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Pressurized intraperitoneal Aerosol chemotherapy as PIPAC / a generic drug delivery system

Pr Marc Pocard

INSERM U.1275 :

CAP Paris Tech : Carcinomatosis Peritoneum Paris Technology

Oncological surgical unit = Lariboisière/Bégin Hospitals, Paris, France

International Society for Study of Pleura and Peritoneum

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Marc POCARD

Université de Paris

Inserm

Institut national
de la santé et de la recherche médicale

ASSISTANCE PUBLIQUE HÔPITAUX DE PARIS

HOPITAL D'INSTRUCTION DES ARMEES BEGIN 1858

RENAPE
CENTRE NATIONAL DE RÉFÉRENCE DES TUMEURS RARES DU PÉRITOINE

ISSPP
INTERNATIONAL SOCIETY FOR THE STUDY OF PLEURA AND PERITONEUM - 2018 -

Links of interest 2016 - 2020

Honorary / Consultant :

GAMIDA, LEO Pharm, FISHER&PAYLER, NOVARTIS, ROCHE, SANOFI .

Award – congress – laboratory research grant :

ALLERGAN; AstraZeneca, BARD, CAPNOMED, ETHICON; FISHER&PAYLER, FUJINON; GAMIDA; INTEGRA, IPSEN; INTUITIVE surgical; LEO Pharm; NOVARTIS, RAND; ROCHE; STORZ; SANOFI

Intraperitoneal chemotherapy: limitations

Poor drug **distribution** within the peritoneal cavity

Limited **penetration** of drugs into tumor / normal tissue

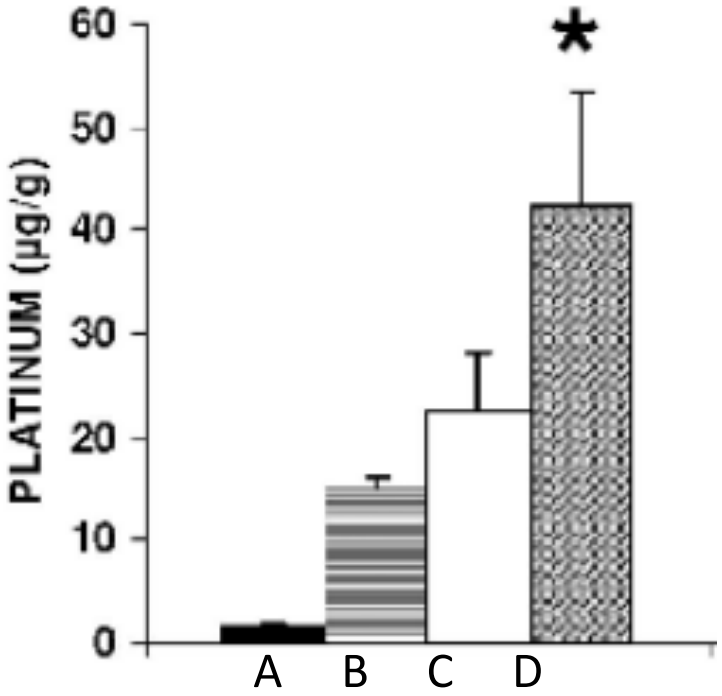
Escape into systemic circulation after regional delivery by capillary flow

Local toxicity: bowel perforation, abdominal pain, infection, obstruction

Inconvience: Logistics, time, costs

Markman M. Intraperitoneal antineoplastic drug delivery: rationale and results. Lancet Oncol. 2003 May;4(5):277-83. Review

Influence of intraperitoneal pressure on intratumoral platin concentration: rodent



A: iv administration
B: conventional ip = same total dose as IAP
C: conventional ip = same concentration as IAP
D: pressurized ip (IAP: 22 mmHg)

Platinum concentration in peritoneal tumors after IV, IP, or IAP cisplatin treatment. Rats with 21-day-old carcinomatosis treated with cisplatin by intravenous (IV) or conventional intraperitoneal (IP) injection, or by a 1-hour intraperitoneal infusion with a sustained 22 mm Hg intra-abdominal pressure (IAP). For the conventional IP treatments, cisplatin was given either to obtain the same concentration (50 mg/L in 20 mL; 1 mg/rat; 3 mg/kg; horizontal bars) or the same total dose (7.5 mg/rat; 22.5 mg/kg; 375 mg/L in 20 mL; clear bars) as for the IAP treatment. * $P < 0.05$, Kruskal-Wallis test)

Esquis P et al, Ann Surg 2006

High Pressure Enhances the Effect of Hyperthermia in Intraperitoneal Chemotherapy With Oxaliplatin

An Experimental Study

Olivier Facy, MD,† Sophie Al Samman, MD,† Guy Magnin, MD,‡ Francois Ghiringhelli, MD, PhD,* Sylvain Ladoire, MD, PhD,* Bruno Chauffert, MD,* Patrick Rat, MD,*† and Pablo Ortega-Deballon, MD, PhD*†*

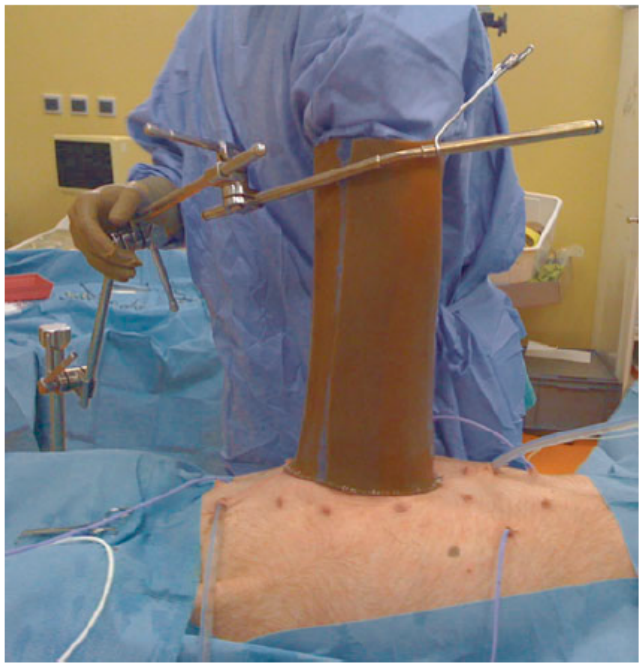
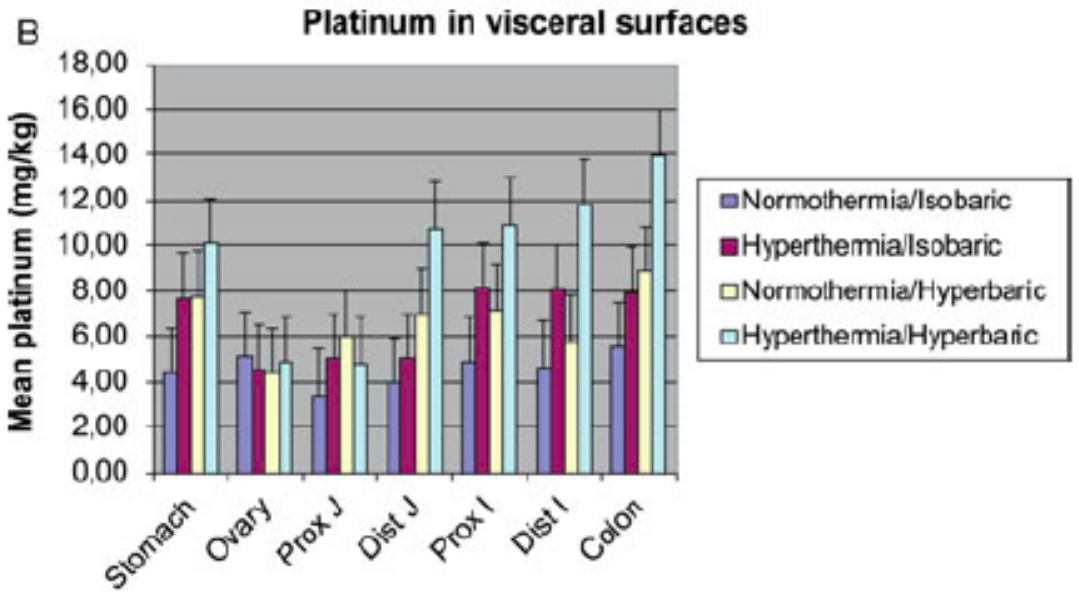
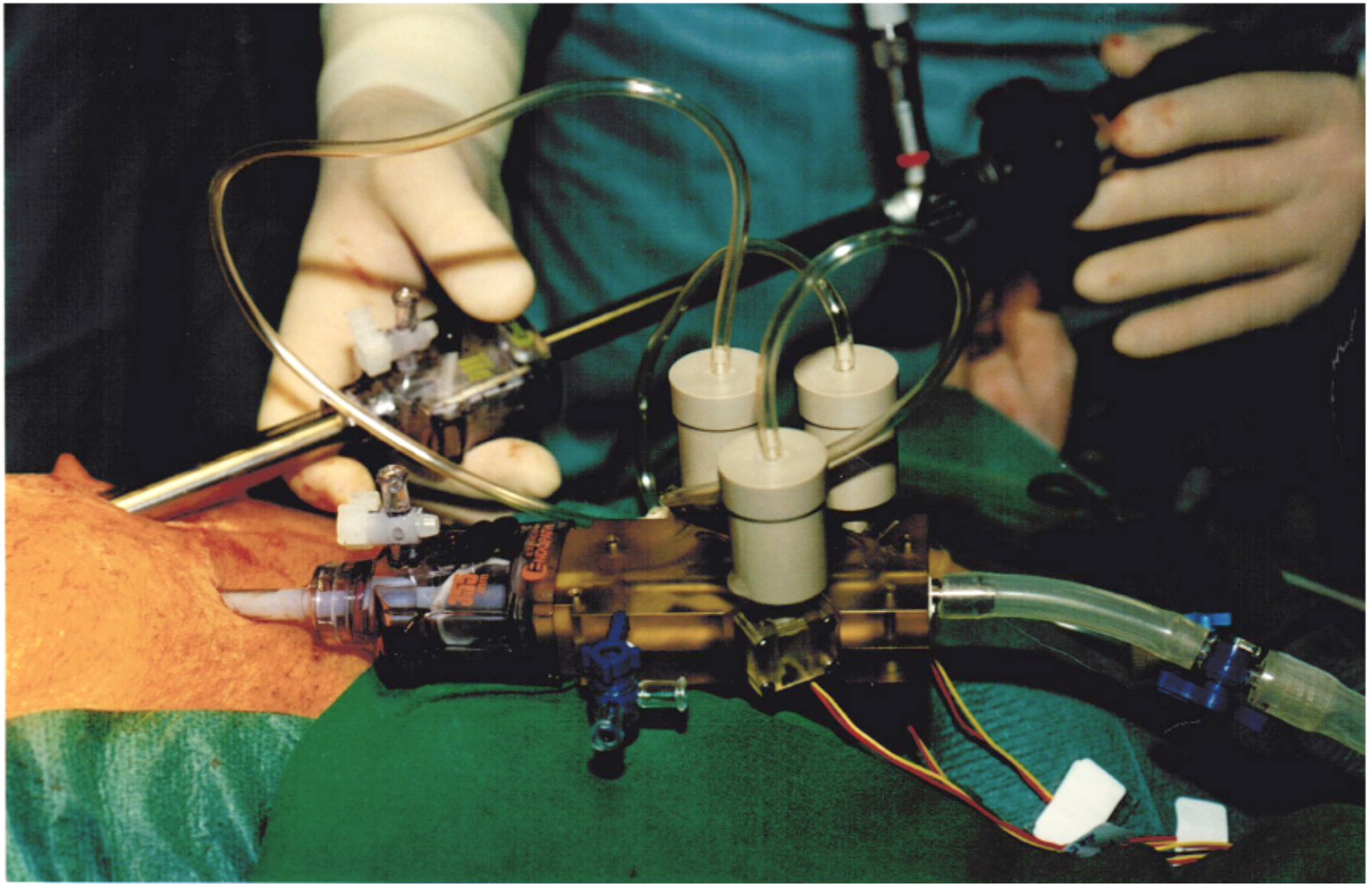


