Transcatheter Arterial Chemo Infusion/TACI for Breast Cancer Treatment: A Case Series

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INTRODUCTION

Breast cancer is the most common cancer in the female population in the world. It has high mortality and morbidity rates. Based on WHO, the mortality rate in 2020 was 15.3 per 100,000 people. GLOBOCAN 2020 estimated that the incidence of breast cancer globally was 2.3 million cases, representing 11.7% of all cancer cases. International Agency for Research on Cancer reported there were 65,858 new cases of breast cancer in Indonesia in 2020 [1–3].

Transcatheter intraarterial chemo infusion (TACI) is image-guided local, regional therapy used to treat primary or metastatic tumors. The rationale of regional chemotherapy is to increase the local concentration of the drug which will lead to a better therapeutic response. This therapy has been used in several cases of malignancy such as liver malignancy, glioblastoma multiforme, and breast cancer. Intra-arterial chemo infusion aims to deliver a highly concentrated chemotherapy agent to the target locally but increases the therapeutic dose and reduces toxic effects on the healthy cells [4]. The method and the clinical evidence of chemo-infusion therapy versus systemic therapy have been reviewed extensively. It shows how chemo-infusion therapy got a higher response than systemic chemotherapy [5]. In Addition, TACI has fewer adverse effects than systemic chemotherapy due to minimal exposure to the cytotoxic agent in body cells [6].

Doxorubicin, alongside carboplatin, has long been the choice for conventional systemic therapy for metastatic breast cancer. This is because it has superior efficacy in metastatic breast cancer. However, it also has a very poor selectivity for healthy cells, and the cancer cells develop resistance [7,8]. On the other hand, intra-arterial therapy can deliver chemotherapy agents directly to the tumor feeding artery [9]. Therefore, in this case report, we present TACI as the alternative modality of delivering the highly potent chemotherapeutic agent to patients with (locally advanced breast cancer) LABC.

CASE PRESENTATION

This case series reported three female patients with LABC who were diagnosed and treated at Dr. Sardjito General Hospital, Yogyakarta over three years (2014–2016). The age ranged from 48 to 62 years, with a mean age of 56 years. Clinical features include lumps in breasts, soft tissue swelling, ulcers, dimpling of breast skin, nipple discharge, and pain sensation in the breast area. The three patients underwent the TACI procedure. Therapeutic response was evaluated by observing the clinical morphology of the lesions.

Conclusions: TACI showed potency as an efficient and effective alternative palliative therapy in the three LABC cases presented. However, further study is needed to inspect TACI’s efficacy and adverse effects in breast cancer cases to be used as evidence-based medicine.
mean age of 56 years. Similar clinical features include lumps in breasts, ulcers, soft tissue swelling, dimpling of breast skin, nipple discharge, and pain sensation in the breast area. The pathological diagnosis from all patients was revealed as Invasive Ductal Carcinoma. All three patients were treated with the same TACI procedures.

**Procedures**

TACI was done under local anesthesia by injecting 8–10 cc lidocaine near the right femoral artery. One hour before the TACI procedure, 4 mg dexamethasone and 8 mg ondansetron were injected intravenously. The introducer sheath 5 Fr (Radifocus; Terumo®) was placed; then, a 5Fr Vertebral angiographic catheter (Radifocus; Terumo®) was inserted with a 0.035-inch guidewire (Radifocus; Terumo®) into the subclavian artery and selectively into the axillary, lateral thoracic, and internal mammary arteries. Next, a microcatheter Pro great 2.7 Fr (Terumo®) was inserted through a Vertebral angiographic catheter (Radifocus; Terumo®) 5F into the tumor feeding artery to reach the tumor selectively. This procedure was performed with C-Arm Ceiling Philips FD20.

Doxorubicin 10 mg and Carboplatin 350–450 mg were dissolved with saline solution with a ratio of 1:3. Then, these chemotherapy agents were injected into the internal mammary, lateral thoracic, and branch of the axillary artery gradually.

**Case 1**

A 48-year-old female was diagnosed with breast cancer in her right breast and underwent a right total mastectomy without chemotherapy. The patient refused do chemotherapy due to personal preferences. Two months after the surgery, she felt a sudden unease on the same site and eventually developed into a painful sensation presented with a soft tissue swelling around the mastectomy area. The tumor recurred on the same site, and she was referred to get a TACI procedure. After being treated with TACI procedures, the swelling and the redness on her right chest decreased. The morphologic features can be seen in Figure 1.

