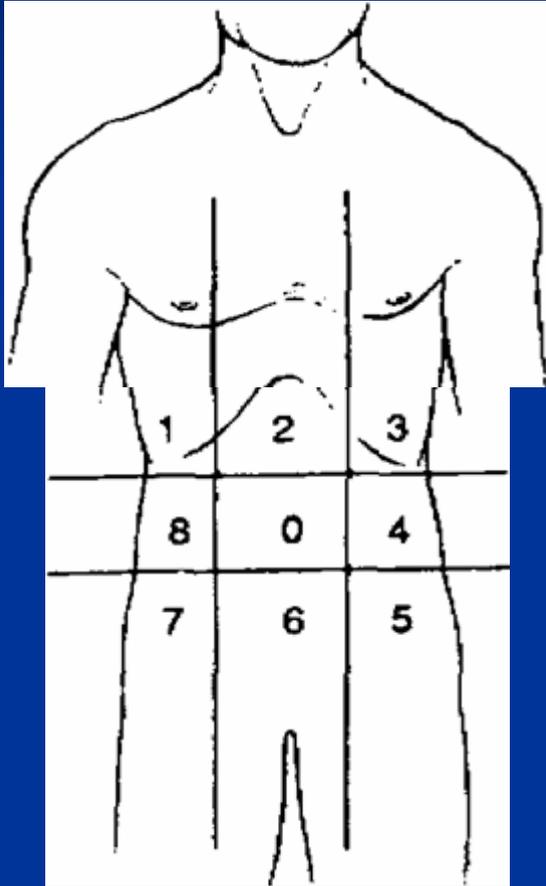
- artificial ascites -

- Intraperitoneal chemotherapy is indicated following the complete resection of appendiceal, colorectal, gastric or other gastrointestinal carcinomas.
- Approximately 24 hours after surgery, early postoperative intraperitoneal chemotherapy is initiated and the drains are closed for 23 hours.
- The abdomen is then drained for one hour until the next chemotherapy infusion.
- This is repeated for 3 – 4 consecutive days.

Peritoneal cancer index

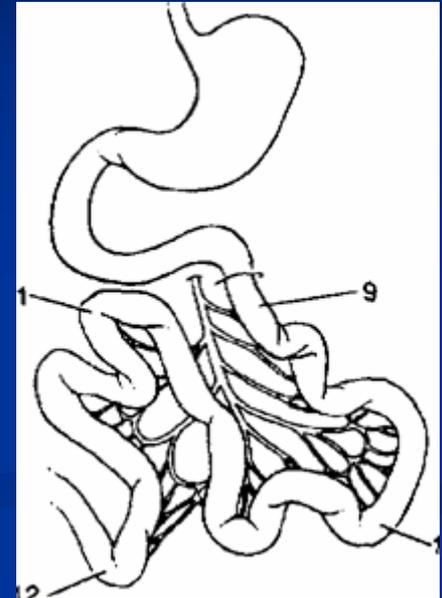
- The peritoneal cancer index is a quantitative prognostic score calculated after abdominal exploration and complete adhesiolysis.
- The success of complete cytoreduction and long-term survival can be predicted by grading the distribution and the mass of peritoneal surface cancer.
- In patients with peritoneal seeding from colon cancer a score of ten or less had a five-year survival of 50 %, from 11 to 20 a survival of 20 %, and a score of greater than 20 survival of 0%.
- It is not useful in grading minimally invasive tumors such as pseudomyxoma peritonei or cystic mesothelioma

Peritoneal Carcinose Index (PCI)