FIGURE 1. Device for high-pressure intraperitoneal chemotherapy: a vertical latex expander is hermetically stapled to the skin and stabilized on the arm of a Thompson retractor. The expander is filled to a height of 25 cm with the liquid and allows access to the whole abdominal cavity. According to Pascal's principle, the pressure induced by the weight of the water column is uniformly transmitted to the entire abdominal cavity. Three thermal probes (blue on the picture) are placed to monitor the temperature within the abdomen, as well as in the outflow and the inflow catheters (transparent tubes).

(*Ann Surg* 2012;256: 1084–1088)

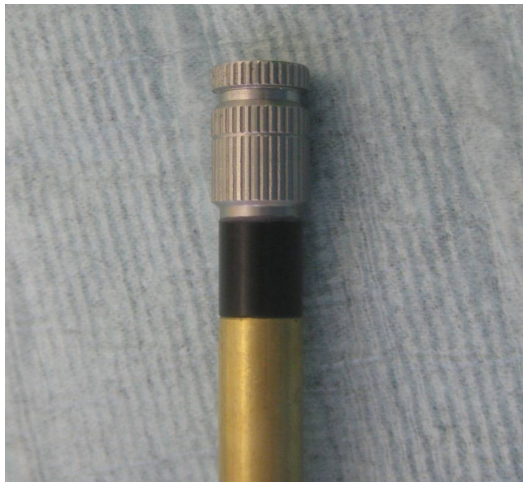


Not a new idea: Pressure and aerosol using First prototype 1999



M Reymond

2010: 2nd generation prototype



- Technology is more simple
- Aerosol delivery system is derived from car industry, from a common rail injector
- Produced by CAPNOMED company
- Drug volumes up to 200 ml
- Certification as class 2A device

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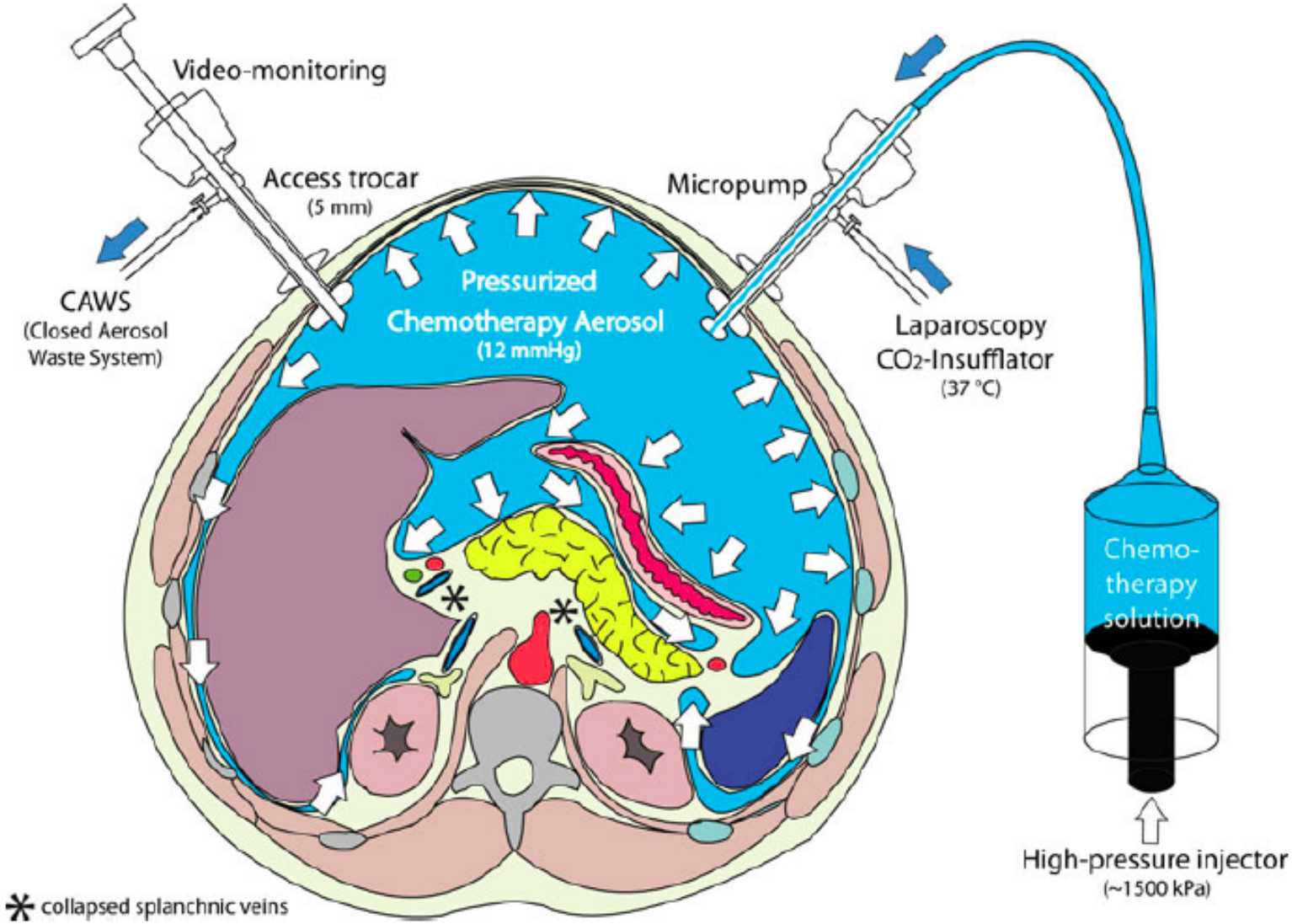
Pressurized intrapéritoneal Aerosol chemotherapy as PIPAC



M Reymond

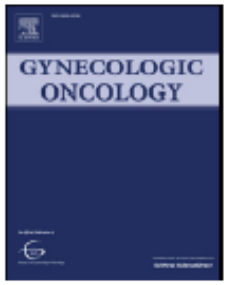
1st PIPAC Nov 5th, 2011
Bielefeld Deutschland

PIPAC

Contents lists available at ScienceDirect

Gynecologic Oncology

journal homepage: www.elsevier.com/locate/ygyno



Activity of Pressurized Intraperitoneal Aerosol Chemotherapy (PIPAC) with cisplatin and doxorubicin in women with recurrent, platinum-resistant ovarian cancer: Preliminary clinical experience

Clemens B. Tempfer [a,*], Ilknur Celik [a], Wiebke Solass [b], Bernd Buerkle [a], Urs G. Pabst [b], Juergen Zieren [b], Dirk Strumberg [c], Marc-André Reymond [b]

[a] Department of Obstetrics and Gynecology, Ruhr University Bochum, Bochum, Germany
[b] Department of Surgery, Ruhr University Bochum, Bochum, Germany
[c] Department of Hemato-Oncology, Ruhr University Bochum, Bochum, Germany

Gynecol Oncol. 2014;132(2):307-11

PIPAC medical plausibility

Applying an **aerosol** in the peritoneal cavity allows a more homogeneous distribution of the chemotherapeutic agent within the abdomen than a liquid solution.

An artificial **pressure** gradient is generated that overcomes tumoral interstitial fluid pressure, an obstacle in cancer therapy.