**Case 2**

A 53-year-old female patient felt a swollen lump on her left breast with a painful sensation and rapidly grew with ulcers and reddish tenderness. She was diagnosed with stage IIIc breast cancer and referred to get a TACI procedure. From Figure 2, the tumor morphologic features were shrunk after TACI procedures.

**Case 3**

A 62-year-old female felt a growing lump and ulcer with a painful redness rash on her right breast. She was diagnosed with stage IIIc breast cancer and referred to get TACI procedures instead of surgery. After three cycles of TACI, the tumor mass on her right breast shrunk. The tumor mass shrinkage can be seen in Figure 3.

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**Figure 1.** A 48 years old woman had undergone a mastectomy in her right breast due to an advanced stage of breast cancer. (a) Two months after mastectomy, the soft tissue and skin area mastectomy swelled due to breast cancer recurrence. (b) After transcatheter arterial chemo infusion (TACI), the swelling and redness in her right chest decreased.

**Figure 2.** A 43 years old woman with locally advanced breast cancer (LABC) stage IIIC (T4N1M0). (A) Before TACI, a large tumor with ulcer and discharge was seen in the left breast. (B) There was a shrinkage in tumor size after TACI.
Figure 3. A 62 years woman with unresected breast cancer stage IIIc (T4N1M0). (A) Before TACI multiple large tumors were seen in her right breast, accompanied by dry ulcer and skin edema. (B) The tumor size decreased after the third cycle of TACI.

Figure 4. (a) Arteriography was done to map the feeding artery from the right axillary artery. (b) Injection doxorubicin and carboplatin to the branch of the right axillary artery through an intra-arterial catheter. (c) Administration of chemotherapy agent was done directly in the branch of the right thoracic artery. (d) TACI in the right mammary artery was done selectively to the tumor feeding artery.

DISCUSSION

The development of therapeutic techniques in the current breast cancer management is variable and heterogeneous. The options and recommendations of breast cancer therapy, especially LABC, depend on the stage, histopathology, patient condition, cost-effectiveness, and possible side effects.

A recent study reported that TACI for breast cancer treatment was done by angiography under local anesthesia [9]. Angiography subclavian, lateral thoracic, and internal mammary arteries must be evaluated due to the possibility of tumor-feeding arteries from the branches of those arteries. Before the chemotherapy agent was injected, it was essential to confirm the location of the catheter by injecting the contrast agent.

After the TACI procedure, the tumor mass decreased deliberately, decreasing redness and soft tissue swelling around the tumor site. TACI was proven to be an effective and safe method to control LABC. A recent study reported that complete and partial responses reached 90.6% after TACI. Drugs regimens and the whole TACI cycle played a significant role in the effectiveness and the response of the therapy [9].

Regional chemotherapy would maximize drug concentration and absorption in organ targets to increase the therapeutic response in patients [10]. The tissue concentration achieved by intraarterial delivery is higher than intravenous/IV delivery. Blood flow, injection characteristics, and vascular geometry affect drug concentration on tissue after intraarterial injections. According to a reported study, drug concentration in the tumor was 50-fold increased after intraarterial injection compared to IV delivery [11]. Chemotherapy agent was delivered selectively to feeding artery tumor causing localized tumor mass necrosis. Selective administration of chemotherapy agents minimized the systemic adverse effects of the cytotoxic drug. It was safer compared to systemic chemotherapy. Since 1987, there have been more than ten clinical trials comparing systemic chemotherapy and regional chemotherapy. From these researches, regional chemotherapy (TACI) constantly showed better response therapy (42–62%) than systemic chemotherapy (9–21%) [12–14].

According to the reported study, the chemotherapy agent’s delivery technique in TACI depends on breast cancer staging. Patients with stage IIIa usually had large tumors accompanied by infiltration to skin and chest wall muscles. Infiltration to axillary lymph nodes was limited. In this stage, the catheter was directed to the lateral thoracic artery to reach an optimum dose of chemotherapy agent in the chest area and provide more
effective local control. On the other hand, involvement of lymph nodes was extensive in inpatient stages IIIb and IIIC. Therefore, it was essential to control the regional lymph nodes. In these stages, the catheter was directed to the subclavian, axillary, and lateral thoracic artery to provide a more considerable chemotherapy agent in the area subclavian, supraclavicular, and axilla. This method contributed to increasing response therapy [9,15].