Region extent

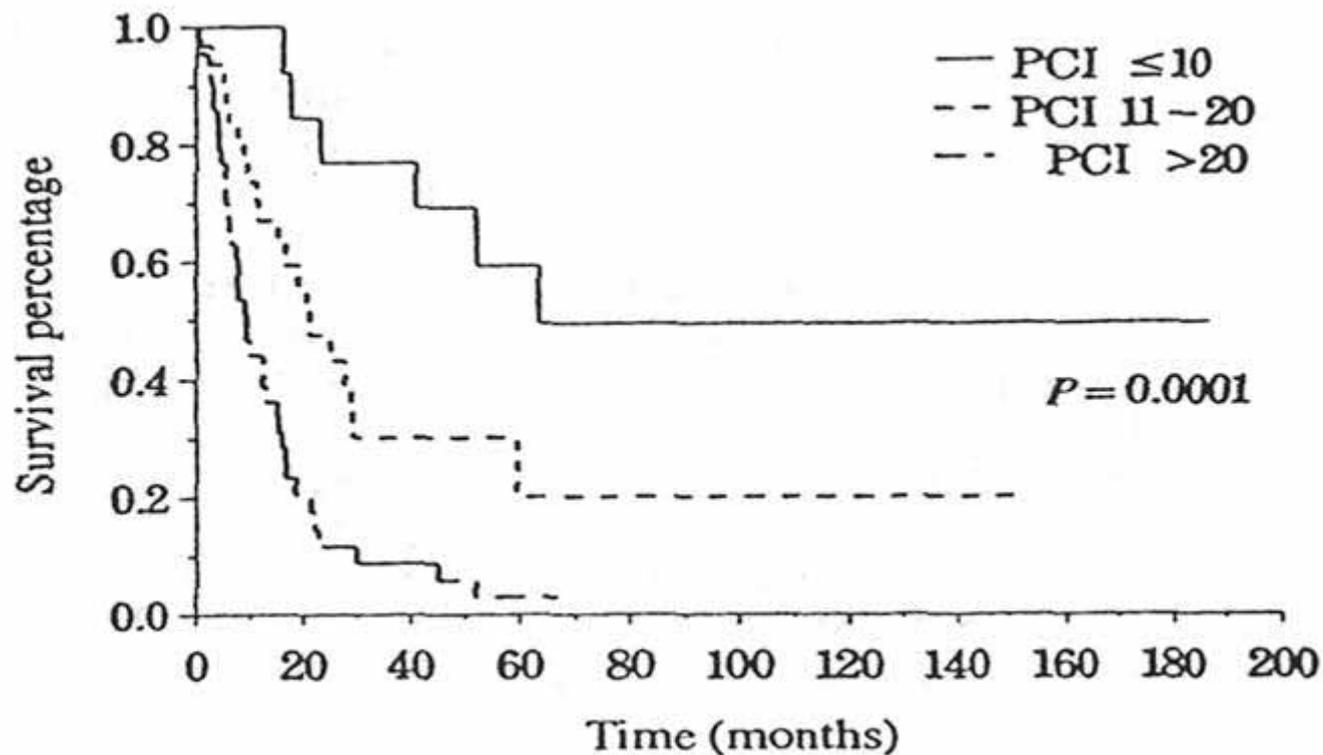
0 central	_____
1 right upper	_____
2 epigastric	_____
3 left upper	_____
4 left flank	_____
5 left lower	_____
6 pelvis	_____
7 right lower	_____
8 right flank	_____
9 upper Jejunum	_____
10 lower Jejunum	_____
11 upper Ileum	_____
12 lower Ileum	_____



Extent of tumor involvement

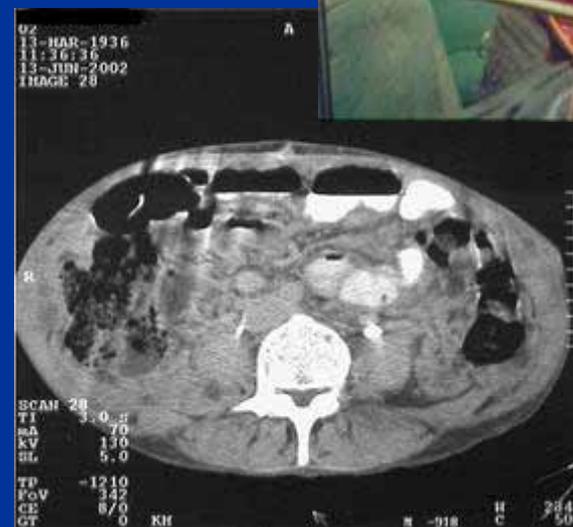
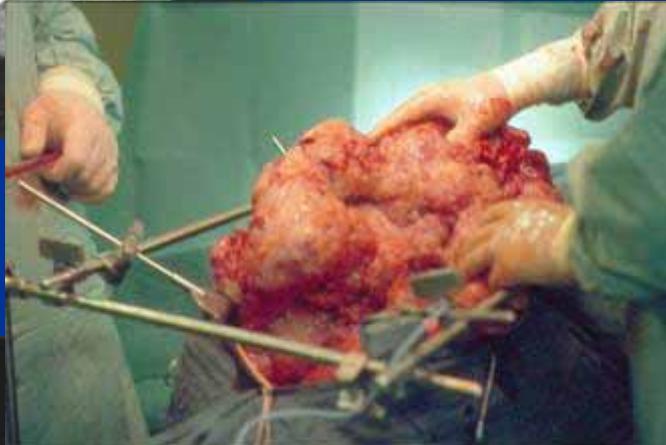
LS 0	no tumor
LS 1	< 0,5 cm
LS 2	< 5,0 cm
LS 3	> 5,0 cm or confluent