PIPAC medical plausibility

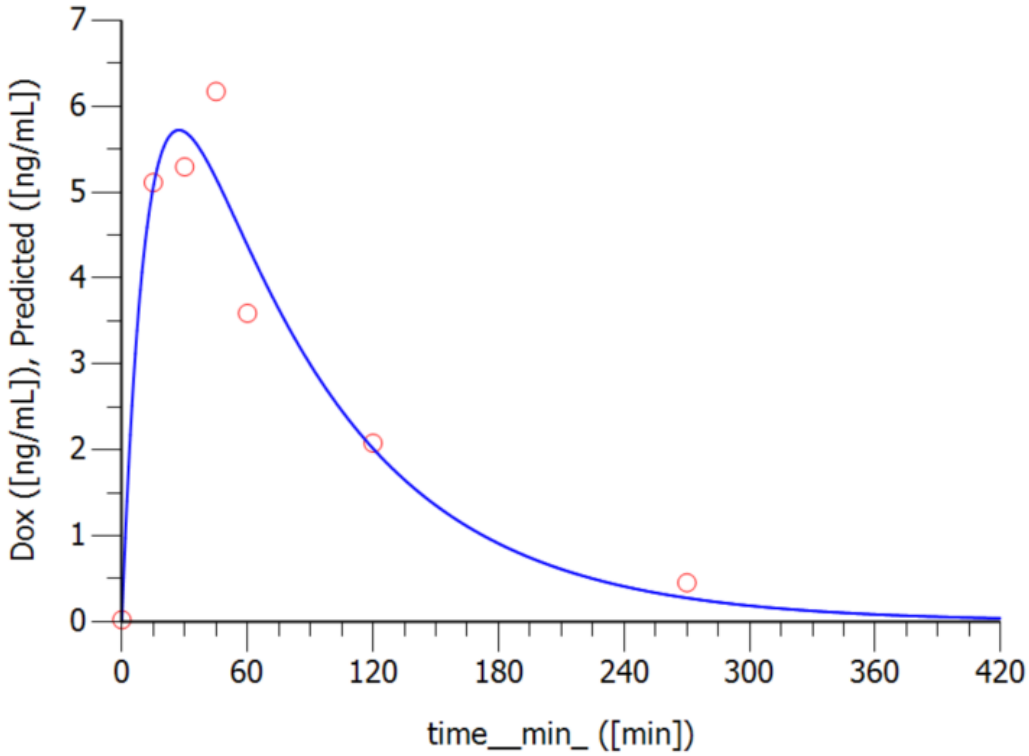
This results in a higher tissue drug concentration compared to IV chemotherapy or IP chemotherapy with liquids. Therefore, only a **low dose** (10%-20% of a normal systemic dose) needs to be applied.

Organ toxicity and adverse events remain low, therapy is well tolerated.

Staging laparoscopy is performed anyway; there are no catheter-linked complications

PIPAC: Systemic uptake (Doxorubicin)

Pharmacocinetic profile in peripheric venous blood (typical profile)
after PIPAC with Doxorubicin [Dox] 1,5 mg/m² KOF for 30 min. with i. -abd. Pressure of 12 mmHg.



Systemic doxorubicin exposure during PIPAC, showing a typical pharmacokinetic profile in peripheral venous blood after PIPAC with doxorubicin 1.5 mg/m2 body surface for 30 min at an intraabdominal pressure of 12 mmHg. Peak doxorubicin plasma concentrations were low (4.0–6.2 ng/ml). Line predicted profile. Dots experimental values.

PIPAC: occupational health safety program

1. Risk management program started in 2011

- Substances and amount

- Identification of potential hazards and possible contamination pathways

2. Design of simulations in the operating room

3. Working out a safety protocol, health workers training

4. Repeated workplace measurements under real conditions

5. Mathematical simulations (worst case scenario)

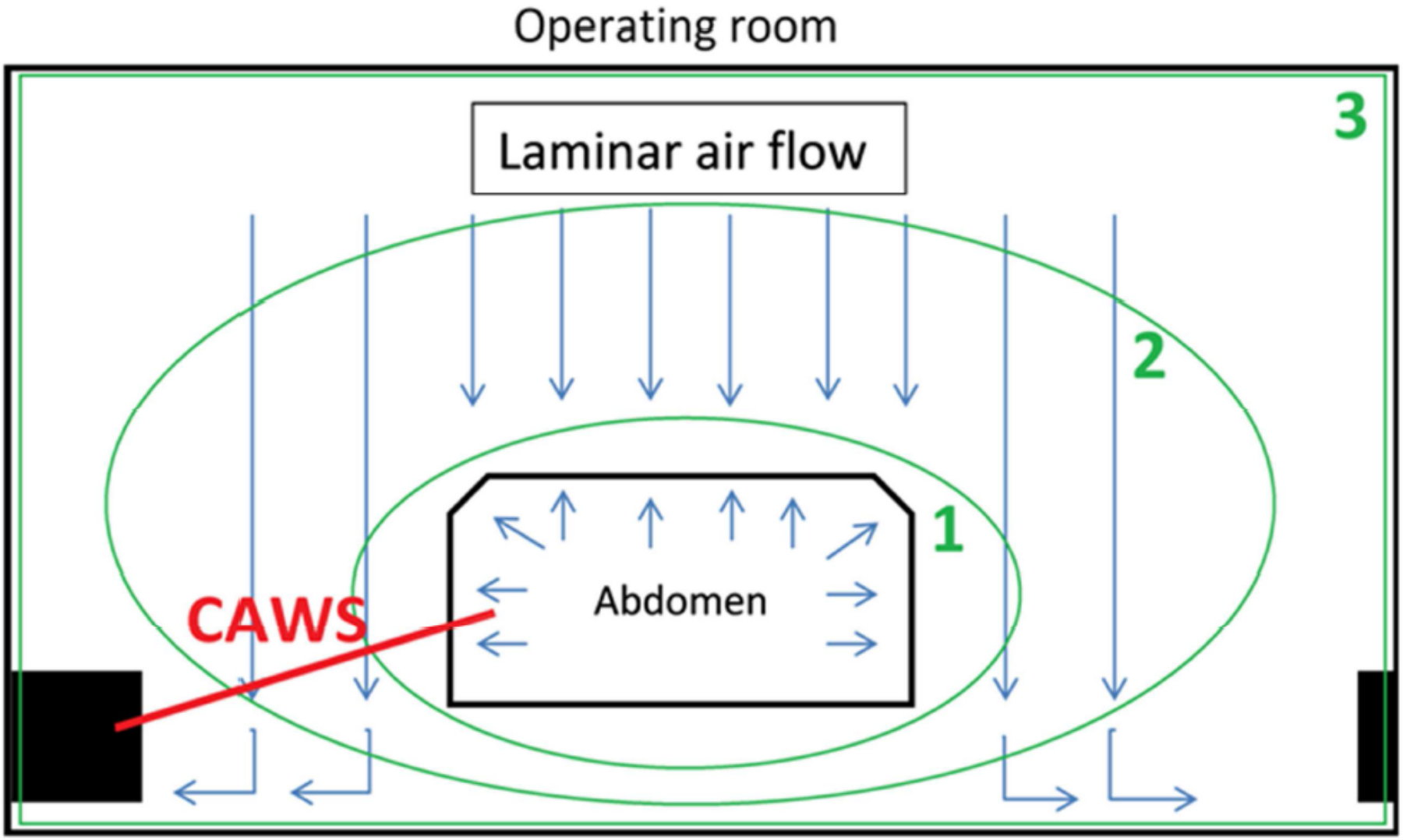
6. Critical Incident Reporting System (CIRS)

7. Biological assessment after 500 and 1500 PIPACs

8. Regulatory approval of safety guidelines for PIPAC

Inhalation risk: Safety concept

National Center for Pleura and Peritoneum 2018

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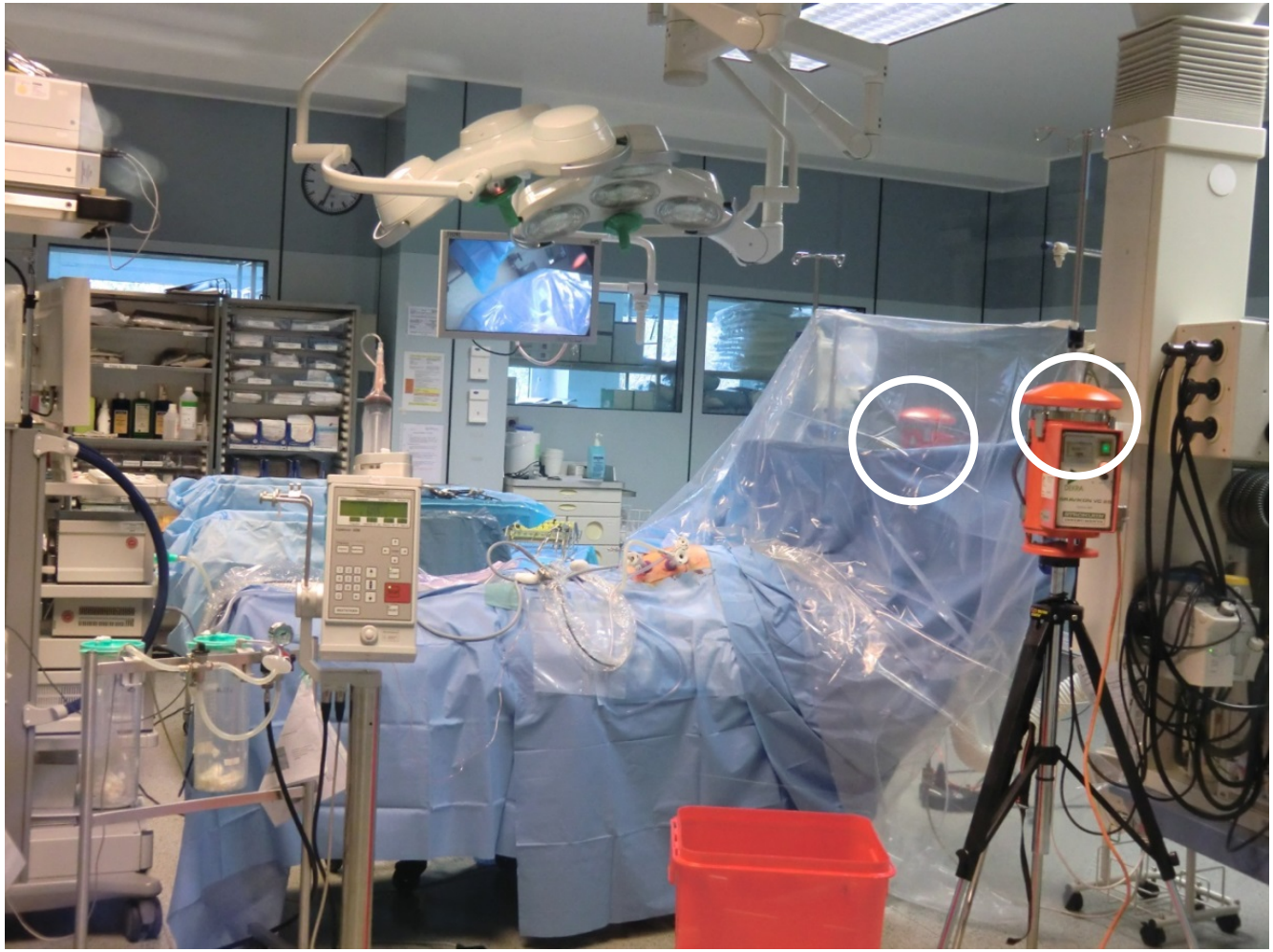
Workplace measurements: air