The studies proved that, in the management of LABC in these cases, TACI therapy using Doxorubicin 10 mg and Carboplatin 450 mg was quite effective as palliative therapy. However, further studies should be undertaken to verify these findings. Future studies should focus on a different approach with TACI. One study showed the favorable response of adding the poly ADP polymerase (PARP) inhibitor, veliparib, and carboplatin to triple-negative breast cancer [16]. It is interesting to see the TACI method deliver PARP inhibitor agent regionally to the site of LABC in the future.

CONCLUSIONS

Transcatheter arterial infusion chemotherapy (TACI) is a minimally invasive technique used in breast cancer management, especially unresectable locally advanced breast cancer. TACI showed its potency as an efficient and effective alternative palliative therapy. However, further study is needed to inspect TACI’s efficacy and adverse effects in breast cancer cases to be used as evidence-based medicine.

DECLARATIONS

Competing of Interest
The authors declare no competing interest in this study.

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REFERENCES

1. The Global Cancer Observatory. Cancer Incident in Indonesia. Int Agency Res Cancer. 2020;858:1–2.
2. Sung H, Ferlay J, Siegel RL, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin. 2021;71(3):209–49.
3. Tryfonidis K, Senkus E, Cardoso MJ, Cardoso F. Management of locally advanced breast cancer-perspectives and future directions. Nat Rev Clin Oncol. 2015;12(3):147–62.
4. Breedis C, Young G. The blood supply of neoplasms in the liver. Am J Pathol. 1954;30(5):969–977.
5. Lewandowski RJ, Geschwind JF, Liapi E, Salem R. Transcatheter intraarterial therapies: rationale and overview. Radiology. 2011;259(3):641–657.
6. Poedjomartono B, Pramiadi. The role of transcatheter arterial chemoinfusion (TACI) in unresectable adenocarcinoma colorectal: a case report. J Thee Med Sci Berk Ilmu Kedokt. 2019;51(03):270–81.
7. Nagahama K, Kawano D, Oyama N, et al. Self-Assembling Polymer Micelle/Clay Nanodisk/Doxorubicin Hybrid Injectable Gels for Safe and Efficient Focal Treatment of Cancer. Biomacromolecules. 2015;16(3):880–9.
8. Smith L, Watson MB, O’Kane SL, et al. The analysis of doxorubicin resistance in human breast cancer cells using antibody microarrays. Mol Cancer Ther. 2006 Aug;5(8):2115–20.
9. Wang X, Gan C, Li H, et al. Main complications and results of treatment with intra-arterial infusion chemotherapy through the subclavian and thoracic arteries for locally advanced breast cancer. Mol Clin Oncol. 2013;4(1):745–8.
10. Collins, JM. Pharmacologic rationale for regional drug delivery. J Clin Oncol. 1984 May; 2(5):498-504.
11. Ellis JA, Banu M, Hossain SS, et al. Reassessing the Role of Intra-Arterial Drug Delivery for Glioblastoma Multiforme Treatment. J Drug Deliv. 2015;2015:405735.
12. Okusaka T, Kasugai H, Shioyama Y, et al. Transarterial chemotherapy alone versus transarterial chemoembolization for hepatocellular carcinoma: A randomized phase III trial. J Hepatol. 2009;51(6):1030–6.
13. Aksoy S, Akce B, Kilickesmez O, et al. Transcatheter Arterial Embolization for Controlling Severe Bleeding From Recurrent Locally-Advanced Breast Cancer. J Breast Health. 2016;12(3):137–40.
14. Ensminger WD. Intrahepatic arterial infusion of chemotherapy: Pharmacologic principles. Semin Oncol. 2002;29(2):119–25.
15. Koh J, Kim MJ. Introduction of a new staging system of breast cancer for radiologists: An emphasis on the prognostic stage. Korean J Radiol. 2019;20(1):69–82.
16. Loibl S, O’Shaughnessy J, Untch M, et al. Addition of the PARP inhibitor veliparib plus carboplatin or carboplatin alone to standard neoadjuvant chemotherapy in triple-negative breast cancer (BrighTNess): a randomised, phase 3 trial. Lancet Oncol. 2018;19(4):497–509.