Survival of patients with peritoneal metastasized mucinous adenocarcinoma – dependency to Peritoneal carcinosis Index



postoperative complications

- Careful patient selection is crucial for the success of the peritonectomy procedure and intraperitoneal chemotherapy.
- The most common postoperative sideeffect is prolonged intestinal ileus and gastric paresis.
- Nasogastric suction is maintained until there is evidence of bowel function such as passing gas per rectum and decreasing gastric drainage (less than 750 ml per day), especially of bile.
- Total parenteral nutrition is maintained until full caloric oral intake is achieved.
- In the most recent study of 200 patients who had undergone cytoreductive surgery and heated intraoperative intraperitoneal chemotherapy for peritoneal carcinomatosis, Peripancreatitis (7.1 %) and bowel fistula (4.7%) were the most common reported major complication.
- The incidence of fistula formation, anastomotic leak, intestinal necrosis and prolonged ileus is reduced with the use of diverting and decompressing ileostomy.



peritoneal carcinosis of mucinous adenocarcinoma



peritoneal carcinosis and abdominal wall metastasis of mucinous adenocarcinoma

indications

- curative
 - pseudomyxoma Peritonei
- possibly curative
 - appendiceal carcinoma
 - peritoneal mesothelioma
 - high grade mucinöse carcinoma
 - High grade ovarian carcinoma
 - Müller´ mixed tumor
- palliative
 - small bowel carcinoma
 - colorectal carcinoma
 - duodenal carcinoma
 - sarkoma

literature

Pseudomyxoma peritonei

Author	Pts.	Morbidity	Mortality	5 year - survival
Deraco 2003	33	18%	3 %	96 %
Sugerbaker 2001	385	27 %	2,7 %	86 %
Witkamp. 2001	46	39 %	8,7 %	81 % (after 3 years)

literature

Peritoneal mesothelioma

Author	Pts.	Morbidity	Mortality	survival
Deraco 2003	29	14 %	0 %	70 % 5 year surv
Costamagna 2003	24	11 %	26 %	40 mon.
Sebbag 2000	33	33 %	3 %	31 mon.

literature

Appendiceal carcinoma

Author	Pts.	Morbidity	Mortality	5 year - survival
Esquivel 2001	98	14 %	0 %	73,6 %
Sugerbaker 1999	385	27 %	2.7 %	86 % complete, 50 % incomplete
Piso 2000	13	62 %	15 %	not given

literature

Ovarian cancer

Author	Pts.	Morbidity	Mortality	2 year - survival
Deraco 2001	27	11 %	4 %	55 %
Van der Vange 2000	5	10 %	0 %	not given
Sebbag 2000	33	33 %	3 %	31 mon.

Randomized trial of cytoreduction and hyperthermic intraperitoneal chemotherapy versus systemic chemotherapy and palliative surgery in patients with peritoneal carcinomatosis of colorectal cancer

**Verwaal VJ, Zoetmulder FA, et al. / NCI Netherlands
JCO 2003**

- 105 pts. randomized
- systemic chemo vs. cytoreduction plus systemic chemo
- morbidity 40 %, mortality 8 % for cytoreductive group
- overall survival 11 vs. 22 Monate ($p = 0.015$)
- 3-year survival 11 vs. 25 %