- No contamination detected in any hospital

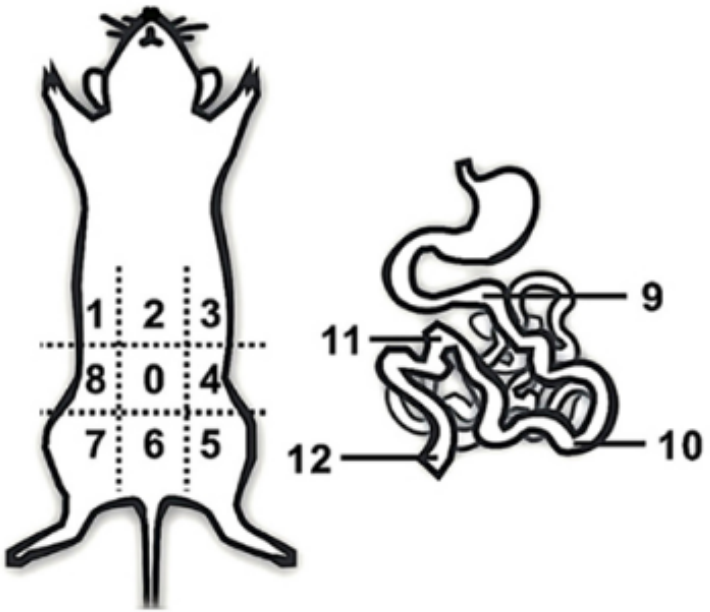
(Lowest sensitivity: **0.004 pmol/m^3)**

Clarisse Eveno, Aminata Haidara, Ibrahim Ali, Cynthia Pimpie, Massoud Mirshahi and Marc Pocard*

Experimental pharmacokinetics evaluation of chemotherapy delivery by PIPAC for colon cancer: first evidence for efficacy

Pleura and Peritoneum 2017; aop

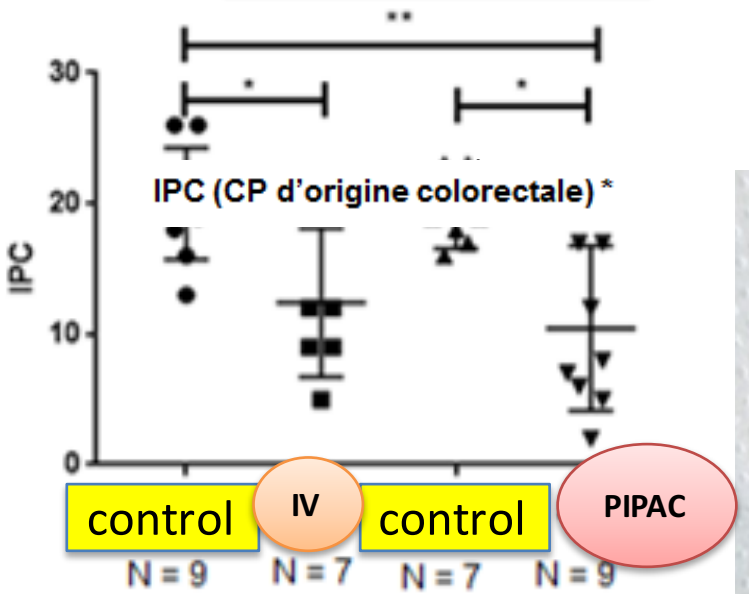
PCI for mice

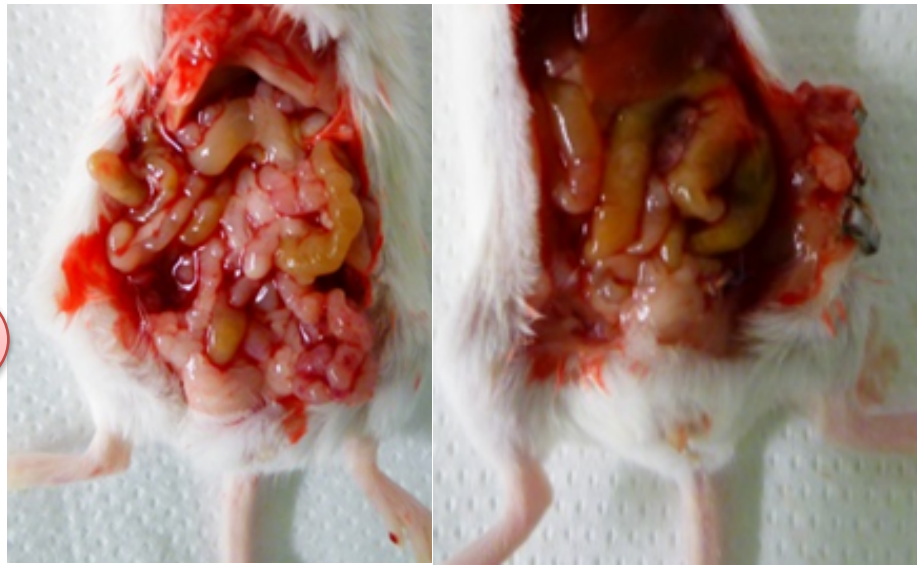


		Score	Tumor size
0	Central abdomen		
1	Right upper quadrant		
2	Epigastric region	0	no macroscopic lesion
3	Left upper quadrant		
4	Left middle quadrant	1	Lesion from 1 to 2 mm,
5	Left lower quadrant		1 to 2 sites
6	Pubic region		
7	Right lower quadrant	2	Lesion from 2 to 4 mm,
8	Right middle quadrant		1 to 2 sites
9	Proximal jejunum		
10	Distal jejunum	3	lesion over 4 mm
11	Proximal ileum		or more than 10 sites
12	Distal ileum		

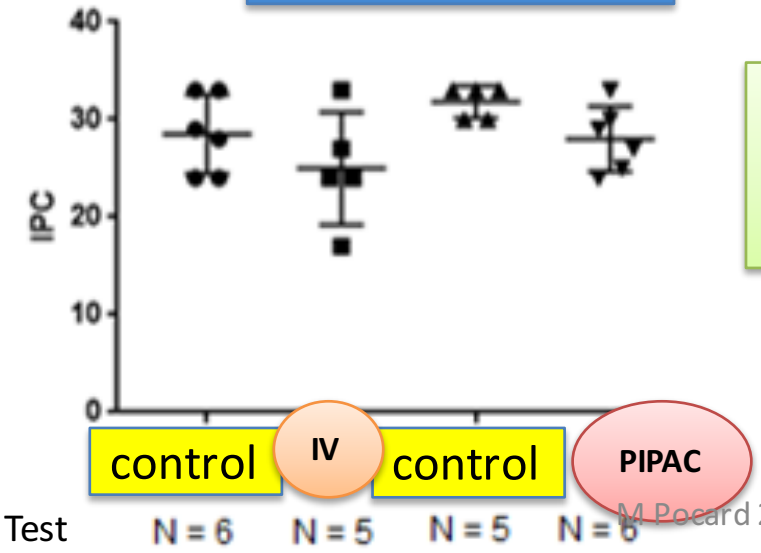
PCI evaluation

PCI colon CT26





PCI ovarian Ovcar

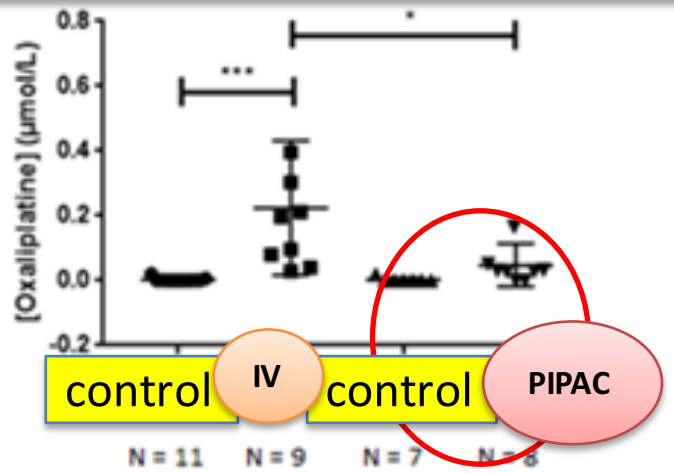


PIPAC is effective as IV Oxapiplatin in a murin model of colon cancer carcinomatosis

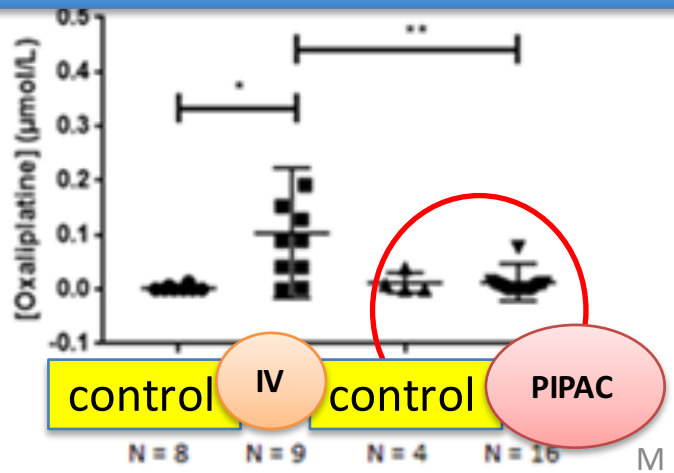
*Kruskal-Wallis Test

Oxaliplatin drugs concentration in blood

Oxalipatin in blood colon CT26



Oxalipatin in blood ovarian OVcar



→ The PIPAC decreases the concentration of oxaliplatin in the blood compared to IV, with less systemic absorption, for Colon and ovarian carcinomatosis mice model

Instituts thématiques
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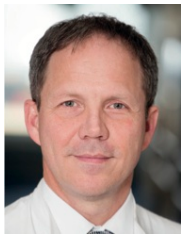


Ann Surg Oncol (2014) 21:553–559
DOI 10.1245/s10434-013-3213-1

Annals of
SURGICAL ONCOLOGY
OFFICIAL JOURNAL OF THE SOCIETY OF SURGICAL ONCOLOGY

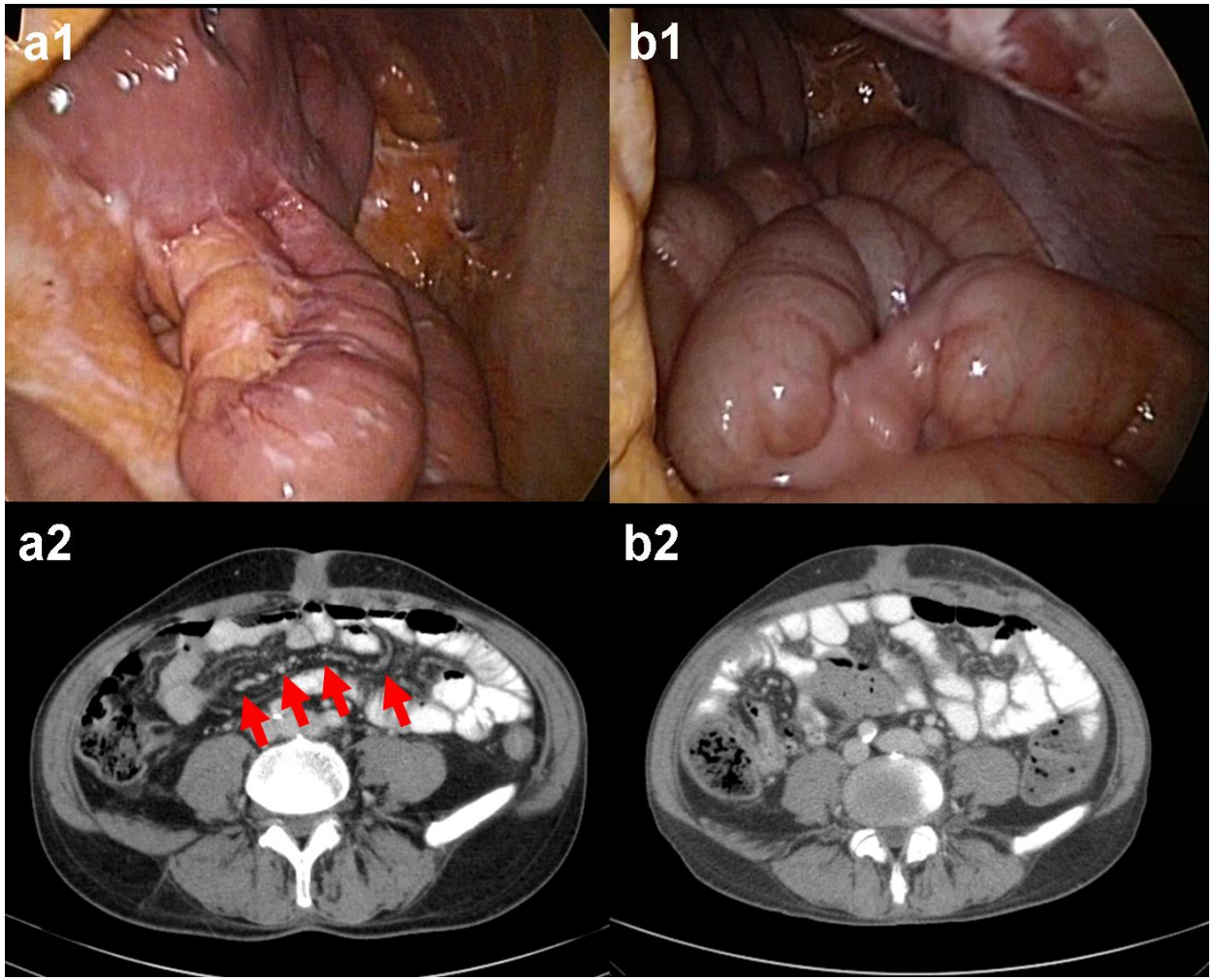
ORIGINAL ARTICLE – GASTROINTESTINAL ONCOLOGY

Intraperitoneal Chemotherapy of Peritoneal Carcinomatosis Using Pressurized Aerosol as an Alternative to Liquid Solution: First Evidence for Efficacy

Wiebke Solass, MD[1], Reinhold Kerb, MD[2,3], Thomas Mürdter, PhD[2,3], Urs Giger-Pabst, MD[4], Dirk Strumberg, MD[5], Clemens Tempfer, MD, MBA[6], Jürgen Zieren, MD[4], Matthias Schwab, MD[2,3], and Marc André Reymond, MD, MBA[4]

[1]Institute of Pathology, Ruhr-University Bochum, Bochum, Germany; [2]Dr. Margarete Fischer-Bosch Institute of Clinical Pharmacology, Stuttgart, Germany; [3]Department of Clinical Pharmacology, University Hospital, Tübingen, Germany; [4]Department of Surgery, Marienhospital Herne, Ruhr-University Bochum, Bochum, Germany; [5]Department of Internal Medicine, Oncology and Hematology, Marienhospital Herne, Ruhr-University Bochum, Bochum, Germany; [6]Department of Gynaecology and Obstetrics, Marienhospital Herne, Ruhr-University Bochum, Bochum, Germany

Efficacy: CT-scan (RECIST) and laparoscopy



PIPAC # 1 PIPAC # 4

53 y.o. patient with signet ring gastric cancer, S/P gastrectomy and chemotherapy (3rd line situation by PCI 19). Patient is alive 90 Monate after diagnosis, and 6 months after PIPAC #1 with complete radiolohgical and histological remission. Karnofsky 100%.

2018

European Journal of Surgical Oncology xxx (2018) 1–6

Contents lists available at ScienceDirect

European Journal of Surgical Oncology

journal homepage: www.ejso.com

Multicenter comprehensive methodological and technical analysis of 832 pressurized intraperitoneal aerosol chemotherapy (PIPAC) interventions performed in 349 patients for peritoneal carcinomatosis treatment: An international survey study

Maciej Nowacki [a, *], Mohammad Alyami [b, d, e, m], Laurent Villeneuve [c, d, e], Frederic Mercier [b, e], Martin Hubner [f], Wouter Willaert [g], Wim Ceelen [g], Marc Reymond [h], Denis Pezet [i], Catherine Arvieux [j], Vladimir Khomyakov [k], Laura Lay [l], Sergio Gianni [n], Wojciech Zegarski [a], Naoual Bakrin [b, d, e], Olivier Glehen [b, d, e]

Lancet Oncol 2019; 20: e368–77

Pressurised intraperitoneal aerosol chemotherapy: rationale, evidence, and potential indications

Mohammad Alyami*, Martin Hübner*, Fabian Grass, Naoual Bakrin, Laurent Villeneuve, Nathalie Laplace, Guillaume Passot, Olivier Glehen, Vahan Kepenekian

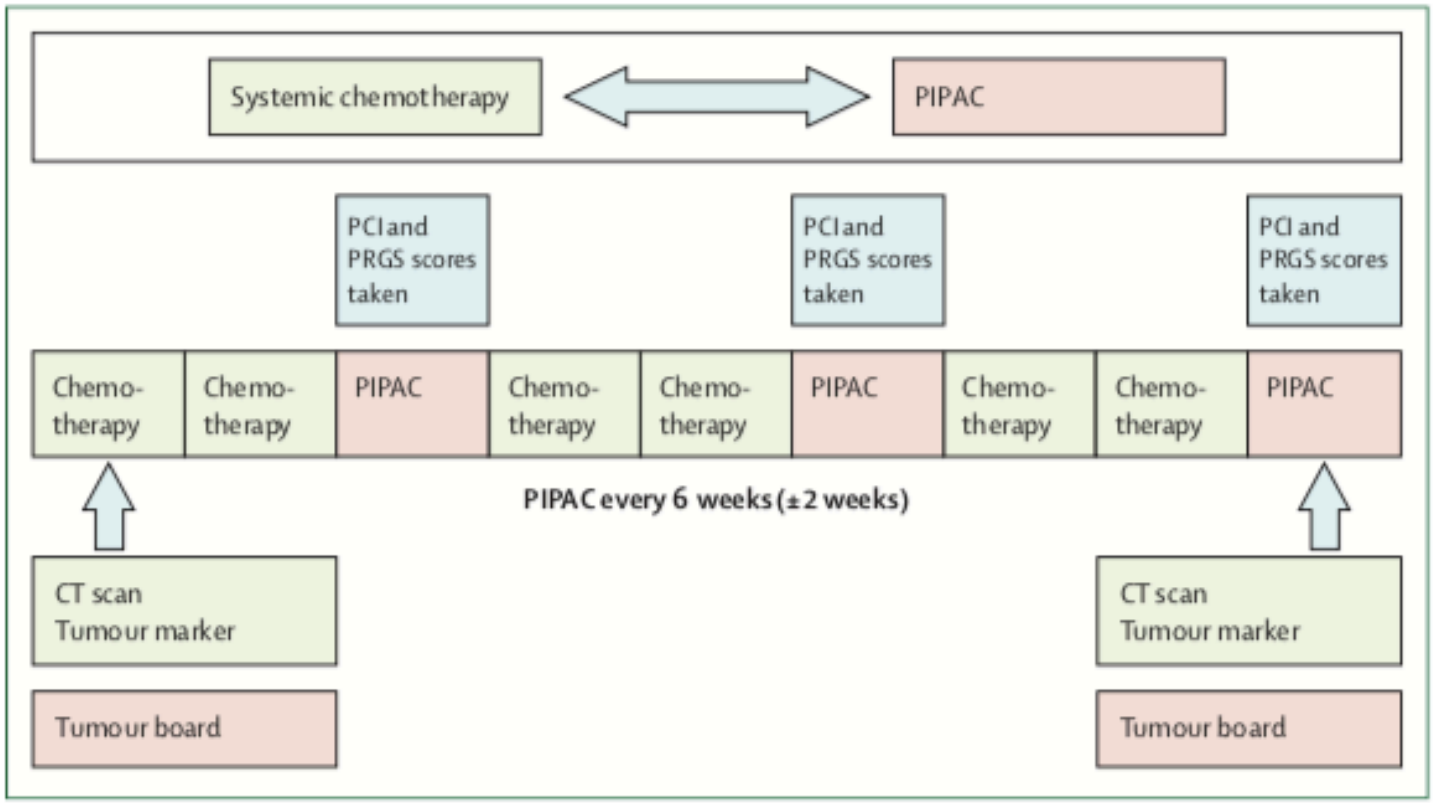


Figure 3: **Concomitant systemic and intraperitoneal treatment**
Suggested treatment schedule for PIPAC every 6 weeks (±2 weeks), alternating with systemic chemotherapy. PIPAC=pressurised intraperitoneal aerosol chemotherapy. PCI=peritoneal cancer index. PRGS=peritoneal regression grading score.

Pressurised intraperitoneal aerosol chemotherapy: rationale, evidence, and potential indications

Mohammad Alyami, Martin Hübner*, Fabian Grass, Naoual Bakrin, Laurent Villeneuve, Nathalie Laplace, Guillaume Passot, Olivier Glehen, Vahan Kepenekian*

	Colorectal cancer		Gastric cancer		Ovarian cancer		Peritoneal mesothelioma		Biliary tract cancer		Appendiceal cancer	
	PIPAC	HIPEC	PIPAC	HIPEC	PIPAC	HIPEC	PIPAC	HIPEC	PIPAC	HIPEC	PIPAC	HIPEC
High risk for peritoneal metastasis after primary tumour resection	USC	USC	USC	USC	–	–	–	–	?	?	–	–
Upfront or interval situation and resectable peritoneal metastasis	USC	PCI≤ 15	USC; PCI >6	USC; PCI ≤6	USC	+	USC	+	USC	USC	–	+
Synchronous or recurrent peritoneal metastasis as sole metastatic site and unresectable disease, or patient not eligible for extensive cytoreductive surgery or HIPEC and with 2nd or 3rd line of systemic chemotherapy	+	–	+	–	+	–	+	–	+	–	+	–
Refractory ascites	+	–	+	–	+	+/–	+	–	+	–	+	–
Systemic chemotherapy intolerance	+	–	+	–	+	–	+	–	+	–	+	–
Unfavourable histology	+*§	–*	+*§	–*	+†§	+†	+‡§	+/–‡	+§	–	+*§	–*

PIPAC=pressurised intraperitoneal aerosol chemotherapy. HIPEC=hyperthermic intraperitoneal chemotherapy. USC=under study condition. PCI=peritoneal cancer index. *Signet ring histology. †Clear cell carcinoma, undifferentiated ovarian cancer. ‡Sarcomatoid or biphasic peritoneal mesothelioma. §Unfavourable histology is an additional argument to introduce PIPAC earlier in the treatment strategy.

Table 3: **Potential indications for the use of PIPAC and HIPEC**

Lancet Oncol 2019; 20: e368–77

PIPAC: completed/ongoing 13 clinical trials

1	Recruiting	Efficacy and Safety of PIPAC/PITAC in Gastric,Ovarian, Colorectal Cancer and Mesothelioma With Pleural Carcinomatosis. **Conditions:** Colorectal Cancer; Ovarian Cancer; Gastric Cancer; Mesothelioma **Intervention:** Procedure: pressurized intraperitoneal/intrathoracal aerosol chemoTx	Switzerland
2	Recruiting	Study of Efficacy and Safety of Laparoscopic Intra-abdominal Chemotherapy (PIPAC) Performed in Patients With Peritoneal Carcinomatosis From Colorectal, Ovarian, Gastric Cancer and Primary Peritoneal Tumors **Condition:** Peritoneal Carcinomatosis **Intervention:** Drug: Pressurized IntraPeritoneal Air-flow Chemotherapy (PIPAC)	Singapore
3	Recruiting	Pressurized Intraperitoneal Aerosol Chemotherapy (PIPAC) Applied to First Platinum-Resistant Recurrence of Ovarian Tumor **Condition:** First Platinum-resistant Recurrent of Epithelial Ovarian Cancer **Intervention:** Device: Pressurized intraperitoneal aerosol chemotherapy with cisplatin and doxorubicin	Italy
4	Recruiting	Treating Peritoneal Carcinomatosis With PIPAC **Condition:** Peritoneal Carcinomatosis **Intervention:** Drug: PIPAC	Denmark
5	Completed	Intraperitoneal Aerosol Chemotherapy in Gastric Cancer **Condition:** Gastric Cancer **Intervention:** Drug: doxorubicin and cisplatin	France
6	Completed	Intraperitoneal Aerosol High-pressure Chemotherapy for Women With Recurrent Ovarian Cancer **Condition:** Recurrent Ovarian Cancer **Intervention:** Drug: chemotherapy with doxorubicin and cisplatin	Belgium
7	Recruiting	A Study With Intraperitoneal Cisplatin and Doxorubicin in Recurrent Ovarian Cancer and Peritoneal Carcinomatosis **Condition:** Ovarian Cancer **Interventions:** Drug: Cisplatin and doxorubicin; Procedure: Cisplatin and doxorubicin	Germany

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La PIPAC à la française, permet un contrôle solide de la carcinose gastrique sans morbidité surajoutée dans plus de la moitié des cas.

M Pocard, I Jouvin, G Mariano G, C Eveno, J-M Gornet , T André.

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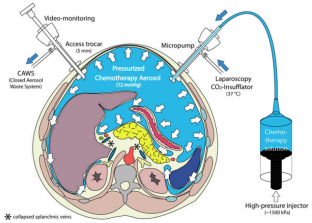

Méthode :

Etude rétrospective monocentrique des patients consécutifs traités par PIPAC pour MPG à l'Hôpital Lariboisière 2017 - 2018

- Soit : PIPAC avec Oxaliplatine
- Soit : PIPAC avec Doxorubicine et Cisplatine

Inclusion : Etat général conservé / OMS 0 – 1 et 2 / PAS d'occlusion / ascite oui / neuropathie oui / gastrectomie antérieure oui / linite oui /

Exclusion : nutrition parentérale / Occlusion /

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Résultats

75 PIPACs ont été réalisées

pour 27 patients

d'âge médian de 58 ans (ext 28 – 72).

Tous ont eu au moins une PIPAC,

85% au moins 2 (n=23),

63% au moins 3 (n=17) (extr 1 – 6).

Résultats de 75 PIPAC pour métastases péritonéales gastriques

La morbidité majeure a été de 1,4% : (1 éviscération),

Pas de mortalité.

Le nombre de jour d'hospitalisation est de **2 jours** (décision liée au PMSI)

La majorité des patients a considéré la PIPAC comme plus facile à supporter que la chimiothérapie IV

La qualité de vie (QLQ C-30) est stabilisée pendant le traitement

Utilisation initiale de l'Oxaliplatine : puis bascule vers Doxo Cisplatine devant la douleur post opératoire moindre et le nombre de patient ayant une neuropathie après la première ligne de chimiothérapie IV

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Résultats de 75 PIPAC pour métastases péritonéales gastriques

La durée maximale du contrôle a été de 11 mois,
avec une patient en attente de sa septième PIPACs.

La durée médiane entre les 2 PIPACs a été de 47 jours
(extr 31 – 67).

Pour deux patients, le contrôle de la maladie a autorisé une proposition de chirurgie secondaire de cytoréduction avec CHIP.

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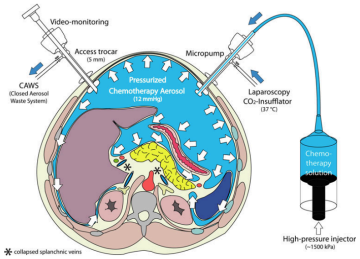
Conclusion



- Un traitement palliatif de PIPACs « à la française », est possible et contrôle la maladie probablement aussi bien qu'une chimiothérapie iv, avec moins d'effets secondaires.

Un troisième patient traité à l'Hôpital St Louis chimio et Bégin pour PIPAC est en cours de discussion pour une tentative de chirurgie et CHIP du fait de la très bonne réponse

Fava et al. World Journal of Surgical Oncology (2018) 16:62
https://doi.org/10.1186/s12957-018-1363-0

World Journal of Surgical Oncology

CASE REPORT Open Access

Neoadjuvant intraperitoneal chemotherapy followed by radical surgery and HIPEC in patients with very advanced gastric cancer and peritoneal metastases: report of an initial experience in a western single center

Equipe à Moscou cohorte de 134 patients Vladimir Khomiakov, survie médiane de 16 mois avec chimio IV et PIPAC contre 7 mois pour chimiothérapie systémique.

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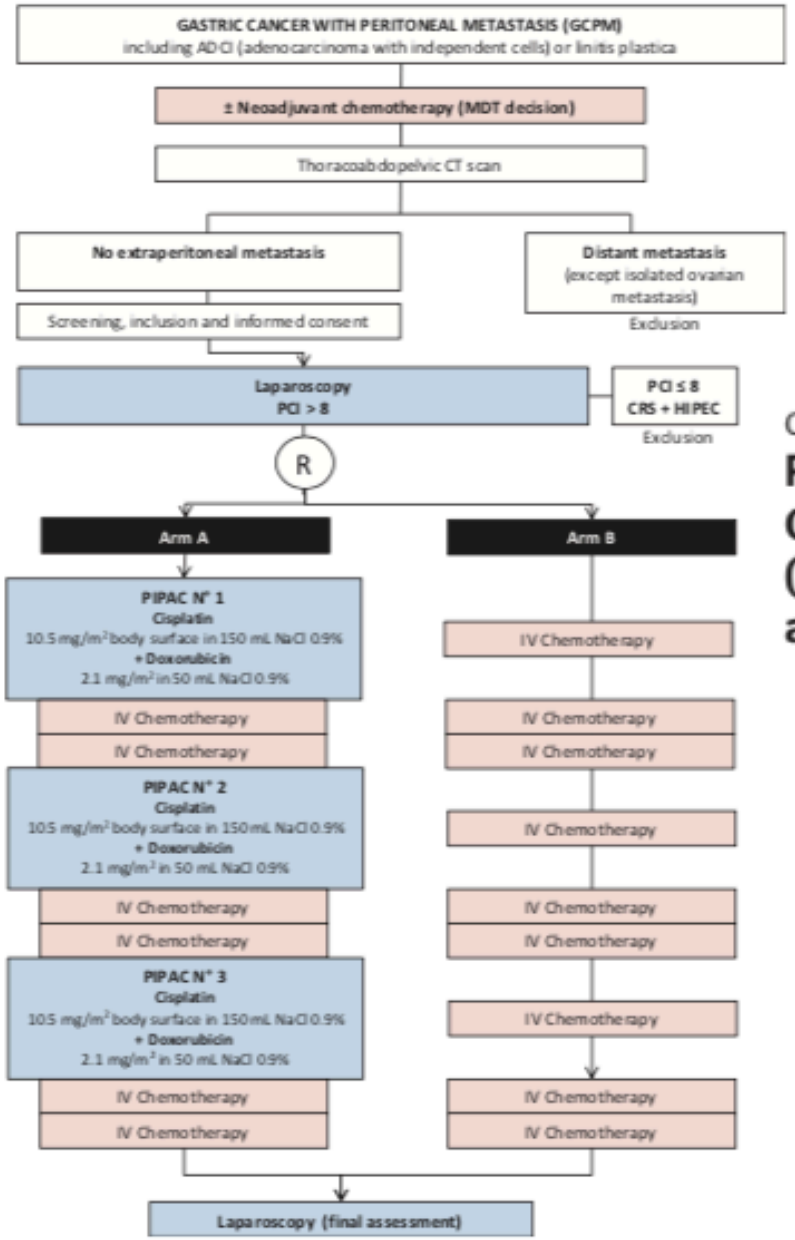

Figure 1: PIPAC EstoK 01 study flow-chart.

Chemo versus Chemo + PIPAC

Clarisse Eveno*, Ingrid Jouvin and Marc Pocard

PIPAC EstoK 01: Pressurized IntraPeritoneal Aerosol Chemotherapy with cisplatin and doxorubicin (PIPAC C/D) in gastric peritoneal metastasis: a randomized and multicenter phase II study

Chemo versus PIPAC

ANTICANCER RESEARCH *35*: 2309-2314 (2015)

Low-dose Pressurized Intraperitoneal Aerosol Chemotherapy (PIPAC) as an Alternative Therapy for Ovarian Cancer in an Octogenarian Patient

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PIPAC as neoadjuvant before cytoreductive surgery and HIPEC

Girshally *et al. World Journal of Surgical Oncology* (2016) 14:253
DOI 10.1186/s12957-016-1008-0

World Journal of Surgical Oncology

RESEARCH Open Access

Pressurized intraperitoneal aerosol chemotherapy (PIPAC) as a neoadjuvant therapy before cytoreductive surgery and hyperthermic intraperitoneal chemotherapy

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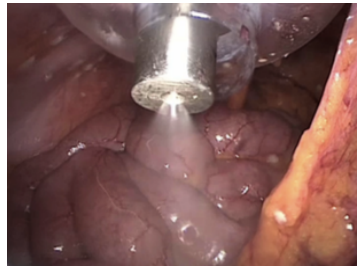
My clinical experience

- Quality of life is stabilized during the PIPAC courses
- Nutritional status is stabilized during the PIPAC courses
- Symptoms could disappear for some patient

- The major problem is to go inside the abdomen without making any bowel traumatic lesion
- The PIPAC is a non eventful procedure

- Stopping a PIPAC course for holidays, or to make a stopping procedure is not a good idea because when carcinomatosis coming to be clinically present, new PIPAC course is inefficient
- Important ascites (> 4 liters) is not well controlled by PIAPC

PIPAC For what ?



- In case of inefficacy of systemic chemotherapy for peritoneal metastasis and/or ascites control, on gastric or ovarian cancer
  - 1 PIPAC every 6 or 8 weeks /
  - Evaluated criteria : quality of life
- Associated with a systemic chemotherapy at the first line as palliation, including at first diagnosis ?
  - 1 PIPAC / 1 IV cycle / 2 PIPAC / 2 IV cycle, …
  - Evaluated criteria : OS or DFS
- Associated with an intensive anticancer strategy for non resectable carcinomatosis in a patient affected by a gastric carcinomatosis
  - 1 PIPAC / 1 IV cycle / 2 PIPAC / IV etc
  - Evaluated criteria : secondary CC0 resection

New ideas are coming

Different animals models are available:

mice / rat / pseudoperitoneal cavity

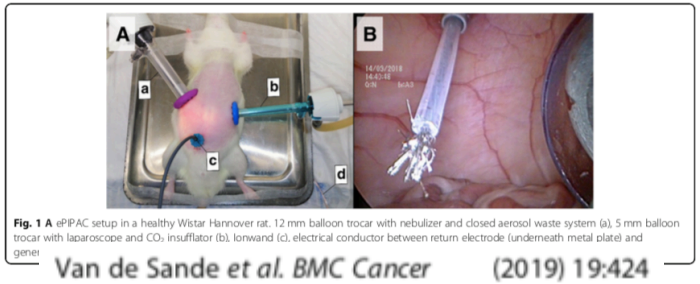


Fig. 1 A ePIPAC setup in a healthy Wistar Hannover rat. 12 mm balloon trocar with nebulizer and closed aerosol waste system (a), 5 mm balloon trocar with laparoscope and CO_2 insufflator (b), lonwand (c), electrical conductor between return electrode (underneath metal plate) and gene

Van de Sande *et al. BMC Cancer* (2019) 19:424
https://doi.org/10.1186/s12885-019-5658-5

Different drugs could be tested

Nanotherapy

Immunotherapy

Virus therapy

DE GRUYTER Pleura and Peritoneum 2018; 20180112

Leen Van De Sande, Martin Graversen, Martin Hubner, Marc Pocard, Marc Reymond, Marco Vaira, Sarah Cosyns, Wouter Willaert and Wim Ceelen*

Intraperitoneal aerosolization of albumin-stabilized paclitaxel nanoparticles (Abraxane™) for peritoneal carcinomatosis – a phase I first-in-human study

Individualization of treatment based on genetic testing

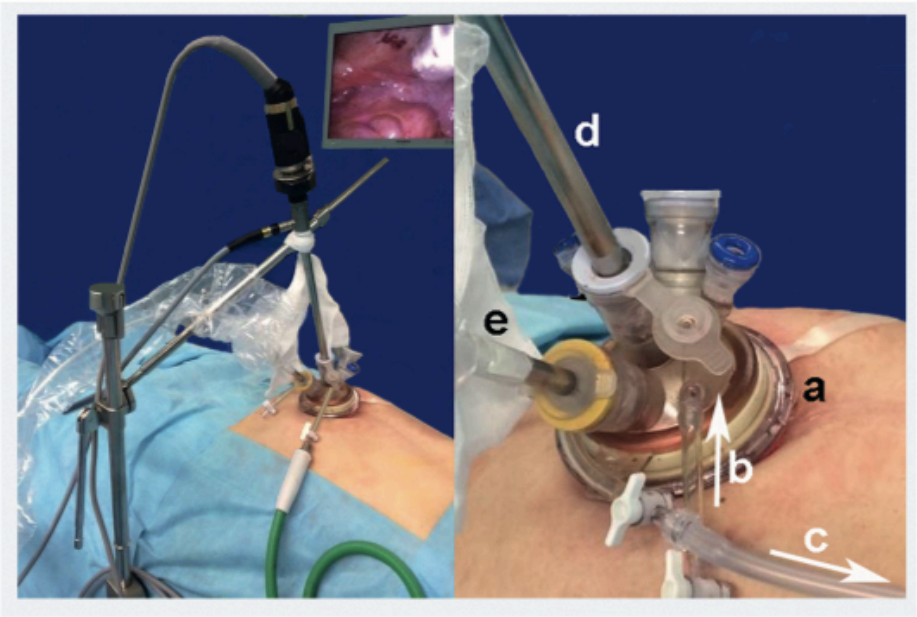
Single-port access technology

DE GRUYTER

Pleura and Peritoneum 2016; 1(4): 217–222

Marco Vaira*, Manuela Robella, Alice Borsano and Michele De Simone

Single-port access for Pressurized IntraPeritoneal Aerosol Chemotherapy (PIPAC): technique, feasibility and safety



Hyperthermia : New PIPAC technology

Surg Endosc
DOI 10.1007/s00464-015-4738-0

Feasibility of hyperthermic pressurized intraperitoneal aerosol chemotherapy in a porcine model

Do Hyun Jung[1,2] · Sang Yong Son[1,3] · Aung Myint Oo[1,4] · Young Suk Park[1] · Dong Joon Shin[1] · Sang-Hoon Ahn[1,5] · Do Joong Park[1,5] · Hyung-Ho Kim[1,5]

Surg Endosc

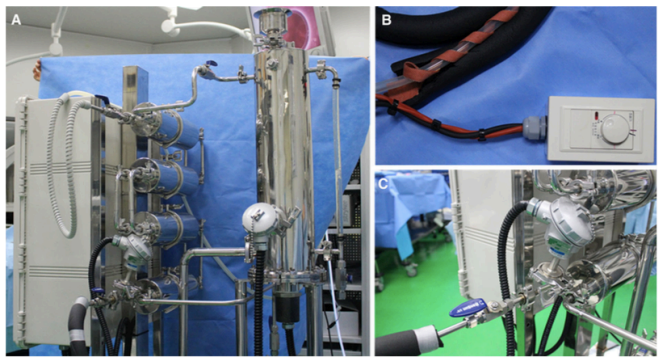


Fig. 2 **A** A heater to create hyperthermic capnoperitoneum, **B** a CO_2 gas delivery line covered with a heating line, **C** a temperature-monitoring unit was located at the outflow pipe of the heating units where the CO_2 gas delivery line connected to the heating units

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Electrostatic : New PIPAC technology

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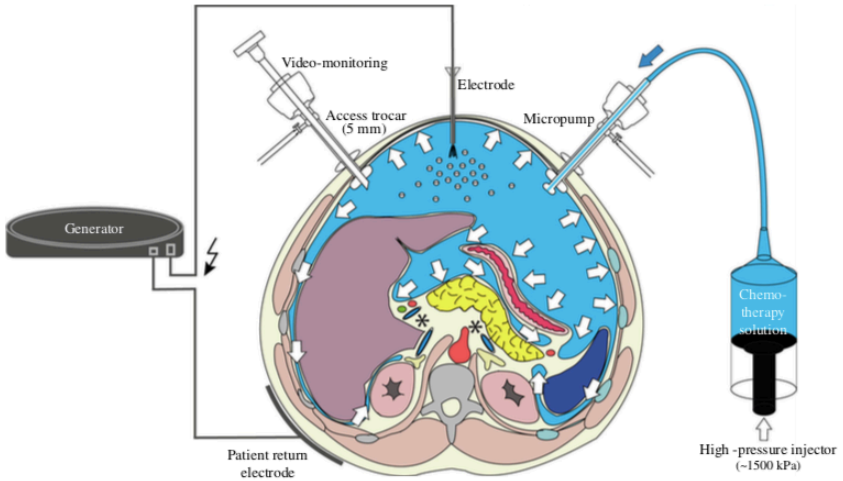
ORIGINAL ARTICLE – TRANSLATIONAL RESEARCH AND BIOMARKERS

In Vivo Feasibility of Electrostatic Precipitation as an Adjunct to Pressurized Intraperitoneal Aerosol Chemotherapy (ePIPAC)



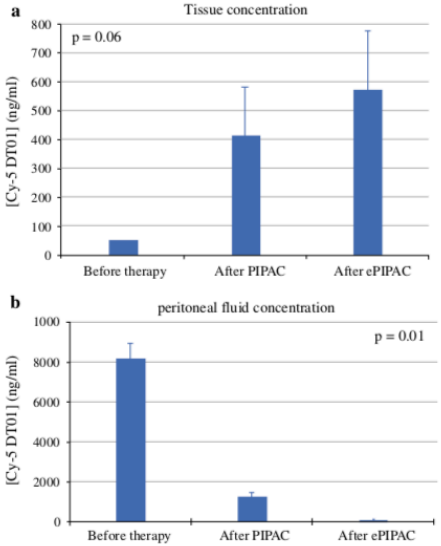
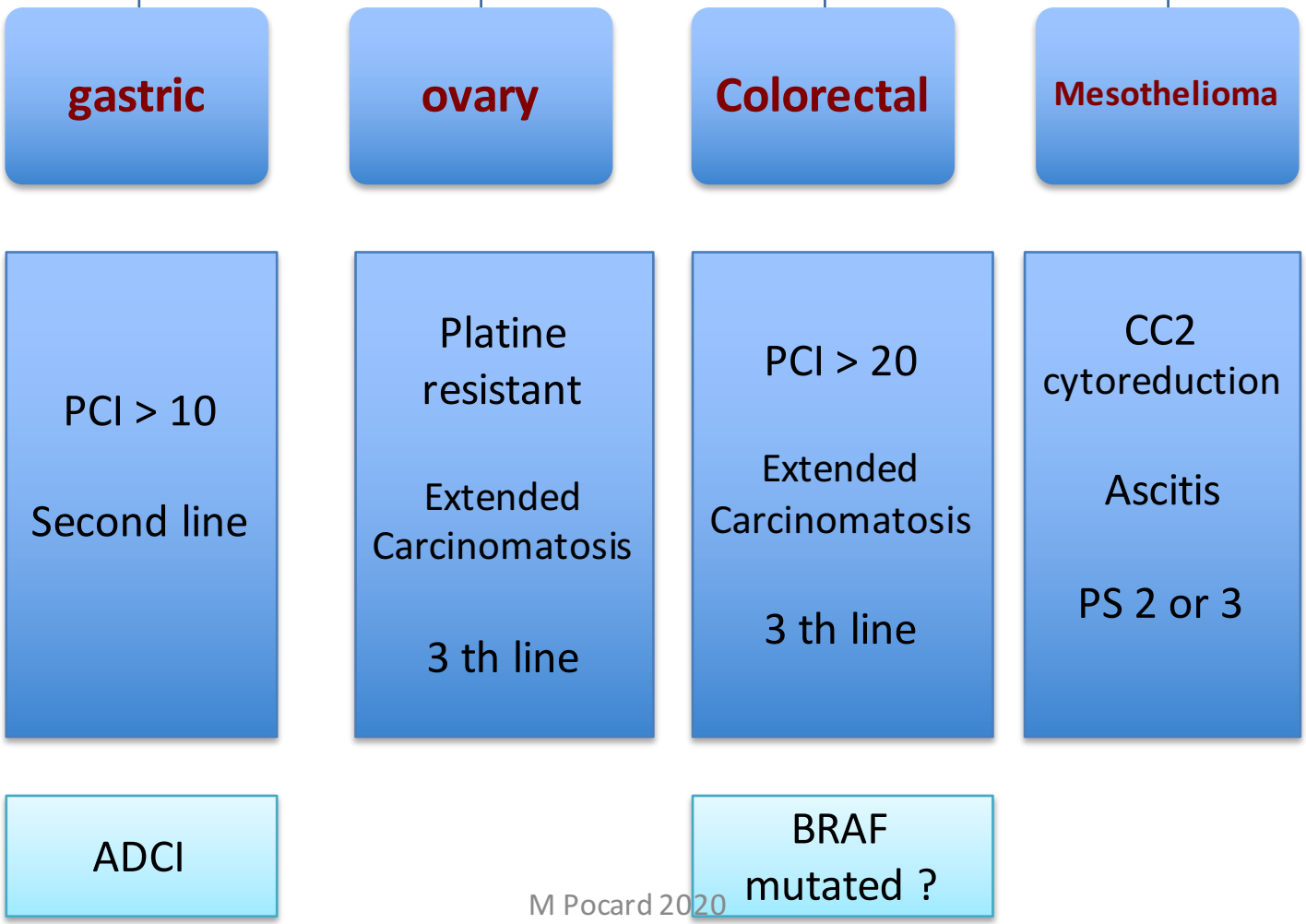


FIG. 1 Principle of electrostatic precipitation ePIPAC. **a** Technical setting for ePIPAC, including high-pressure injector containing therapeutic solution micropump generating pressurized intraperitoneal aerosol, brush electrode for electrostatic loading of therapeutic aerosol, and return electrode (solid plate). **b** Intraoperative view of abdomen showing micropump producing aerosol and electrode actively loading this aerosol with electrostatic charges, leading to precipitation of aerosol particles

Palliation with PIPAC indications
Lariboisière – Paris



Take home messages

PIPAC is not a therapy but a drug delivery system

Innovative technologies for intraperitoneal drug delivery (taking advantage of physical laws) open new research avenues in peritoneal diseases

Available clinical evidence shows that PIPAC is feasible, safe and well tolerated

Preliminary oncological results call for further comparative clinical studies

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ISSPP. International Society for the Study of Pleura and Peritoneum

Roma 2021

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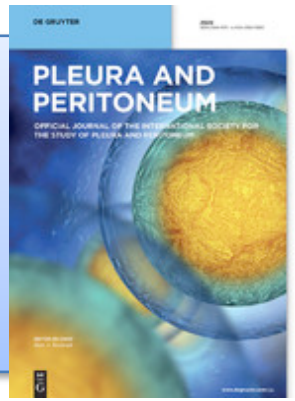

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